OCS EIS/EA
BOEM 2023-020

Docket Number: BOEM-2023-0029

Ocean Wind 1 Offshore Wind Farm Final Environmental Impact Statement Volume 2

May 2023

Estimated Lead Agency Total Costs to Prepare the Draft and Final EIS: $2,136,326

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

BOEM
Bureau of Ocean Energy Management

Appendix A. Required Environmental Permits and Consultations

A.1. Required Environmental Permits

Table A-1 includes a summary of federal, state, and local permits or approvals that are required for Project implementation.

Table A-1 Required Environmental Permits and Approvals for the Proposed Project

Agency/Regulatory Authority	Permit/Approval	Status
Federal (Portions of the Project within Federal Jurisdiction)		
BOEM	COP Approval	COP filed with BOEM on August 15, 2019. Updates to the COP were submitted on March 13, 2020, September 24, 2020, March 24, 2021, November 16, 2021/December 10, 2021, May 27, 2022, October 14, 2022, and April 24, 2023.
BSEE	Oil Spill Response Plan	Submitted with COP
FAA	FAA Form 7460-1, Notice of Proposed Construction or Alteration (for Hazard to Air Navigation Determination)	Received No Hazard to Air Navigation determination in February 2022; Oyster Creek Substation: Submitted in March 2023; BL England Substation application planned for submittal Q2 2023
NMFS	MMPA Section 101(a)(5) Letter of Authorization	Proposed Incidental Take Regulations published on October 26, 2022
USACE	CWA Section 404 and RHA Section 10 Individual Permit	Complete application received May 11, 2022; Public Notice published June 17, 2022
USACE	Section 408	Complete application received May 27, 2022
USCG	PATON authorization	Anticipate filing in July/August 2023
USCG	Local Notice to Mariners per Ports and Waterways Safety Act	Anticipate filing in August 2023
USEPA	CAA OCS Air Permit	Complete application received January 4, 2023
State (Portions of the Project within State Jurisdiction)		
NJDEP, DLUR	Waterfront Development Permit and Coastal Consistency Determination	Permit issued April 27, 2023
NJDEP, DLUR	Coastal Areas Facility Review Act Permit and Coastal Consistency Determination	Permit issued April 27, 2023

Agency/Regulatory Authority	Permit/Approval	Status
NJDEP, DLUR	Coastal Wetlands Permit	Permit issued April 27, 2023
NJDEP, DLUR	Flood Hazard Area Verification	Permit issued April 27, 2023
NJDEP, DLUR	Freshwater Wetlands Permit	Permit issued April 27, 2023
NJDEP, DLUR	Section 401 Water Quality Certification	Permit issued April 27, 2023
NJDEP, Division of Water Quality	Stormwater Construction General Permit (5G3)	Expected Q3 2023
NJDEP, Division of Water Quality	Short Term De Minimis General Permit (B7)	Expected Q3 2023
NJDEP, Bureau of Water Allocation and Well Permitting	Temporary Dewatering Permit	Expected Q3 2023
NJDEP, Bureau of Tidelands Management	Tidelands License	Expected Q3 2023
NJDEP, Green Acres Program	Major Diversion of Parkland	Diversion approved by the State House Commission March 9, 2023
NJDEP, Division of Parks and Forestry, Natural Heritage Program	New Jersey Endangered Species Conservation Act, threatened and endangered species consultation	Consultation concluded with permit issuance April 27, 2023
NJDEP, New Jersey Historic Preservation Office	NHPA Act Section 106 Review and New Jersey Register of Historic Places Act	Ongoing BOEM coordination as part of NHPA Section 106 process. Historic and cultural resources assessment was also part of the DLRP permit (issued April 27, 2023)
NJDEP, Site Remediation and Waste Management Program	Linear Construction Project Notification	Expected Q3 2023
NJDEP, Division of Parks and Forestry	Consultations and approvals for activities on State Lands and Parks	State House Commission approval received March 9, 2023; Right of Entry Agreement expected to be signed July 2023
New Jersey Department of Transportation	Highway Occupancy Permit	Expected Q3 2023
New Jersey Pinelands Commission	Development Application	No development application required.
Local (Portions of the Project within Local Jurisdiction)		
Ocean County Soil Conservation District	Soil Erosion and Sediment Control Plan Certification	Expected Q3 2023
Cape Atlantic Soil Conservation District	Soil Erosion and Sediment Control Plan Certification	Expected Q3 2023
Cape May County Division of Engineering	Utility Opening/Highway Occupancy Permit	Expected Q3 2023
Ocean City Engineering Department	Road Opening Permit	Expected Q3 2023

Agency/Regulatory Authority	Permit/Approval	Status
Municipal/county building and zoning permits and approvals	Lacey Township, Ocean Township, Ocean City, Upper Township, Ocean County, Atlantic County, Cape May County	Expected Q3/Q4 2023

CAA = Clean Air Act; DLRP = Division of Land Resource Protection; DLUR = Division of Land Use Regulation; Q = quarter

A.2. Consultation and Coordination

A.2.1 Introduction

This section discusses public and agency involvement leading up to the preparation and publication of the Final EIS, including formal consultations, cooperating agency exchanges, the public scoping comment period, and correspondence. This section discusses public involvement in the preparation of this EIS, including BOEM's responses to public comments, formal consultations, and cooperating agency exchanges. Interagency consultation, coordination, and correspondence throughout the development of this Final EIS occurred primarily through virtual meetings, teleconferences, and written communications (including email). BOEM coordinated with numerous agencies throughout the development of this document, as listed in Section A.2.3.2, *Cooperating Agencies*.

A.2.2 Consultations and Authorizations

The following section provides a summary and status of each consultation. BSEE, USACE, and USEPA are co-action agencies for the ESA, MSA, and NHPA consultations.

A.2.2.1. Coastal Zone Management Act

The Coastal Zone Management Act requires that any applicant for a required federal license or permit to conduct an activity, within the coastal zone or within the geographic location descriptions (i.e., areas outside the coastal zone in which an activity would have reasonably foreseeable coastal effects), affecting any land or water use or natural resource of the coastal zone be consistent with the enforceable policies of a state's federally approved coastal management program. Although the Project's Lease Area does not fall within a Geographic Location Description for purposes of 16 USC 1456(c)(3)(A) and the implementing regulations at 15 CFR 930 Subparts D and E, following a request by NJDEP, Ocean Wind voluntarily submitted a federal consistency certification and a copy of the COP on March 30, 2021. Ocean Wind 1's COP (Ocean Wind 2023) provided the necessary data and information under 15 CFR 930.58. NJDEP will review the reasonably foreseeable effects of the Project on coastal use or resources for consistency with the enforceable policies of the New Jersey coastal zone management program. On March 31, 2021, NJDEP notified BOEM that NJDEP and Ocean Wind mutually agreed to stay NJDEP's 6-month consistency review period consistent with 15 CFR 930.60(b), and provided BOEM with a copy of the stay agreement. Pursuant to the executed extended stay agreement, the NJDEP issued a consistency determination on April 27, 2023. The state's concurrence is required before BOEM may approve or approve with conditions the Ocean Wind 1 COP per 30 CFR 585.628(f) and 15 CFR 930.130(1).

A.2.2.2. Endangered Species Act

Section 7(a)(2) of the ESA of 1973, as amended (16 USC 1531 et seq.), requires that each federal agency ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of those species. When the action of a federal agency may affect a protected species or its critical habitat, that agency is required to consult with either NMFS or USFWS, depending upon the jurisdiction. Pursuant to 50 CFR 402.07, BOEM has accepted designation as the lead federal agency for the purposes of fulfilling interagency consultation under Section 7 of the ESA for listed species under the jurisdiction of NMFS and USFWS. BOEM consulted on the proposed activities considered in this Final EIS with both NMFS and USFWS and has prepared biological assessments for listed species under their respective jurisdictions. NMFS's biological opinion was issued on April 3, 2023. USFWS's concurrence letter and biological opinion were issued on May 12, 2023

A.2.2.3. Government-to-Government Tribal Consultation

Executive Order 13175 commits federal agencies to engage in government-to-government consultation with tribes when federal actions have tribal implications, and Secretarial Order No. 3317 requires U.S. Department of the Interior agencies to develop and participate in meaningful consultation with federally recognized tribes where a tribal implication may arise. A June 29, 2018, memorandum outlines BOEM's current tribal consultation policy (BOEM 2018). This memorandum states that "consultation is a deliberative process that aims to create effective collaboration and informed federal decision-making" and is in keeping with the spirit and intent of the NHPA and NEPA, Executive and Secretarial Orders, and U.S. Department of the Interior Policy (BOEM 2018). BOEM implements tribal consultation policies through formal government-to-government consultation, informal dialogue, collaboration, and other engagement.

On March 19, 2021, BOEM initiated formal consultation with nine tribes under the NHPA and invited them to be NHPA Section 106 consulting parties to the Project through individual letters mailed and emailed to tribal leaders with the Absentee-Shawnee Tribe of Indians of Oklahoma, the Delaware Nation, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, the Rappahannock Tribe, Shawnee Tribe, Stockbridge-Munsee Community Band of Mohican Indians, the Narragansett Indian Tribe, and the Shinnecock Indian Nation. Three tribal leaders responded that they would like to participate as consulting parties to the Project: the Delaware Nation, the Delaware Tribe of Indians, and the Stockbridge-Munsee Community Band of Mohican Indians.

On March 30, 2021, BOEM sent another set of letters and emails to tribal leaders notifying them that the Notice of Intent (NOI) to prepare an EIS for the Project was issued that day and noted that the scoping comment period was open until April 29, 2021. BOEM then sent an email to tribal leaders on May 5, 2021, offering a government-to-government consultation meeting to discuss the public scoping information for the Project. BOEM held a government-to-government meeting with the tribes that responded, the Delaware Tribe of Indians and the Delaware Nation, on June 17, 2021. Both tribes expressed interest in continuing consultation for offshore wind, and emphasized the importance of early consultation in Project development. The Wampanoag Tribe of Gay Head Aquinnah notified BOEM that they would like to participate as a consulting party to the Project. Additional attempts were made to contact the Absentee-Shawnee Tribe of Indians of Oklahoma, Eastern Shawnee Tribe of Oklahoma, Shawnee Tribe, Narragansett Indian Tribe, and Shinnecock Indian Nation via phone and email in August and September 2021; however, no responses have been received to date.

BOEM separately contacted the Mashantucket Pequot Tribal Nation on August 17, 2021, in response to a request to participate as a cooperating agency. The Mashantucket Pequot Tribal Nation confirmed they would like to consult with BOEM as a Cooperating Tribal Nation under NEPA and an NHPA Section 106 consulting party. However, in a letter dated November 22, 2021, the Mashantucket Pequot Tribal Nation indicated that they no longer wanted to consult on the Project.

BOEM sent an email to tribal leaders on October 7, 2022, offering a government-to-government consultation meeting to discuss the Draft EIS. BOEM held a government-to-government meeting with the tribes that responded, the Shinnecock Indian Nation and Delaware Tribe of Indians, on November 2, 2022.

A.2.2.4. National Historic Preservation Act

Section 106 of the NHPA (54 USC 306108) and its implementing regulations (36 CFR 800) require federal agencies to consider the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment. BOEM has determined that the proposed Project is an undertaking subject to Section 106 review. The construction of WTGs and OSS, installation of inter-array cables, and development of staging areas are ground- or seabed-disturbing activities that may adversely affect archaeological resources. The presence of WTGs may also introduce visual elements out of character with the historic setting of historic structures or landscapes; in cases where historic setting is a contributing element of historic properties' eligibility for the NRHP, the Project may adversely affect those historic properties.

The Section 106 regulations at 36 CFR 800.8 provide for use of the NEPA substitution process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR 800.3 through 800.6. This process is commonly known as "NEPA substitution for Section 106" and BOEM is using this process and documentation required for the preparation of this EIS and the ROD to comply with Section 106. Appendix N of this Final EIS contains BOEM's Finding of Adverse Effect, which includes a description and summary of BOEM's consultation so far. On March 9, 2021, BOEM contacted ACHP and New Jersey SHPO to provide Project information and notify of BOEM's intention to use the NEPA process to fulfill Section 106 obligations in lieu of the procedures set forth in 36 CFR 800.3 through 800.6. BOEM will continue consulting with the New Jersey SHPO, ACHP, federally recognized tribes, and the consulting parties regarding the Finding of Adverse Effect and the resolution of adverse effects.

BOEM has and will be conducting Section 106 consultation meeting(s) on the Finding of Adverse Effect and the resolution of adverse effects, and the agency will be requesting the consulting parties to review and comment on the Finding of Adverse Effect and proposed resolution measures. BOEM held virtual NHPA Section 106 Consultation Meeting #1 on March 8, 2022, and shared with consulting parties a summary of the NHPA Section 106 Consultation Meeting #1 and materials presented at that meeting on March 31, 2022. BOEM held virtual NHPA Section 106 Consultation Meeting #2 on May 4, 2022, and shared with consulting parties a summary of the NHPA Section 106 Consultation Meeting #2 and materials presented at that meeting on June 8, 2022. BOEM held virtual NHPA Section 106 Consultation Meeting #3 on November 30, 2022, and shared with consulting parties a summary of the NHPA Section 106 Consultation Meeting #3 and materials presented at that meeting on November 30, 2022. BOEM held virtual NHPA Section 106 Consultation Meeting #4 on February 10, 2023, and shared with consulting parties a summary of the NHPA Section 106 Consultation Meeting #4 and materials presented at that meeting on February 22, 2023. BOEM held an additional consultation meeting with New Jersey Historic Preservation Office on February 24, 2022 to discuss the materials presented at NHPA Section 106 Consultation Meeting #4. BOEM plans to hold an additional consultation meeting to consult on the finding of effect and the resolution of adverse effects, to receive additional input regarding the EIS analysis, and to consult on a Memorandum of Agreement prior to issuing the ROD. BOEM will hold virtual NHPA Section 106 Consultation Meeting #5 in the second quarter of 2023.

On March 21, 2022, BOEM shared with consulting parties the complete terrestrial archaeological resources report, complete marine archaeological resources report, complete historic resources visual effects assessment, and complete cumulative historic resources visual effects analysis. At that time, BOEM also shared with consulting parties a technical memorandum detailing the delineation of the APE for the Project. BOEM shared with consulting parties a supplemental architectural intensive-level survey report on April 1, 2022. On November 11, 2022, BOEM shared with consulting parties the revised terrestrial archaeological resources report, revised marine archaeological resources report, revised historic resources visual effects assessment, revised architectural intensive-level survey report, and revised cumulative historic resources visual effects analysis. BOEM also distributed a consulting parties comments response matrix, which itemizes consultation comments received from consulting parties on documents distributed by BOEM on March 21 and April 1, 2022, and provides BOEM's responses to those comments.

BOEM distributed a Notice of Availability to notify the consulting parties that the Draft EIS was available for public review and comment for the period of June 24 to August 8, 2022. On November 11, 2022, BOEM shared with consulting parties the revised Appendix N, *Finding of Adverse Effect for the Ocean Wind 1 Construction and Operations Plan*, with attachments including the draft Memorandum of Agreement. BOEM published the Final EIS on May 26, 2023.

BOEM fulfilled public involvement requirements for Section 106 of the NHPA through the NEPA public scoping and public meetings process, pursuant to 36 CFR 800.2(d)(3). The Scoping Summary Report (BOEM 2021), available on BOEM's Project-specific website, summarizes comments on historic preservation issues. On March 17, 2021, BOEM initiated consultation with nine federally recognized tribes: Absentee-Shawnee Tribe of Indians of Oklahoma, the Delaware Nation, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, the Rappahannock Tribe, Shawnee Tribe, Stockbridge-Munsee Community Band of Mohican Indians, the Narragansett Indian Tribe, and the Shinnecock Indian Nation (Section A.2.2.3). On May 5, 2021, BOEM invited Absentee-Shawnee Tribe of Indians of Oklahoma, the Delaware Nation, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, the Narragansett Indian Tribe, Shawnee Tribe, Stockbridge-Munsee Community Band of Mohican Indians, and the Shinnecock Indian Nation to participate in a government-to-government consultation meeting. On May 17, 2021, BOEM corresponded with tribes who responded to the government-to-government consultation meeting invitation—the Delaware Nation and Delaware Tribe of Indians—to schedule the meeting during a day and time of mutual availability. BOEM followed up the request for scheduling on May 27 and June 1, 2021. On June 8, 2021, BOEM invited the Delaware Nation and Delaware Tribe of Indians to participate in a government-to-government consultation meeting on Thursday, June 17, 2021. BOEM hosted a government-to-government consultation meeting with the Delaware Nation and Delaware Tribe of Indians on June 17, 2021, and distributed a draft meeting summary of the June 17, 2021, government-to-government consultation meeting and requested representatives from the Delaware Nation and Delaware Tribe of Indians provide comment on July 2, 2021. BOEM reached out via phone to the Absentee-Shawnee Tribe of Indians of Oklahoma, the Eastern Shawnee Tribe of Oklahoma, the Narragansett Indian Tribe, Shawnee Tribe, and the Shinnecock Indian Nation on August 5, 2021, August 17, 2021, and September 3, 2021, to remind them of the March 30, 2021, invitations to participate as Section 106 consulting parties or NEPA cooperating agencies and requested their feedback. The Stockbridge-Munsee Community Band of Mohican Indians notified BOEM of their interest in participating as a consulting party on September 27, 2021. The Shinnecock Indian Nation notified BOEM of their interest in participating as a consulting party on September 27, 2021. The Wampanoag Tribe of Gay Head (Aquinnah) notified BOEM of their interest in participating as a consulting party on September 27, 2021. BOEM requested information on sites of religious and cultural significance to the tribes that the proposed Project could affect, and BOEM offered its assistance in providing additional details and information on the proposed Project to the tribes. The Mashantucket Pequot Tribal Nation later contacted BOEM to request participation as a sovereign tribal nation in the NEPA cooperating agency review process, and BOEM added this tribal nation to the Project as a participant in the cooperating agency review process as well as a consulting party on November 19, 2021. However, in a letter dated November 22, 2021, the Mashantucket Pequot Tribal Nation indicated that they no longer wanted to consult on the Project.

On March 30, 2021, BOEM contacted representatives of local governments, state and local historical societies, economic development commissions, and other federal agencies to solicit information on historic properties and determine their interest in participating as consulting parties. During the period of April 13–16, 2021, outreach was conducted by phone to confirm receipt of correspondence among the governments and organizations that had not responded to the invitation to consult.

On November 18, 2022, BOEM contacted representatives for eight of the ten aboveground historic properties within the Project's visual APE determined by BOEM to be adversely affected by the Project that had not previously accepted consulting party status to determine their interest in participating as consulting parties. On February 2, 2023, and February 15, 2023, BOEM contacted representatives for seven additional aboveground historic properties within the Project's visual APE determined by BOEM to be adversely affected by the Project that had not previously accepted consulting party status to determine their interest in participating as consulting parties. On March 28, 2023, BOEM contacted representatives of all 17 historic properties within the Project's visual APE determined by BOEM to be adversely affected by the Project, inviting those parties that had not previously accepted consulting party status to participate as consulting parties and to invite participating consulting parties to a meeting with BOEM to discuss Applicant-proposed mitigation to resolve the adverse effects from the Project on their respective properties. Participants that have accepted consulting party status for the NHPA Section 106 Consultation are listed in Table A-2.

Table A-2 NHPA Section 106 Consulting Parties

Participants in the Section 106 Process	Participating Consulting Parties
SHPOs and state agencies	NJDEP, Historic Preservation Office NJDEP, Office of Historic Site & Parks New Jersey Historic Trust
Federal agencies	ACHP BSEE USACE USEPA USCG National Park Service U.S. Naval History and Heritage Command
Federally recognized tribes	Delaware Nation Delaware Tribe of Indians Stockbridge-Munsee Community Band of Mohican Indians The Shinnecock Indian Nation Wampanoag Tribe of Gay Head (Aquinnah)

Participants in the Section 106 Process	Participating Consulting Parties
Local governments	Atlantic County Cape May City Cape May County City of North Wildwood Harvey Cedars Borough Linwood City Margate City Ocean City Sea Isle City Somers Point City Stafford Township
Nongovernmental organizations or groups	Absecon Lighthouse Flanders Condominium Association Garden State Seafood Association House at 114 South Harvard Avenue Long Beach Island Historical Association Ritz Condominium Association Rutgers University Save Lucy Committee, Inc. The Noyes Museum of Art Vassar Square Condominiums

A.2.2.5. Magnuson-Stevens Fishery Conservation and Management Act

Pursuant to Section 305(b) of the MSA, federal agencies are required to consult with NMFS on any action that may result in adverse effects on EFH. NMFS regulations implementing the EFH provisions of the MSA can be found at 50 CFR 600. As provided for in 50 CFR 600.920(b), BOEM has accepted designation as the lead agency for the purposes of fulfilling EFH consultation obligations under Section 305(b) of the MSA. Certain OCS activities authorized by BOEM may result in adverse effects on EFH and, therefore, require consultation with NMFS. BOEM prepared and submitted an EFH Assessment to NMFS, which was deemed complete for EFH consultation to initiate on December 16, 2022. In a letter dated February 24, 2023, NMFS issued Conservation Recommendations, to which BOEM will provide a detailed response prior to issuance of the ROD.

A.2.2.6. Marine Mammal Protection Act

Section 101(a) of the MMPA (16 USC 1361) prohibits persons or vessels subject to the jurisdiction of the United States from taking any marine mammal in waters or on lands under the jurisdiction of the United States or on the high seas (16 USC 1372(a)(l), (a)(2)). Sections 101(a)(5)(A) and (D) of the MMPA provide exceptions to the prohibition on take, which give NMFS the authority to authorize the incidental but not intentional take of small numbers of marine mammals, provided certain findings are made and statutory and regulatory procedures are met. Under Section 3 of the MMPA, “take” is defined as “harass, capture, hunt, kill, or attempt to harass, capture, hunt, or kill any marine mammal.” The incidental take of a marine mammal falls under three categories: mortality, serious injury, and harassment. Harassment is further defined as Take authorizations divide underwater noise effects on marine mammals into Level A and Level B harassment categories. MMPA regulations define Level A or Level B harassment as follows:

- Level A: Any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment) and
- Level B: Any act of pursuit, torment, or annoyance that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing a disruption of behavioral patterns including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but that does not have the potential to injure a marine mammal or marine mammal stock in the wild (Level B harassment) (16 USC 1362)

Level A harassment includes physiological impacts associated with PTS (and other non-serious injuries), whereas Level B harassment includes physiological impacts associated with TTS, masking, and behavioral effects (discussed in greater detail below).

Entities seeking to obtain authorization for the incidental take of marine mammals under NMFS jurisdiction must submit such a request (in the form of an application). Incidental Take Authorizations may be issued as either (1) regulations and associated Letters of Authorization, or (2) an Incidental Harassment Authorization. Letters of Authorizations may be issued for up to a maximum period of 5 years, and Incidental Harassment Authorizations may be issued for a maximum period of 1 year. NMFS has also promulgated regulations to implement the provisions of the MMPA governing the taking and importing of marine mammals (50 CFR 216) and has published application instructions that prescribe the procedures necessary to apply for an Incidental Take Authorization. Applicants seeking to obtain authorization for the incidental take of marine mammals under NMFS' jurisdiction must comply with these regulations and application instructions in addition to the provisions of the MMPA.

Once NMFS determines an application is adequate and complete, NMFS has a corresponding duty to determine whether and how to authorize take of marine mammals incidental to the activities described in the application. To authorize the incidental take of marine mammals, NMFS evaluates the best available scientific information to determine whether the take would have a negligible impact on the affected marine mammal species or stocks and an immitigable impact on their availability for taking for subsistence uses. NMFS must also prescribe the "means of effecting the least practicable adverse impact" on the affected species or stocks and their habitat, and on the availability of those species or stocks for subsistence uses, as well as monitoring and reporting requirements.

Ocean Wind submitted a Letter of Authorization application to NMFS on October 1, 2021. The application was reviewed and considered complete on February 11, 2022. NMFS published a Notice of Receipt in the Federal Register on March 7, 2022. NMFS published the proposed Incidental Take Regulations in the *Federal Register* on October 26, 2022.

A.2.2.7. Clean Water Act and Rivers and Harbors Act

Section 404 of the CWA (33 USC 1344) regulates the discharge of dredged or fill material into waters of the U.S., including wetlands. A permit from USACE is required regardless of whether the work is temporary or permanent and includes discharges such as dewatering of dredged material prior to disposal and temporary fills for cofferdams and work areas. Section 10 of the RHA (33 USC 403) regulates the construction of any structure in or over navigable waters of the U.S. and prohibits the creation of any obstruction to the navigable capacity of any water of the U.S. A Section 10 permit is required for structures or work that affect the course, location, or condition of the waterbody, including dredging/excavation, submarine cable installation, and WTGs/OSS. Ocean Wind submitted an application to USACE on April 27, 2022. The application was reviewed and considered complete on May 11, 2022. USACE published a Public Notice on the Philadelphia District's website on June 17, 2022.

"Section 408 permission" is required pursuant to Section 14 of the RHA (33 USC 408) for any proposed alterations that have the potential to alter, occupy, or use any federally authorized civil works projects. The Section 408 review verifies that changes to authorized USACE Civil Works projects will not be injurious to the public interest and will not impair the usefulness of the project. Ocean Wind submitted an application to USACE on April 27, 2022, which was determined complete on May 27, 2022. A final permit decision is anticipated to be rendered by October 2023.

A.2.2.8. Clean Air Act

The OCS Air Regulations (40 CFR 55) establish the applicable air pollution control requirements, including provisions related to permitting, monitoring, reporting, fees, compliance, and enforcement, for facilities subject to the Clean Air Act (CAA) Section 328. Ocean Wind submitted an initial OCS Air Permit application on March 29, 2022. Revised applications were submitted on July 19, 2022 and September 30, 2022. EPA deemed the application complete on January 4, 2023.

A.2.3 Development of Draft Environmental Impact Statement

This section provides an overview of the development of the Draft EIS, including public scoping, cooperating agency involvement, and distribution of the Draft EIS for public review and comment.

A.2.3.1. Scoping

On March 30, 2021, BOEM issued an NOI to prepare an EIS consistent with NEPA regulations (42 USC 4321 et seq.) to assess the potential impacts of the Proposed Action and alternatives (83 *Federal Register* 13777). The NOI commenced a public scoping process for identifying issues and potential alternatives for consideration in the EIS. The formal scoping period was from March 30 through April 29, 2021. BOEM held three virtual public scoping meetings to solicit feedback and to identify issues and potential alternatives for consideration in the EIS. Throughout this timeframe, federal agencies, state and local governments, and the general public had the opportunity to help BOEM identify potential significant resources and issues, IPFs, reasonable alternatives (e.g., size, geographic, seasonal, or other restrictions on construction and siting of facilities and activities), and potential mitigation measures to analyze in the EIS, as well as provide additional information. BOEM also used the NEPA scoping process to initiate the Section 106 consultation process under the NHPA (54 USC 300101 et seq.), as permitted by 36 CFR 800.2(d)(3), which requires federal agencies to assess the effects of projects on historic properties. Additionally, BOEM informed its Section 106 consultation by seeking public comment and input through the NOI regarding the identification of historic properties or potential effects on historic properties from activities associated with approval of the COP (Ocean Wind 2023). The NOI requested comments from the public in written form, delivered by hand or by mail, or through the regulations.gov web portal.

BOEM held three virtual scoping meetings on April 13, 15, and 20, 2021. BOEM reviewed and considered all scoping comments in the development of the Draft EIS, and used the comments to identify alternatives for analysis. A Scoping Summary Report (BOEM 2021) summarizing the submissions received and the methods for analyzing them is available on BOEM's website at https://www.boem.gov/renewable-energy/state-activities/ocean-wind-1. In addition, all public scoping submissions received can be viewed online at http://www.regulations.gov by typing "BOEM-2021-0024" in the search field. As detailed in the Scoping Summary Report, the resource areas or NEPA topics most referenced in the scoping comments include NEPA/Public Involvement Process; recreation and tourism; mitigation and monitoring; commercial fisheries and for-hire recreational fishing; birds; demographics, employment and economics; and others.

A.2.3.2. Cooperating Agencies

BOEM invited other federal agencies and state, tribal, and local governments to consider becoming cooperating agencies in the preparation of the Draft EIS. According to CEQ guidelines, qualified agencies and governments are those with "jurisdiction by law or special expertise" (CEQ 1981). BOEM asked potential cooperating agencies to consider their authority and capacity to assume the responsibilities of a cooperating agency, and to be aware that an agency's role in the environmental analysis neither enlarges nor diminishes the final decision-making authority of any other agency involved in the NEPA process. BOEM also asked agencies to consider the "Factors for Determining Cooperating Agency Status" in Attachment 1 to CEQ's January 30, 2002, Memorandum for the Heads of Federal Agencies (CEQ 2002). BOEM held interagency meetings on May 18, 2020, and on March 2, May 24, June 29, July 19, 2021, and January 13, 2022, to discuss the environmental review process, schedule, responsibilities, consultation, and potential alternatives.

The following federal agencies and state governments have supported preparation of the Final EIS as cooperating agencies:

- NMFS
- National Park Service
- USACE
- BSEE
- USEPA
- USCG
- USFWS
- DOD
- NJDEP
- New York State Department of State (NYSDOS)
- New Jersey BPU

NMFS is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involve activities that have the potential to affect marine resources under its jurisdiction by law and special expertise. As applicable, permits and authorizations are issued pursuant to the MMPA, as amended (16 USC 1361 et seq.); the regulations governing the taking and importing of marine mammals (50 CFR 216); the ESA (16 USC 1531 et seq.); and the regulations governing the taking, importing, and exporting of threatened and endangered species (50 CFR 222–226). In accordance with 50 CFR 402, NMFS also serves as the Consulting Agency under Section 7 of the ESA for federal agencies proposing action that may affect marine resources listed as threatened or endangered. NMFS has additional responsibilities to conserve and manage fishery resources of the United States, which include the authority to engage in consultations with other federal agencies pursuant to the MSA and 50 CFR 600 when proposed actions may adversely affect EFH. The MMPA is the only authorization for NMFS that requires NEPA compliance. NMFS intents to adopt BOEM's Final EIS if, after independent review and analysis, NMFS determines the Final EIS to be sufficient to support the authorization.

The National Park Service is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect National Park Service resources under its jurisdiction by law and special expertise. The National Park Service is also participating as a consulting party for consultation under Section 106 of the NHPA.

USACE is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect resources under its jurisdiction by law and special expertise. As applicable, permits and authorizations are issued pursuant to Sections 10 and 14 of the RHA and Section 404 of the CWA. As an offshore wind energy project, the Project needs to be situated offshore in the water. Consequently, the fill activities associated with the Project, which consist of the inter-array cables, armoring at the base of the WTG foundations, protective cable armoring for the export cables, and temporary cofferdams, are water dependent. Issuance of Section 10 or Section 404 permits requires NEPA compliance, which will be met via adoption of BOEM's EIS and issuance of the ROD.

BSEE is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect marine resources under its jurisdiction by law and special expertise; and safety, compliance, and enforcement issues. Pursuant to a December 2020 Memorandum of Agreement between BOEM and BSEE, BSEE conducts activities, consults, and advises BOEM on safety and environmental enforcement for renewable energy projects.

USEPA is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect resources under its jurisdiction by law and special expertise, including air quality and water quality.

USCG is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect navigation and safety issues that fall under its jurisdiction by law and special expertise.

USFWS is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect resources under its jurisdiction by law and special expertise. USFWS also serves as the consulting agency under Section 7 of the ESA for federal agencies proposing actions that may affect terrestrial resources listed as threatened or endangered.

DOD is serving as a cooperating agency pursuant to 40 CFR 1501.8 because it has special expertise with respect to potential impacts that may occur as a result of the Proposed Action.

NJDEP, NYSDOS, and New Jersey BPU are serving as cooperating agencies pursuant to 40 CFR 1501.8 because they have special expertise with respect to potential impacts that may occur as a result of the Proposed Action.

A.2.3.3. Distribution of the Draft Environmental Impact Statement for Review and Comment

On June 24, 2022, BOEM published a Notice of Availability for the Draft EIS. The Draft EIS was made available in electronic format for public viewing at https://www.boem.gov/renewable-energy/state-activities/ocean-wind-1. Notification was provided as indicated in Appendix K of the Draft EIS. Hard copies and digital copies of the Draft EIS were delivered to entities as requested. The Notice of Availability commenced the 45-day public review and comment period of the Draft EIS. On August 3, 2022, BOEM announced the 15-day extension of the public review and comment period. BOEM held three virtual public hearings to solicit feedback and identify issues for consideration in preparing the Final EIS. Throughout the public review and comment period, government agencies, members of the public, and interested stakeholders had the opportunity to provide comments on the Draft EIS in various ways, including the following:

- In hard copy form, delivered by mail, enclosed in an envelope labeled "Ocean Wind 1 COP EIS" and addressed to Program Manager, Office of Renewable Energy Programs, Bureau of Ocean Energy Management, 45600 Woodland Road, Sterling, Virginia 20166.

- Through the regulations.gov web portal by navigating to https://www.regulations.gov/, searching for docket number "BOEM-2022-0021," and submitting a comment.
- By attending one of the public hearings on the dates listed in the notice of availability and providing written or verbal comments.

BOEM reviewed and considered all comment submissions in the development of the Final EIS. BOEM's evaluation of public submissions focused on those comments within the submissions that were identified as substantive. EIS Appendix O describes the public comment processing methodology and includes comment responses. All public comment submissions received on the Draft EIS can be viewed online at https://www.regulations.gov/ by typing "BOEM-2022-0021" in the search field.

A.2.3.4. Distribution of the Final Environmental Impact Statement

The Final EIS is available in electronic form for public viewing at https://www.boem.gov/renewable-energy/state-activities/ocean-wind-1. Hard copies and digital copies of the Final EIS can be requested by contacting the Program Manager, Office of Renewable Energy Programs in Sterling, Virginia. Publication of the Final EIS initiates a minimum 30-day mandatory waiting period, during which BOEM is required to pause before issuing a ROD. The ROD will state clearly whether BOEM intends to approve, approve with conditions, or disapprove the COP for construction, operation, and eventual decommissioning of the Project. Notification will be provided as indicated in Appendix K of the Final EIS.

A.3. References Cited

Bureau of Ocean Energy Management (BOEM). 2018. *Tribal Consultation Guidance*. June 29, 2018. Available: https://www.boem.gov/sites/default/files/about-boem/Public-Engagement/Tribal-Communities/BOEM-Tribal-Consultation-Guidance-with-Memo.pdf.

Bureau of Ocean Energy Management (BOEM). 2021. *Ocean Wind Construction and Operations Plan Scoping Report*. June 2021. Available: https://www.boem.gov/renewable-energy/state-activities/ocean-wind-1.

Council on Environmental Quality (CEQ). 1981. Memorandum to Agencies: Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulation. Amended 1986. Available: https://www.energy.gov/sites/prod/files/2018/06/f53/G-CEQ-40Questions.pdf. Accessed: August 2021.

Council on Environmental Quality (CEQ). 2002. Memorandum for the Heads of Federal Agencies: Cooperating Agencies in Implementing the Procedural Requirements of the National Environmental Policy Act. Available: https://www.energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-CoopAgenciesImplem.pdf. Accessed: September 11, 2020.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

This page intentionally left blank.

Appendix B. List of Preparers and Reviewers, References Cited, and Glossary

B.1. List of Preparers and Reviewers

Table B-1 Bureau of Ocean Energy Management Contributors

Name	Role/Resource Area
National Environmental Policy Act (NEPA) Coordinator	
Landers, Lisa	Environmental Protection Specialist
Resource Scientists and Contributors	
Ajilore, Ololade (Lola)	Navigation and Vessel Traffic
Baker, Arianna	Navigation and Vessel Traffic
Bigger, David	Birds; Bats; Coastal Habitat and Fauna
Boatman, Mary	Other Uses
Brune, Genevieve	Land Use and Coastal Infrastructure
Bucatari, Jennifer	Other Uses – Marine Minerals
Chaiken, Emma	Demographics, Employment, and Economics; Recreation and Tourism; Commercial Fisheries and For-Hire Recreational Fishing
Cody, Mary	Marine Mammals; Sea Turtles
Conrad, Alexander	Marine Mammals; Sea Turtles
Dobbs, Kerby	Other Uses – Marine Minerals
Draher, Jennifer	Water Quality
Fulling, Gregory	Marine Mammals; Sea Turtles
Heinze, Martin	Demographics, Employment, and Economics
Hesse, Jeffrey T.	Other Uses
Horrell, Christopher	Cultural Resources
Howson, Ursula	Benthic Resources; Coastal Habitat and Fauna; Commercial Fisheries and For-Hire Recreational Fishing; Finfish, Invertebrates, and Essential Fish Habitat; Other Uses; Recreation and Tourism; Wetlands
Jensen, Mark	Demographics, Employment, and Economics
Renick, Hillary	Tribal Liaison
McCarty, John	Visual Resources; Recreation and Tourism
McCoy, Angel	Meteorologist, Technical Design Elements
Miller, Jennifer	Other Uses
Moshier, Marissa	Cultural Resources
Schnitzer, Laura (LK)	Cultural Resources
Shanahan, Amy	Cultural Resources
Slayton, Ian	Air Quality
Stokely, Sarah	Cultural Resources
Waskes, Will	Project Coordinator
Wolf, Jacob	Air Quality

Table B-2 Reviewers

Name	Title	Agency
Brown, William Y.	Chief Environmental Officer	BOEM
Baker, Karen	Chief, Office of Renewable Energy	BOEM
Morin, Michelle	Chief, Environment Branch for Renewable Energy	BOEM
Stromberg, Jessica	Acting Chief, Environment Branch for Renewable Energy	BOEM
Ottman, Noel	Solicitor	DOI
Vorkoper, Stephen	Solicitor	DOI
Heckman, Andrea	Lead Environmental Protection Specialist	BSEE
Sample, Steven	Executive Director, DOD Siting Clearinghouse	DOD
Austin, Mark	Strategic Programs, Environmental Review Team Lead	USEPA Region 2
Nolan, Katie	Team Leader for Renewable Energy & Offshore Wind, Team Leader of Redevelopment & Restoration	NJDEP
McLean, Laura	Ocean and Lakes Policy Analyst	NYSDOS
Krueger, Mary	Energy Specialist	NPS Interior Region 1, North Atlantic - Appalachian
Tuxbury, Susan	Wind Program Coordinator, GARFO Habitat and Ecosystems Division	NMFS
Crocker, Julie	Endangered Fish Branch Chief, GARFO Protected Resources Division	NMFS
Keith Hanson	Marine Habitat Resource Specialist, GARFO Habitat and Ecosystem Services Division	NMFS
Anthony, Brian	Biologist	USACE Philadelphia District
Creelman, Matthew	Marine Transportation Specialist	USCG District 5
Ciappi, Michael	Senior Fish and Wildlife Biologist	USFWS

DOI = Department of the Interior; GARFO = Greater Atlantic Regional Fisheries Office; NPS = National Park Service

Table B-3 Consultants

Name	Company	Role/Resource Area
Baer, Sarah	ICF	Demographics, Employment, and Economics; Environmental Justice
Byram, Saadia	ICF	Editor
Copeland, Tanya	ICF	Project Manager
Diller, Elizabeth	ICF	Project Director
Ernst, David	ICF	Air Quality/Climate
Gleaton, Soniya	ICF	Comment Processing
Johnson, David	ICF	Bats; Birds; Coastal Habitat; Water Quality; Wetlands
Jost, Rebecca	ICF	Other Uses; Recreation and Tourism; Land Use and Coastal Infrastructure
Lentz, Corey	ICF	Cultural Resources and Section 106 Support
Mendoza, Tiffany	ICF	Public Involvement

Name	Company	Role/Resource Area
Munaretto, Claire	ICF	Demographics, Employment, and Economics; Environmental Justice
Paulson, Merlyn	ICF	Scenic and Visual Resources
Read, Brent	ICF	Geographic Information Systems
Schanel, Pam	ICF	Public Involvement
Tavel, January	ICF	Cultural Resources and Section 106 Lead
Valley, Nathalie	ICF	Navigation and Vessel Traffic
Wheaton, Jenna	ICF	Section 106 Support; Comment Processing
Winslow, Anne	ICF	Deputy Project Manager
Latham, Pam	RPI	Benthic Resources; Finfish, Invertebrates, and Essential Fish Habitat
Butwin, Matt	Prospect Hill Consulting	Commercial Fisheries and For-Hire Recreational Fishing
Baigas, Phil	WSP	Sea Turtles
Mathies, Noelle	WSP	Marine Mammals
Zottenberg, Katelyn	WSP	Marine Mammals

QA/QC = quality assurance/quality control; RPI = Research Planning, Inc.

B.2. References Cited

B.2.1 Chapter 1, Introduction

Bureau of Ocean Energy Management (BOEM). 2012. *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia Final Environmental Assessment*. (OCS EIS/EA BOEM 2012-003). January. Available: https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Renewable_Energy_Program/Smart_from_the_Start/Mid-Atlantic_Final_EA_012012.pdf.

Bureau of Ocean Energy Management (BOEM). 2021a. Commercial Wind Leasing Offshore New Jersey. Available: https://www.boem.gov/commercial-wind-leasing-offshore-new-jersey. Accessed: September 14.

Bureau of Ocean Energy Management (BOEM). 2021b. Ocean Wind. Available: https://www.boem.gov/renewable-energy/state-activities/ocean-wind-1. Accessed: September 14.

Bureau of Ocean Energy Management (BOEM). 2021c. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2021-0012. Available: https://www.boem.gov/vineyard-wind.

Bureau of Ocean Energy Management (BOEM). 2021d. *South Fork Wind Farm and South Fork Export Cable Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2020-057. Available: https://www.boem.gov/renewable-energy/state-activities/sfwf-feis.

Bureau of Ocean Energy Management (BOEM). 2022a. *Ocean Wind 1 Offshore Wind Farm Biological Assessment for the United States Fish and Wildlife Service*. November.

Bureau of Ocean Energy Management (BOEM). 2022b. *Ocean Wind 1 Offshore Wind Farm Biological Assessment for National Marine Fisheries Service*. September.

Bureau of Ocean Energy Management (BOEM). 2022c. *Ocean Wind 1 Offshore Wind Farm Essential Fish Habitat Assessment for National Marine Fisheries Service.* November.

Minerals Management Service (MMS). 2007. *Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf.* (OCS EIS/EA MMS 2007-046). October. Available: https://www.boem.gov/renewable-energy/guide-ocs-alternative-energy-final-programmatic-environmental-impact-statement-eis.

B.2.2 Chapter 2, Alternatives Including the Proposed Action

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

U.S. Army Corps of Engineers (USACE). 2020a. *Final Environmental Assessment, National Regional Sediment Management (RSM) Program, WRDA 2016 Section 1122 Beneficial Use Pilot Project: Barnegat Inlet, Ocean County, New Jersey*. July. Available: https://www.nap.usace.army.mil/Portals/39/docs/Civil/Reports/Final-EA-Barn-Inlet-Section-1122.pdf?ver=5ZCXRjPZrKroezSsUb6Lww%3d%3d.

U.S. Army Corps of Engineers (USACE). 2020b. *Final Environmental Assessment, National Regional Sediment Management (RSM) Program, WRDA 2016 Section 1122 Beneficial Use Pilot Project: Oyster Creek Channel, Barnegat Inlet Federal Navigation Project, Ocean County, New Jersey*. November. Available: https://www.nap.usace.army.mil/Portals/39/docs/Civil/Reports/Final-EA-Barn-Inlet-Section-1122-Oyster-Creek-November-2020.pdf?ver=SrZ2PrKeCtXGydSRoGZKzw%3d%3d.

B.2.3 Chapter 3, Affected Environment and Environmental Consequences

B.2.3.1. Section 3.1, Impact-Producing Factors

Bureau of Ocean Energy Management (BOEM). 2017. *Evaluating Benefits of Offshore Wind Energy Projects in NEPA*. July. BOEM 2017-048. Available: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/Final-Version-Offshore-Benefits-White-Paper.pdf.

Bureau of Ocean Energy Management (BOEM). 2019. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf*. May. OCS Study BOEM 2019-036. Available: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/IPFs-in-the-Offshore-Wind-Cumulative-Impacts-Scenario-on-the-N-OCS.pdf.

B.2.3.2. Section 3.2, Mitigation Identified for Analysis in the Environmental Impact Statement

None.

B.2.3.3. Section 3.3, Definition of Impact Levels

None.

B.2.3.4. Section 3.4, Air Quality

Barthelmie, R. J. and S. C. Pryor. 2021. “Climate Change Mitigation Potential of Wind Energy.” *Climate* 9(9):136. Available: https://www.mdpi.com/2225-1154/9/9/136. Accessed: November 5, 2021.

Buonocore, J. J., P. Luckow, J. Fisher, W. Kempton, and J. I. Levy. 2016. “Health and Climate Benefits of Offshore Wind Facilities in the Mid-Atlantic United States,” *Environmental Research Letters* 11 (2016) 074019. DOI:10.1088/1748-9326/11/7/074019.

Bureau of Ocean Energy Management (BOEM). 2017. *BOEM Offshore Wind Energy Facilities Emission Estimating Tool, User’s Guide*. Available: https://www.boem.gov/Wind-Power-User-Guide/. Accessed: November 5, 2021.

Council on Environmental Quality (CEQ). 2016. *Final Guidance on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change*. Available: https://ceq.doe.gov/guidance/ceq_guidance_nepa-ghg.html. Accessed: November 5, 2022.

Council on Environmental Quality (CEQ). 2023. *National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change*. Available: https://www.federalregister.gov/d/2023-00158. Accessed: March 2023.

Dolan, Stacey L., and Garvin A. Heath. *Life Cycle Greenhouse Gas Emissions of Utility-Scale Wind Power*. Journal of Industrial Ecology 16(S1):S136–54. Available https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1530-9290.2012.00464.x. Accessed: January 31, 2023.

Ebi, K. L., and G. McGregor. 2008. Climate change, tropospheric ozone and particulate matter, and health impacts. *Environ Health Perspect.* 116(11):1449–1455. DOI: 10.1289/ehp.11463.

Exponent Engineering and Scientific Consulting (Exponent). 2000. *A User’s Guide for the CALPUFF Dispersion Model (Version 5).* Available: http://www.src.com/calpuff/download/CALPUFF_UsersGuide.pdf. Accessed: November 15, 2022.

Federal Land Managers’ Air Quality Related Values Work Group (FLAG). 2010. *Phase I Report—Revised (2010)*. Natural Resource Report NPS/NRPC/NRR—2010/232. U.S. Forest Service, National Park Service, and U.S. Fish and Wildlife Service. Available: https://irma.nps.gov/DataStore/DownloadFile/568936. Accessed: September 20, 2022.

Ferraz de Paula, L., and B. S. Carmo. 2022. Environmental Impact Assessment and Life Cycle Assessment for a DeepWater Floating OffshoreWind Turbine on the Brazilian Continental Shelf. *Wind* (2):495–512. Available: https://doi.org/10.3390/wind2030027.

Hogrefe, C., K. Civerolo, J-Y. Ku, B. Lynn, J. Rosenthal, K. Knowlton, B. Solecki, J. Cox, C. Small, S. Gaffin, R. Goldberg, C. Rosenzweig, and P. L. Kinney. 2004. *Modeling the Air Quality Impacts of Climate and Land Use Change in the New York City Metropolitan Area*. Models-3 Users’ Workshop, 18–20 October 2004. Research Triangle Park, NC.

Interagency Working Group on Social Cost of Greenhouse Gases (IWG). 2021. *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide – Interim Estimates under Executive Order 13990*. Available: https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf. Accessed: November 2, 2022.

Katzenstein, W., and J. Apt. 2009. Air Emissions Due to Wind and Solar Power. *Environmental Science and Technology* 43(2):253–258. Available: https://pubs.acs.org/doi/abs/10.1021/es801437t.

Kempton, W., J. Firestone, J. Lilley, T. Rouleau, and P. Whitaker. 2005. “The Offshore Wind Power Debate: Views from Cape Cod.” *Coastal Management Journal* 33(2):119–149. DOI: 10.1080/08920750590917530.

Monitoring Analytics. 2021. *2020 State of the Market Report for PJM*. Available: https://www.pjm.com/-/media/committees-groups/committees/mc/2021/20210329-special/20210329-state-of-the-market-report-for-pjm-2020.ashx. Accessed: November 8, 2021.

National Oceanographic and Atmospheric Administration (NOAA). 2006. *Small Diesel Spills (500–5000 gallons)*. Available: https://dec.alaska.gov/spar/ppr/response/sum_fy10/100111201/NOAAFactsheet_Diesel.pdf. Accessed: November 2, 2021.

National Renewable Energy Laboratory (NREL). 2021. *Life Cycle Assessment Harmonization*. Available: https://www.nrel.gov/analysis/life-cycle-assessment.html. Accessed: January 31, 2023.

New Jersey Board of Public Utilities. 2019. *2019 New Jersey Energy Master Plan*. Available: https://nj.gov/emp/docs/pdf/2020_NJBPU_EMP.pdf. Accessed: November 5, 2021.

New Jersey Department of Environmental Protection (NJDEP). 2019. *New Jersey 2019 IEP Technical Appendix*. Prepared by Evolved Energy research. Available: https://nj.gov/emp/pdf/New_Jersey_2019_IEP_Technical_Appendix.pdf. Accessed: November 5, 2021.

Ocean Wind LLC (Ocean Wind). 2022. *Ocean Wind Offshore Wind Farm OCS Air Permit Application*. September 30.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

O’Donoughue, Patrick R., Garvin A. Heath, Stacey L. Dolan, and Martin Vorum. 2014. *Life Cycle Greenhouse Gas Emissions of Electricity Generated from Conventionally Produced Natural Gas: Systematic Review and Harmonization*. *Journal of Industrial Ecology* 18(1):125–144. https://doi.org/10.1111/jiec.12084. Accessed: January 31, 2023.

Rueda-Bayona, J. G., J. J. Cabello Eras, and T. R. Chaparro. 2022. Impacts generated by the materials used in offshore wind technology on Human Health, Natural Environment and Resources. *Energy* 261, Part A:125223. Available: https://doi.org/10.1016/j.energy.2022.125223.

Shoaib, Nawal. 2022. “A Study on Wind Farms in New Jersey : Life Cycle Assessment and Acceptance of Wind Farms by the Tourists.” *Theses, Dissertations and Culminating Projects* 1114. Available: https://digitalcommons.montclair.edu/etd/1114.

U.S. Energy Information Administration. 2014. *Oil Tanker Sizes Range from General Purpose to Ultra-Large Crude Carriers on AFRA Scale*. September 16, 2014. Available: https://www.eia.gov/todayinenergy/detail.php?id=17991. Accessed September 12, 2021.

U.S. Energy Information Administration. 2022. Coal will account for 85% of U.S. electric generating capacity retirements in 2022. Website. Available: https://www.eia.gov/todayinenergy/detail.php?id=50838. Accessed April 4, 2023.

U.S. Environmental Protection Agency (USEPA). 1992. Memo from John S. Seitz, Director, Office of Air Quality Planning and Standards, to regional air quality directors. October 19, 1992. https://www.epa.gov/sites/default/files/2015-07/documents/class1.pdf. Accessed: April 29, 2022.

U.S. Environmental Protection Agency (USEPA). 1997. *User's Guide for Offshore and Coastal Dispersion (OCD) Model, Version 5*. Available: https://gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/ocd/ocdug.pdf. Accessed: November 11, 2022.

U.S. Environmental Protection Agency (USEPA). 2019. *Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program*. https://www.epa.gov/sites/default/files/2019-05/documents/merps2019.pdf. Accessed: November 11, 2022.

U.S. Environmental Protection Agency (USEPA). 2020a. CO-Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool. Available: https://www.epa.gov/statelocalenergy/co-benefits-risk-assessment-cobra-health-impacts-screening-and-mapping-tool. Accessed: September 16, 2021.

U.S. Environmental Protection Agency (USEPA). 2020b. *User's Manual for the CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA)*. Available: https://www.epa.gov/sites/default/files/2020-06/documents/cobra_user_manual_june_2020.pdf. Accessed: September 16, 2021.

U.S. Environmental Protection Agency (USEPA). 2020c. *Greenhouse Gases Equivalencies Calculator—Calculations and References*. Available: https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references#vehicles. Accessed: September 16, 2021.

U.S. Environmental Protection Agency (USEPA). 2021. Nonattainment Areas for Criteria Pollutants (Green Book). Available: https://www.epa.gov/green-book. Accessed: September 13, 2021.

U.S. Environmental Protection Agency (USEPA). 2022. 2017 National Emissions Inventory. Tier 1 Summaries. Available: https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data. Data file: https://gaftp.epa.gov/air/nei/2017/tier_summaries/tier1_summary_2017nei.accdb. Accessed: September 12, 2022.

B.2.3.5. Section 3.5, Bats

Ahlen, I., L. Bach, H. J. Baagoe, and J. Petersson. 2007. Bats and offshore wind turbines studied in southern Scandinavia. Report 5571. Naturvardsverket. Swedish Environmental Protection Agency, Stockholm, Sweden. Available: https://docs.wind-watch.org/SE-EPA-bats-offshore-wind.pdf. Accessed: January 13, 2023.

Arnett, E. B., K. Brown, W. P. Erickson, J. Fiedler, B. L. Hamilton, T. H. Henry, A. Jain, G. D. Johnson, J. Kerns, R. R. Kolford, C. P. Nicholson, T. O'Connell, M. Piorkowski, and R. Tankersley, Jr. 2008. Patterns of Bat Fatalities at Wind Energy Facilities in North America. *Journal of Wildlife Management* 72:61–78.

Atlantic Shores Offshore Wind (Atlantic Shores). 2021. *Construction and Operations Plan, Atlantic Shores Offshore Wind*. Volume I. September. Available: https://www.boem.gov/renewable-energy/state-activities/atlantic-shores-offshore-wind-construction-and-operations-plan.

Baerwald, E. F., and R. M. R. Barclay. 2009. Geographic Variation in Activity and Fatality of Migratory Bats at Wind Energy Facilities. *Journal of Mammalogy* 90:1341–1349.

Brabant, R., Y. Laurent, B. Jonge Poerink, and S. Degraer. 2021. The Relation between Migratory Activity of *Pipistrellus* Bats at Sea and Weather Conditions Offers Possibilities to Reduce Offshore Wind Farm Effects. *Animals* 2021(11):3457.

Bureau of Ocean Energy Management (BOEM). 2015. *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia: Revised Environmental Assessment*. Office of Renewable Energy Programs. OCS EIS/EA BOEM 2015-031. Accessed: September 1, 2020. Available: https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/VA/VOWTAP-EA.pdf.

Bureau of Ocean Energy Management (BOEM). 2019. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Continental Shelf*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, VA. OCS Study BOEM 2019- 036. May 2019.

Bureau of Ocean Energy Management (BOEM). 2021a. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2021-0012. Available: https://www.boem.gov/vineyard-wind. Accessed August 2021.

Bureau of Ocean Energy Management (BOEM). 2022. Ocean Wind Offshore Wind Farm Biological Assessment for the United States Fish and Wildlife Service. May.

Choi, D. Y., T. W. Wittig, and B. M. Kluever. 2020. An Evaluation of Bird and Bat Mortality at Wind Turbines in the Northeastern United States. *PLOS ONE* 15(8): e0238034. Available: https://doi.org/10.1371/journal.pone.0238034.

Cryan P. M., M. Gorresen, C. D. Hein, M. R. Schirmacher, R. H. Diehld, M. M. Husoe, D. T. S. Hayman, P. D. Fricker, F. J. Bonaccorso, D. H. Johnson, K. Heist, and D. C. Dalton. 2014. Behavior of Bats at Wind Turbine. *Proceedings of the National Academy of Sciences* 11(42): 15126–15131.

Cryan, P. M. 2007. Mating Behavior as a Possible Cause of Bat Fatalities at Wind Turbines. *Journal of Wildlife Management* 72(3):845–849; 2008) DOI: 10.2193/2007-37.

Cryan, P. M., and A. C. Brown. 2007. Migration of Bats Past a Remote Island Offers Clues Toward the Problem of Bat Fatalities at Wind Turbines. *Biological Conservation* 139:1–11.

Cryan, P. M., and R. M. R. Barclay. 2009. Causes of Bat Fatalities at Wind Turbines: Hypotheses and Predictions. *Journal of Mammalogy* 90:1330–1340.

Dowling, Z., P. R. Sievert, E. Baldwin, L. Johnson, S. von Oettingen, and J. Reichard. 2017. *Flight Activity and Offshore Movements of Nano-Tagged Bats on Martha's Vineyard, MA*: Final Report. OCS Study BOEM 2017-054. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, Virginia. June. Available: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/Flight-Activity-and-Offshore-Movements-of-Nano-Tagged-Bats-on-Martha%27s-Vineyard%2C-MA.pdf.

Erickson, W. P., G. D. Johnson, M. D. Strickland, D. P. Young, Jr., K. J. Sernka, R. E. Good, M. Bourassa, K. Bay, and K. Sernka. 2002. *Synthesis and Comparison of Baseline Avian and Bat Use, Raptor Nesting and Mortality Information from Proposed and existing Wind Developments*. Bonneville Power Administration, Portland, Oregon, USA.

Fiedler, Jenny K. 2004. "Assessment of Bat Mortality and Activity at Buffalo Mountain Windfarm, Eastern Tennessee." Master's Thesis, University of Tennessee, 2004. Available: https://trace.tennessee.edu/cgi/viewcontent.cgi?article=3488&context=utk_gradthes. Accessed: September 1, 2020.

Haddaway, L., and L. P. McGuire. 2022. Seasonal and nightly activity patterns of migrating silver-haired bats (Lasionycteris noctivagans) compared to non-migrating big brown bats (*Eptesicus fuscus*) at a fall migration stopover site. *Acta Chiropterologica* 24:83–90.

Hamilton, R. M. 2012. *Spatial and Temporal Activity of Migratory Bats at Landscape Features*. Electronic Thesis and Dissertation Repository. 886.

Hann, Z. A., M. J. Hosler, and P. R. Mooseman, Jr. 2017. Roosting Habits of Two Lasiurus borealis (eastern red bat) in the Blue Ridge Mountains of Virginia. *Northeastern Naturalist* 24 (2): N15–N18.

Hatch, S. K., E. E. Connelly, T. J. Divoll, I. J. Stenhouse, and K. A. Williams. 2013. Offshore observations of eastern red bats (*Lasiurus borealis*) in the mid-Atlantic United States using multiple survey methods. *PLOS ONE* 8(12):e83803. DOI:10.1371/journal.pone.0083803.

Hein, C., K. A. Williams, and E. Jenkins. 2021. *Bat Workgroup Report for the State of the Science Workshop on Wildlife and Offshore Wind Energy 2020: Cumulative Impacts*. Report to the New York State Energy Research and Development Authority (NYSERDA). Albany, NY. 21 pp. Available: https://tethys.pnnl.gov/sites/default/files/publications/Bat-Workgroup-Report.pdf. Accessed: March 25, 2022.

Johnson J. B., J. E. Gates, and N. P. Zegre. 2011. Monitoring seasonal bat activity on a coastal barrier island in Maryland, USA. *Environmental Monitoring and Assessment* 173:685–699.

Johnson, L., and A. Ostroski. 2022. *Acoustic Bat Surveying at Oyster Creek in Waretown, Ocean Township, Ocean City, NJ and B.L. England in Marmora, Upper Township, Cape May County, NJ*. Prepared for Ocean Wind by Environmental Consulting Services, Inc.

Kerns, J., W. P. Erickson, and E. B. Arnett. 2005. "Bat and bird fatality at wind energy facilities in Pennsylvania and West Virginia." Pages 24–95 in B. Arnett, editor, *Relationships Between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Bat Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines*. A final report submitted to the Bats and Wind Energy Cooperative, pp 24–95. Bat Conservation International, Austin, Texas, USA. Available: http://centrostudinatura.it/public2/documenti/687-50647.pdf. Accessed: October 19, 2020.

Kunz, T. H., E. B. Arnett, W. P. Erickson, A. R. Hoar, G. D. Johnson, R. P. Larkin, M. D. Strickland, R. W. Thresher, and M. D. Tuttle. 2007. Ecological Impacts of Wind Energy Development on Bats: Questions, Research Needs, and Hypotheses. *Frontiers in Ecology and the Environment* 5:315–324.

Maine Department of Inland Fisheries and Wildlife. 2021. “Bats.” Available: https://www.maine.gov/ifw/fish-wildlife/wildlife/species-information/mammals/bats.html. Accessed: August 27, 2021.

New Hampshire Fish and Game. No date. “Bats of New Hampshire.” Available: https://wildlife.state.nh.us/nongame/bats-nh.html. Accessed: August 27, 2021.

New Jersey Department of Environmental Protection (NJDEP). 2010. NJDEP Digital Data Downloads in Personal Geo-Database Format (version 9.3.1): Ocean/Wind Power Baseline Ecological Studies Data Downloads. Available: https://www.nj.gov/dep/gis/windpower.html. Accessed: September 16, 2021.

New Jersey Department of Environmental Protection (NJDEP). 2013. Special Status Review of Terrestrial Mammals. Presented to the NJ Endangered Nongame Species Advisory Committee on September 26, 2012, and March 20, 2013. Available: https://www.nj.gov/dep/fgw/ensp/pdf/mammal_status_rprt.pdf. Accessed: June 2, 2022.

New Jersey Division of Fish and Wildlife. 2019. *Nuisance Wildlife Control Guidelines for Bats*. Endangered and Nongame Species Program. Available: https://www.njfishandwildlife.org/ensp/pdf/bat_control.pdf. Accessed: August 27, 2021.

North Carolina Wildlife Resources Commission. 2017. Bats of North Carolina. Available: https://www.ncwildlife.org/Portals/0/Conserving/documents/Bats_Species_Profile.pdf. Accessed: August 27, 2021.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Pelletier, S. K., K. Omland, K. S. Watrous, and T. S. Peterson. 2013. *Information Synthesis on the Potential for Bat Interactions with Offshore Wind Facilities*–Final Report. U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM No. 2013-01163. Available: https://tethys.pnnl.gov/sites/default/files/publications/BOEM_Bat_Wind_2013.pdf. Accessed: September 1, 2020.

Rhode Island Department of Environmental Management. No date. *Bats of Rhode Island*. Available: http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/bat.pdf. Accessed: August 27, 2021.

Schaub, A., J. Ostwald, and B. M. Siemers. 2008. Foraging Bats Avoid Noise. *Journal of Experimental Biology* 211:3147–3180.

Simmons, A. M., K. N. Horn, M. Warnecke, and J. A. Simmons. 2016. Broadband Noise Exposure Does Not Affect Hearing Sensitivity in Big Brown Bats (*Eptesicus fuscus*). *Journal of Experimental Biology* 219:1031–1040.

Sjollema, A. L., J. E. Gates, R. H. Hilderbrand, and J. Sherwell. 2014. Offshore Activity of Bats along the Mid-Atlantic Coast. *Northeastern Naturalist* 21(2):154–163.

Smith, A., and S. McWilliams. 2016. Bat Activity During Autumn Relates to Atmospheric Conditions: Implications for Coastal Wind Energy Development. *Journal of Mammalogy*, 97(6):1565–1577.

Stantec Consulting Services (Stantec). 2016. *Long-Term Bat Monitoring on Islands, Offshore Structures, and Coastal Sites in the Gulf of Maine, Mid-Atlantic, and Great Lakes*—Final Report. Prepared for the U.S. Department of Energy. Available: https://tethys.pnnl.gov/sites/default/files/publications/Stantec-2016-Bat-Monitoring.pdf. Accessed: October 30, 2018.

Stantec Consulting Services (Stantec). 2020. *Avian and Bat Acoustic Survey Final Post-Construction Monitoring Report, 2017–2020; Block Island Wind Farm, Rhode Island*. November 25.

True, M. C., R. J. Reynolds, and W. M. Ford. 2021. Monitoring and Modeling Tree Bat (Genera: *Lasiurus*, *Lasionycteris*) Occurrence Using Acoustics on Structures off the Mid-Atlantic Coast – Implications for Offshore Wind Development. *Animals* 11(11):31416. November.

U.S. Fish and Wildlife Service (USFWS). 2015. *White Nose Syndrome: The devastating disease of hibernating bats in North America*. Available: https://www.fws.gov/mountain-prairie/pressrel/2015/WNS%20Fact%20Sheet%20Updated%2007012015.pdf. Accessed: September 20, 2021.

U.S. Fish and Wildlife Service (USFWS). 2021a. Information for Planning and Consultation (IPaC): list of federally listed threatened, endangered, and proposed species in the Ocean Wind offshore and onshore project components. List generated on July 1.

U.S. Fish and Wildlife Service (USFWS). 2021b. "Midwest Species on the National Listing Work Plan 2021 to 2025. April 26." Available: https://www.fws.gov/midwest/Endangered/listing/MidwestNLP.html. Accessed: August 25, 2021.

Virginia Department of Wildlife Resources. 2021. "Bats." Available: https://dwr.virginia.gov/wildlife/nuisance/bats/. Accessed: August 27, 2021.

Voigt, C., K. Schneeberger, S. Voigt-Heucke, and D. Lewanzik. 2011. Rain Increases the Energy Cost of Bat Flight. *Biology Letters* 7(5). May. Available: https://royalsocietypublishing.org/doi/10.1098/rsbl.2011.0313. Accessed: January 13, 2023.

Whitaker, J. O., Jr. 1998. Life History and Roost Switching in Six Summer Colonies of Eastern Pipistrelles in Buildings. *Journal of Mammalogy* 79(2):651–659.

Whitenosesyndrom.org. 2021. "Where is WNS Now?" Available: https://www.whitenosesyndrome.org/where-is-wns. Accessed: August 27, 2021.

B.2.3.6. Section 3.6, Benthic Resources

Adams, T., R. G. Miller, D. Aleynik, and M. T. Burrows. 2014. Offshore marine renewable energy devices as stepping stones across biogeographical boundaries. *Journal of Applied Ecology* 51:330–338.

Albert, L., F. Deschamps, A. Jolivet, F. Olivier, L. Chauvaud, and S. Chauvaud. 2020. A current synthesis on the effects of electric and magnetic fields emitted by submarine power cables on invertebrates. *Marine Environmental Research* 159:104958. DOI: 10.1016/j.marenvres.2020.104958.

Almeda, R, C. Hyatt, and E. Buskey. 2014a. Toxicity of dispersant Corexit 9500A and crude oil to marine microzooplankton. *Ecotoxicology and environmental safety*. 106C. 76–85. 10.1016/ j.ecoenv.2014.04.028.

Almeda, R., S. Bona, C. R. Foster, and E. J. Buskey. 2014b. Dispersant Corexit 9500A and chemically dispersed crude oil decreases the growth rates of meroplanktonic barnacle nauplii (*Amphibalanus improvisus*) and tornaria larvae (*Schizocardium* sp.). *Marine Environmental Research* 99:212–217.

Arveson, P., and D. Vendittis. 2000. Radiated noise characteristics of a modern cargo ship. *Journal of the Acoustical Society of America* 2000(107):118–129.

Barnegat Bay Partnership. 2021. *2021 Comprehensive Conservation and Management Plan for the Barnegat Bay-Little Egg Harbor Estuary*. Available: https://www.barnegatbaypartnership.org/wp-content/uploads/2021/12/BBP-CCMP-Updated-Dec-2021-forScreens.pdf.

Beatrice Offshore Windfarm. 2016. UXO Clearance Marine License – Environmental Report. 89 pages. Available: https://marine.gov.scot/sites/default/files/00506118.pdf.

Bejarano, Adriana, Jacqueline Michel, Jill Rowe, Zhengkai Li, Deborah French McCay, and Dagmar Schmidt Etkin. 2013. *Environmental Risks, Fate, and Effects of Chemicals Associated with Wind Turbines on the Atlantic Outer Continental Shelf*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2013-213. Available: https://espis.boem.gov/final%20reports/5330.pdf. Accessed: October 11, 2021.

Berry, W. J., N. I. Rubinstein, E. K. Hinchey, G. Klein-MacPhee, and D. G. Clarke. 2011. Assessment of Dredging-Induced Sedimentation Effects on Winter Flounder (*Pseudopleuronectes americanus*) Hatching Success: Results of Laboratory Investigations. Proceedings of the Western Dredging Association Technical Conference and Texas A&M Dredging Seminar, Nashville, Tennessee, June 5–8, 2011.

Bilinski, J. 2021. *Review of the Impacts to Marine Fauna from Electromagnetic Frequencies (EMF) Generated by Energy Transmitted through Undersea Electric Transmission Cables*. NJDEP – Division of Science and Research. Available: https://www.nj.gov/dep/offshorewind/docs/njdep-marine-fauna-review-impacts-from-emf.pdf. Accessed: April 8, 2022.

Bologna, Paul A. X., and Michael S. Sinnema. 2012. Restoration of Seagrass Habitat in New Jersey, United States. *Journal of Coastal Research*. January.

Boyd, S. E., D. S. Limpenny, H. L. Rees, and K. M. Cooper. 2005. “The Effects of Marine Sand and Gravel Extraction on the Macrobenthos at a Commercial Dredging Site (Results 6 Years Post-dredging).” *ICES Journal of Marine Science* 62:145–162.

Bray, L., D. Kassis, and J. M. Hall-Spencer. 2017. Assessing larval connectivity for marine spatial planning in the Adriatic. *Marine Environmental Research* 125:73–81.

Brand, A. R., and U. A. W. Wilson. 1996. *Seismic surveys and scallop fisheries: A report on the impact of a seismic survey on the 1994 Isle of Man queen scallop fishery*. Report to a consortium of oil companies by Port Erin Marine Laboratory, University of Liverpool, Port Erin, Isle of Man.

Brooks, R., C. N. Purdy, S. S. Bell, and K. J. Sulak. 2005. *The benthic community of the eastern US continental shelf: A literature synopsis of benthic faunal resources*. USGS Staff – Published Research. 1051. Available: http://digitalcommons.unl.edu/usgsstaffpub/1051.

Brothers, C. J., J. Harianto, J. B. McClintock, and M. Byrne. 2016. "Sea Urchins in a High-CO_2 World: The Influence of Acclimation on the Immune Response to Ocean Warming and Acidification." *Proceeding of the Royal Society* B 283:20161501. Available: http://dx.doi.org/10.1098/rspb.2016.1501. Accessed: October 11, 2021.

Bureau of Ocean Energy Management (BOEM). 2014. *FINDING OF NO SIGNIFICANT IMPACT for Proposed Geological and Geophysical Activities in the Atlantic OCS to Identify Sand Resources and Borrow Areas*. 5 pages. Available: https://www.boem.gov/sites/default/files/non-energy-minerals/Finding-of-No-Significant-Impact.pdf.

Bureau of Ocean Energy Management (BOEM). 2015. *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia: Revised Environmental Assessmen*t. OCS EIS/EA BOEM 2015-031. Available: https://www.boem.gov/VOWTAP-EA/. Accessed: October 11, 2021.

Bureau of Ocean Energy Management (BOEM). 2018. *Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf Biological Assessment*. 152 pages. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/OREP-Data-Collection-BA-Final.pdf.

Bureau of Ocean Energy Management (BOEM). 2019. Office of Renewable Energy Programs. *Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585*. June 2019.

Bureau of Ocean Energy Management (BOEM). 2020a. Office of Renewable Energy Programs. *Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585*. May 27, 2020.

Bureau of Ocean Energy Management (BOEM). 2020b. Comparison of Environmental Effects from Different Offshore Wind Turbine Foundations. Office of Renewable Energy Programs. OCS Study BOEM 2020-041. 53 pages.

Byrnes, M. R., R. M. Hammer, B. A. Vittor, J. S. Ramsey, D. B. Snyder, J. D. Wood, K. F. Bosma, T. D. Thibaut, and N. W. Phillips. 2000. *Environmental Survey of Potential Sand Resource Sites: Offshore New Jersey*. U.S. Dept. of the Interior, Minerals Management Service, International Activities and Marine Minerals Division (INTERMAR). Herndon, VA. OCS Report MMS 2000-052. Vol I: 380 pp., Vol II: Appendices 291 pp.

Byrnes, M. R., R. M. Hammer, T. D. Thibaut, and D. B. Snyder. 2004. Effects of sand mining on physical processes and biological communities offshore New Jersey, USA. *Journal of Coastal Research* 20(1):25–43.

Carman, M., and D. Grunden. 2019. preliminary assessment of crab predation on epifaunal fouling organisms attached to eelgrass at Martha's Vineyard, Massachusetts, USA. *Management of Biological Invasions* 10(4):626–640.

Carpenter, J. R., L. Merckelbach, U. Callies, S. Clark, L. Gaslikova, and B. Baschek. 2016. Potential impacts of offshore wind farms on North Sea stratification. *PLOS ONE* 11(8), e0160830.

Carroll, A. G., R. Przeslawski, A. Duncan, M. Gunning, and B. Bruce. 2017. A critical review of the potential impacts of marine seismic surveys on fish & invertebrates. *Marine Pollution Bulletin* 114:9–24.

Causon, P. D., and A. B. Gill. 2018. Linking ecosystem services with epibenthic biodiversity change following installation of offshore wind farms. *Environmental Science and Policy* 89:340–347.

Cazenave, P. W., R. Torres, and J. I. Alen. 2016. Unstructured grid modelling of offshore wind farm impacts on seasonally stratified shelf seas. *Progress in Oceanography* 145(2016):25–41.

Chen, C. 2021. *Assessing Potential Impacts of Offshore Wind Facilities on Regional Sea Scallop Laval and Early Juvenile Transports*. NOAA Grant Number: NA19NMF450023. 19 pages.

Christiansen, Nils, Ute Daewel, Bughsin Djath, and Corinna Schrum. 2022. Emergence of Large-Scale Hydrodynamic Structures Due to Atmospheric Offshore Wind Farm Wakes. *Frontiers in Marine Science* 9. DOI: 10.3389/fmars.2022.818501.

Colarusso, P., and A. Verkade. 2016. *Submerged Aquatic Vegetation Survey Guidance for the New England Region*. Joint Federal Agency Publication including NOAA, EPA, and USACE.

CSA Ocean Sciences, Inc. and Exponent. 2019. *Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Headquarters, Sterling, VA. OCS Study BOEM 2019-049.

Dacanay, K. 2015. *Inventory of New Jersey's Estuarine Shellfish Resources: Hard Clam Stock Assessment Barnegat Bay (Survey Year 2012)*. New Jersey Department of Environmental Protection. 54 pp.

Daewel, U., N. Akhtar, N. Christiansen, et al. 2022. Offshore wind farms are projected to impact primary production and bottom water deoxygenation in the North Sea. *Commun Earth Environ* 3:292. Available: https://doi.org/10.1038/s43247-022-00625-0.

Daigle, S. T. 2011. "What is the Importance of Oil and Gas Platforms in the Community Structure and Diet of Benthic and Demersal Communities in the Gulf of Mexico?" Master's Thesis, Louisiana State University. Available: https://core.ac.uk/reader/217380300. Accessed: October 11, 2021.

Dannheim, J., L. Bergström, S. N. R. Birchenough, R. Brzana, A. R. Boon, J. W. P. Coolen, J.-C. Dauvin, I. De Mesel, J. Derweduwen, A. B. Gill, Z. L. Hutchison, A. C. Jackson, U. Janas, G. Martin, A. Raoux, J. Reubens, L. Rostin, J. Vanaverbeke, T. A. Wilding, D. Wilhelmsson, and S. Degraer. 2019. Benthic effects of offshore renewables: identification of knowledge gaps and urgently needed research. *ICES Journal of Marine Science* 77:1092–1108.

Dernie, K. M., M. J. Kaiser, E. A. Richardson, and R. M. Warwick. 2003. "Recovery Rates of Benthic Communities Following Physical Disturbance." *Journal of Animal Ecology* 72:1043–1056.

Dorrell, R. M., C. J. Lloyd, B. J. Lincoln, T. P. Rippeth, J. R. Taylor, C. P. Caulfield, J. Sharples, J. A. Polton, B. D. Scannell, D. M. Greaves, R. A. Hall, and J. H. Simpson. 2022. Anthropogenic mixing in seasonally stratified shelf seas by offshore wind farm infrastructure. *Frontiers in Marine Science* 9:830927.

Duarte, M. 2002. The future of seagrass meadows. *Environmental Conservation* 29(2):192–206. Foundation for Environmental Conservation.

Duarte, C. M., J. J. Middelburg, and N. Caraco. 2005. Major role of marine vegetation on the oceanic carbon cycle. *Biogeosciences* 2:1–8.

Duarte, C., T. Sintes, and N. Marba. 2013. Assessing the CO_2 capture potential of seagrass restoration projects. *Journal of Applied Ecology* 50:1341–1349.

Duarte, C. M., and D. Krause-Jensen. 2017. Export from seagrass meadows contributes to marine carbon sequestration. *Frontiers in Marine Science* 4:13.

English, P. A., T. I. Mason, J. T. Backstrom, B. J. Tibbles, A. A. Mackay, M. J. Smith, and T. Mitchell. 2017. *Improving Efficiencies of National Environmental Policy Act Documentation for Offshore Wind Facilities Case Studies Report*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2017-026. Available: https://tethys.pnnl.gov/sites/default/files/publications/English-et-al-2017-BOEM.pdf. Accessed: October 11, 2021.

Essink, K. 1999. "Ecological Effects of Dumping of Dredged Sediments; Options for Management." *Journal of Coastal Conservation* 5:69–80.

Exponent Engineering, P.C. (Exponent). 2018. *Deepwater Wind South Fork Wind Farm. Offshore Electric and Magnetic Field Assessment*. May 24.

Field, C., M. Behrenfeld, J. Randerson, and P. Falkowski. 1998. Primary Production of the Biosphere: Integrating Terrestrial and Oceanic Components. *Science* 281:237–240.

Floeter, J., T. Pohlmann, A. Harmer, and C. Mollmann. 2022. Chasing the offshore wind farm wind-wake-induced upwelling/downwelling dipole. *Frontiers in Marine Science* 9:884943.

Ford, S. E. 1997. History and Present Status of Molluscan Shellfisheries from Barnegat Bay to Delaware Bay. In: *The History, Present Condition, and Future of the Molluscan Fisheries of North and Central American and Europe*. NOAA Technical Report NMFS 127; September 1997. 499p.

Gilbert, P. M., C. J. Madden, W. Boynton, D. Flemer, C. Heil, and J. Sharp. 2010. *Nutrients in Estuaries: A Summary Report of the National Estuarine Experts Workgroup 2005–2007*.

Gill, A. B. and M. Desender. 2020. Risk to Animals from Electromagnetic Fields Emitted by Electric Cables and Marine Renewable Energy Devices. In A.E. Copping and L.G. Hemery (Eds.), *OES-Environmental 2020 State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World.* Report for Ocean Energy Systems (OES). (pp. 86–103). DOI:10.2172/1633088.

Graham, O. J., L. R. Aoki, T. Stephens, J. Stokes, S. Dayal, B. Rappazzo, C. P. Gomes, and C. D. Harvell. 2021. Effects of seagrass wasting disease on eelgrass growth and belowground sugar in natural meadows. *Frontiers in Marine Science* 8:768668.

Greene, J. K., M. G. Anderson, J. Odell, and N. Steinberg, eds. 2010. *The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems. Phase One*. The Nature Conservancy, Eastern U.S. Division, Boston, MA.

Guida, V., A. Drohan, H. Welch, J. McHenry, D. Johnson, V. Kentner, J. Brink, D. Timmons, and E. Estela-Gomez. 2017. *Habitat Mapping and Assessment of Northeast Wind Energy Areas*. U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-088.

Harsanyi, P., K. Scott, B. A. A. Easton, G. de la Cruz Ortiz, E. C. N. Chapman, A. J. R. Piper, C. M. V. Rochas, and A. R. Lyndon. 2022. The effects of anthropogenic electromagnetic fields (EMF) on the early development of two commercially important crustaceans, European Lobster, *Homarus gammarus* (L.) and Edible Crab, *Cancer pagurus* (L.). 2022. *Journal of Marine Science and Engineering* 10:564.

Hawkins, A., R. Hazelwood, and A. Popper et al. 2021. Substrate vibrations and their potential effects upon fishes and invertebrates. *The Journal of the Acoustical Society of America* 149:2782. DOI: 10.1121/10.0004773.

Henderson, D., B. Hu, and E. Bielefeld. 2008. Patterns and mechanisms of noise-induced cochlear pathology. Pp. 195–217 in: National Marine Fisheries Service (NMFS). 2018. 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. National Oceanic and Atmospheric Administration Technical Memorandum NMFS-OPR-59. U.S. Department of Commerce, National Oceanographic and Atmospheric Administration.

Howard, J., A. Sutton-Grier, D. Herr, J. Kleypas, E. Landis, E. Mcleod, E. Pidgeon, and S. Simpson. 2017. Clarifying the role of coastal and marine systems in climate mitigation. *Frontiers in Ecology and Environment* 15(1):1–9.

Hutchison, Z. L., D. H. Secor, and A. B. Gill. 2020. The interaction between resource species and electromagnetic fields associated with electricity production by offshore wind farms. *Oceanography* 33(4):96–107.

Hutchison, Z. L., P. Sigray, H. He, A. B. Gill, J. King, and C. Gibson. 2018. *Electromagnetic Field (EMF) Impacts on Elasmobranch (Shark, Rays, and Skates) and American Lobster Movement and Migration from Direct Current Cables*. U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-003.

Inspire Environmental (Inspire). 2021. *Ocean Wind Offshore Wind Farm Benthic Habitat Mapping and Benthic Assessment to Support Essential Fish Habitat Consultation*. Prepared for HDR Engineering. June 2021. Ocean Wind COP Appendix E Supplement.

Inspire Environmental (Inspire). 2022a. *Ocean Wind Offshore Wind Farm Benthic Habitat Mapping and Benthic Assessment to Support Essential Fish Habitat Consultation*. Prepared for HDR Engineering.

Inspire Environmental (Inspire). 2022b. *Ocean Wind Offshore Wind Farm Submerged Aquatic Vegetation Monitoring Plan*. Prepared for Ocean Wind, Ørsted US. Submitted by Inspire Environmental. June 15, 2022.

Jakubowska, M., B. Urban-Malinga, Z. Otremba, and E. Andrulewicz. 2019. Effect of low frequency electromagnetic field on the behavior and bioenergetics of the polychaete Hediste diversicolor. *Marine Environmental Research* 150:104766.

Johnson, T., J. van Berkel, L. Mortensen, M. Bell, I. Tiong, B. Hernandez, D. Snyder, F. Thomsen, and O. Petersen. 2021. *Hydrodynamic modeling, particle tracking, and agent-based modeling of larvae in the U.S. mid-Atlantic bight*. OCS Study BOEM 2021-049. Prepared under 140M120C0004 By DHI Water & Environment, Inc. Lakewood, Colorado 80235 USA.

Kennish, M. J., S. B. Bricker, W. C. Dennison, P. M. Glibert, R. J. Livingston, K. A. Moore, R. T. Noble, H. W. Paerl, J. M. Ramstack, S. Seitzinger, D. A. Tomasko, and I. Valiela. 2007. Barnegat Bay–Little Egg Harbor Estuary: case study of a highly eutrophic coastal bay system. *Ecological Applications* 17(sp5):S3–S16.

Kennish, M. J., and V. N. de Jonge. 2011. Chemical introductions to the systems: Diffuse and nonpoint source pollution from chemicals (nutrients: eutrophication). In: M. J. Kennish and M. Elliott, eds., *Treatise on Estuarine and Coastal Science*, Vol. 8, Human-induced Problems (Uses and Abuses). Treatise on Estuarine and Coastal Science, Elsevier, Oxford, England, pp. 113-148.

Kirchgeorg, T., I. Weinberg, M. Hornig, R. Baier, M. J. Schmid, and B. Brockmeyer. 2018. Emissions from corrosion protection systems of offshore wind farms: evaluation of the potential impact on the marine environment. *Marine Pollution Bulletin* 136:257–268.

Kurihara, H. 2008. Effects of CO_2-driven ocean acidification on the early developmental stages of invertebrates. *Marine Ecology Progress Series* 373:275–284.

Küsel, E., M. Werathmueller, K. Zammit, M. Reeve, S. Dufault, K. Limpert, and D. Zeddies. 2021. *Underwater Acoustic Analysis and Exposure Modeling Revolution Wind: Impact Pile Driving during Foundation Installation*. Prepared by JASCO Applied Sciences, Inc. for Revolution Wind. 169 pages. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/App_P3%20Underwater%20Acoustic%20Modeling%20Report.pdf.

Langhamer, O., H. Holand, and G. Rosenqvist. 2016. Effects of an Offshore Wind Farm (OWF) on the Common Shore Crab Carcinus maenas: Tagging Pilot Experiments in the Lillgrund Offshore Wind Farm (Sweden). *PLOS ONE* 11(10): e0165096. DOI:10.1371/journal.pone.0165096.

Lathrop, R. G., and S. Haag. 2011. *Assessment of Seagrass Status in the Barnegat Bay-Little Egg Harbor Estuary System: 2003–2009*. CRSSA Technical Report, Rutgers University, New Brunswick, NJ, 56 pp. Available: http://crssa.rutgers.edu/projects/coastal/sav/downloads.htm.

Lefaible, N., L. Colson, U. Braeckman, and T. Moens. 2019. "Evaluation of Turbine-Related Impacts on Macrobenthic Communities Within Two Offshore Wind Farms During the Operational Phase." In *Memoirs on the Marine Environment: Environmental Impacts of Offshore Wind Farms in the Belgian Part of the North Sea*. S. Degraer, R. Brabant, B. Rumes, and L. Vigin, eds. 73–84. Brussels: Royal Belgian Institute of Natural Sciences, OD Natural Environment, Marine Ecology and Management. Available: https://odnature.naturalsciences.be/downloads/mumm/windfarms/winmon_report_2019_final.pdf. Accessed: October 11, 2021.

Lefcheck, J. S., B. B. Hughes, A. J. Johnson, B. W. Pfirrmann, D. B. Rasher, A. R. Smyth, B. L. Williams, M. W. Beck, and R. J. Orth. 2019. Are coastal habitats important nurseries? A meta-analysis. *Conservation Letters* 12(4):e12645.

Lewis, L. J., J. Davenport, and T. C. Kelly. 2002. "A Study of the Impact of a Pipeline Construction on Estuarine Benthic Invertebrate Communities." *Estuarine Coastal and Shelf Science* 55(2):213–221.

Lewis III, R. R. R., and P. L. Erftemeijer. 2006. Environmental impacts of dredging on seagrasses: a review. *Marine Pollution Bulletin* 52(12):1553–1572.

Lloret, J., A. Turiel, J. Sole, E. Berdalet, A. Sabates, A. Olivares, J. Gili, J. Vila-Subiros, and R. Sarda. 2022. Unravelling the ecological impacts of large-scale offshore wind farms in the Mediterranean Sea. *Science of the Total Environment* 824:153803.

Love, M. S., M. M. Nishimoto, S. Clark, M. McCrea, and A. S. Bull. 2017. Assessing potential impacts of energized submarine power cables on crab harvests. *Continental Shelf Research* 151:23–29. DOI:10.1016/j.csr.2017.10.002.

Macreadie, P. I., A. Anton, J. A. Raven, N. Beaumont, R. M. Connolly, D. A. Friess, J. J. Kelleway, H. Kennedy, T. Kuwae, P. S. Lavery, C. E. Lovelock, D. A. Smale, E. T. Apostolaki, T. B. Atwood, J. Baldock, T. S. Bianchi, G. L. Chmura, B. D. Eyre, J. W. Fourqurean, J. M. Hall-Spencer, M. Huxham, I. E. Hendriks, D. Krause-Jensen, D. Laffoley, T. Luisetti, N. Marba, P. Masque, K. J. McGlathery, J. P. Megonigal, D. Murdiyarso, B. D. Russell, R. Santos, O. Serrano, B. R. Silliman, K. Watanabe, and C. M. Duarte. 2019. The future of Blue Carbon science. *Nature Communications* 10:3998. Available: https://doi.org/10.1038/s41467-019-11693-w.

Mcleod, E., G. L. Chmura, S. Bouillon, R. Salm, M. Bjork, et al. 2011. A blueprint for blue carbon: toward an improvement understanding of the role of vegetated coastal habitats in sequestering CO_2. *Front Ecol Environ* 9:552–560. DOI: https://doi.org/10.1890/110004.

Merson, R. R., and H. L. Pratt. 2007. Sandbar shark nurseries in New Jersey and New York: evidence of northern pupping grounds along the United States east coast. In *American Fisheries Society Symposium* (50):35.

Minerals Management Service (MMS). 2009. Cape *Wind Energy Project Final Environmental Impact Statement*. January 2009. U.S. Department of the Interior. OCS Publication No. 2008-040. Available: https://www.energy.gov/sites/prod/files/DOE-EIS-0470-Cape_Wind_FEIS_2012.pdf. Accessed: October 11, 2021.

Nascimento, F. J. A., M. Dahl, D. Deyanova, L. D. Lyimo, H. M. Bik, T. Schuelke, T. J. Pereira, M. Björk, S. Creer, and M. Gullström. 2019. Above-below surface interactions mediate effects of seagrass disturbance on meiobenthic diversity, nematode and polychaete trophic structure. *Communications Biology* 2:362.

National Oceanic and Atmospheric Administration (NOAA). 2022. *2022 State of the Ecosystem Mid-Atlantic*. NOAA Fisheries. Available: https://www.fisheries.noaa.gov/new-england-mid-atlantic/ecosystems/state-ecosystem-reports-northeast-us-shelf. Accessed: April 6, 2022.

Neckles, Hilary A., Angela D. Brewer, John W. Sowles, Seth Barker, Curtis C. Bohlen, Matthew Craig, Michael Doan, and Sandra Lary. 2015. "Update on a Continuing Saga: Eelgrass and Green Crabs in Casco Bay, Maine (Poster)." *Graphics, Maps, and Posters* 36. Available: https://digitalcommons.usm.maine.edu/cbep-graphics-maps-posters/36.

New Jersey Department of Environmental Protection (NJDEP). 1979. Submerged Aquatic Vegetation Distribution Map 040 – Marmora. Available: https://www.nj.gov/dep/landuse/download/map_040.jpg.

New Jersey Department of Environmental Protection (NJDEP). 1986. Submerged Aquatic Vegetation Distribution Map 024 – Island Beach. Available: https://www.nj.gov/dep/landuse/download/map_024.pdf.

New Jersey Department of Environmental Protection (NJDEP). 2012. *Hard clam distribution for central Barnegat Bay, 2012*. Available: https://www.nj.gov/dep/landuse/shellfish.html.

New York State Energy Research and Development Authority (NYSERDA). 2019. *Geotechnical and Geophysical Desktop Study to Support Offshore Wind Energy Development in the New York Bight Final Report*. Report Number 19-19. NYSERDA Contract 135752. 70 pages.

Normandeau Associates, Inc., Exponent, Inc., T. Tricas, and A. Gill. 2011. *Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species.* Final Report. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09. Available: https://espis.boem.gov/final%20reports/5115.pdf. Accessed: October 11, 2021.

Novak, A. B., M. C. Pelletier, P. Colarusson, J. Simpson, M. N. Guiterrez, A. Arias-Ortiz, M. Charpentier, P. Masque, and P. Vella. 2020. Factors influencing carbon stocks and accumulation rates in eelgrass meadows across New England, USA. *Estuaries and Coasts* 43:2076–2091.

Ocean Wind LLC (Ocean Wind). 2022. *Ocean Wind Submerged Aquatic Vegetation Preliminary Mitigation Plan*. December 2022.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Orth, R. J., J. S. Lefcheck, and D. J. Wilcox. 2017. Boat propeller scarring of seagrass beds in lower Chesapeake Bay, USA: Patterns, causes, recovery, and management. *Estuaries and Coasts* 40(6):1666–1676.

Pendleton, L., D. C. Donato, B. C. Murray, S. Crooks, W. A. Jenkins, S. Sifleet, C. Craft, J. W. Fourqurean, J. B. Kauffman, N. Marba, P. Megonigal, E. Pidgeon, D. Herr, D. Gordon, and A. Baldera. 2012. Estimating global "Blue Carbon" emissions from conversion and degradation of vegetated coastal ecosystems. *PLOS ONE* 7(9):e43542. DOI:10.1371/journal.pone.0043542.

Pezy, J. P., A. Raoux, J. C. Dauvin, and S. Degraer. 2018. "An Ecosystem Approach for Studying the Impact of Offshore Wind Farms: A French Case Study." *ICES Journal of Marine Science*, fsy125, September 12, 2018. Available: https://academic.oup.com/icesjms/article-abstract/77/3/1238/5096674. Accessed: October 11, 2021.

Pickens, B. A., J. C. Taylor, and D. Hansen. 2020. Volume 1: Fish habitat associations and the potential effects of dredging on the Atlantic and Gulf of Mexico Outer Continental Shelf, literature synthesis and gap analysis. In: Pickens, B. A., and J. C. Taylor, editors. *Regional Essential Fish Habitat geospatial assessment and framework for offshore sand features*. Sterling (VA): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2020-002 and NOAA NCCOS Technical Memorandum 270. Available: https://doi.org/10.25923/akzd-8556.

Popper, A. N., L. Hice-Dunton, and E. Jenkins. 2022. Offshore wind energy development: Research priorities for sound and vibration effects on fishes and aquatic invertebrates. *Journal of the Acoustical Society of America* 151:205–215.

Popper, A. N., A. D. Hawkins, R. R. Fay, D. Mann, S. Bartol, T. Carlson, S. Coombs, W. T. Ellison, R. Gentry, M. B. Halvorsen, S. Løkkeborg, P. Rogers, B. L. Southall, D. Zeddies, and W. N. Tavolga. 2014. *Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI*. Springer Briefs in Oceanography, Springer International Publishing, and ASA Press, Cham, Switzerland.

Raoux, A., S. Tecchio, J. P. Pezy, G. Lassalle, S. Degraer, S. Wilhelmsson, M. Cachera, B. Ernande, C. Le Guen, M. Haraldsson, K. Grangeré, F. Le Loc'h, J. C. Dauvin, and N. Niquil. 2017. "Benthic and Fish Aggregation Inside an Offshore Wind Farm: Which Effects on the Trophic Web Functioning?" *Ecological Indicators* 72, January 2017:33–46. Available: https://hal.archives-ouvertes.fr/hal-01398550/document. Accessed: October 11, 2021.

Rico-Martínez, R., T. W. Snell, and T. L. Shearer. 2012. Synergistic toxicity of Macondo crude oil and dispersant Corexit 9500A® to the *Brachionus plicatilis* species complex (Rotifera). *Environmental Pollution* 173:5–10. Available: https://doi.org/10.1016/j.envpol.2012.09.024.

Roberts, L., H. R. Harding, I. Voellmy, R. Bruintjes, S. D. Simpson, A. N. Radford, T. Breithaupt, and M. Elliott. 2016. Exposure of benthic invertebrates to sediment vibration: From laboratory experiments to outdoor simulated pile-driving. *Proceedings of Meetings on Acoustics* 27:010029.

Rutecki, D., T. Dellapenna, E. Nestler, F. Scharf, J. Rooker, C. Glass, and A. Pembroke. 2014. *Understanding the Habitat Value and Function of Shoals and Shoal Complexes to Fish and Fisheries on the Atlantic and Gulf of Mexico Outer Continental Shelf*. Literature Synthesis and Gap Analysis. Prepared for the U.S. Department of the Interior, Bureau of Ocean Energy Management. Contract # M12PS00009. BOEM 2015-012.

Salo, T., and M. Pedersen. 2014. Synergistic Effects of Altered Salinity and Temperature on Estuarine Eelgrass (Zostera marina) Seedlings and Clonal Shoots. *J. Exp. Mar. Biol. Ecol.* 457:143–150. DOI: 10.1016/j.jembe.2014.04.008.

Schultz, I. R., D. L. Woodruff, K. E. Marshall, W. J. Pratt, and G. Roesijadi. 2010. *Effects of Electromagnetic Fields on Fish and Invertebrates*. Task 2.1. 3: Effects on Aquatic Organisms-Fiscal Year 2010 Progress Report- Environmental Effects of Marine and Hydrokinetic Energy (No. PNNL-19883 Final). Pacific Northwest National Laboratory, Richland, Washington.

Segtnan, O. H., and K. Christakos. 2015. Effect of offshore wind farm design on the vertical motion of the ocean. In *Proceedings of the 12th Deep Sea Offshore Wind R&D Conference, EERA DeepWind 2015*. *Energy Procedia* 80:213–222.

Short, Frederick T. 2016. *Eelgrass Distribution and Biomass in the Great Bay Estuary for 2015*. PREP Reports & Publications. 354. Available: https://scholars.unh.edu/prep/354.

Siddagangaiah, S., C.-F. Chen, W.-C. Hu, and N. Pieretti. 2022. Impact of pile-driving and offshore windfarm operational noise on fish chorusing. *Remote Sens Ecol Conserv* 8:119–134. Available: https://doi.org/10.1002/rse2.231.

Slacum, H. W., W. H. Burton, E. T. Methratta, E. D. Weber, R. J. Llanso, and J. Dew-Baxter. 2010. Assemblage structure in shoal and flat-bottom habitats on the inner continental shelf of the Middle Atlantic Bight, USA. *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science* 2:277–298.

Snyder, D. B., W. H. Bailey, K. Palmquist, B. R. T. Cotts, and K. R. Olsen. 2019. Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England. BOEM report 2019-049. Available: https://espis.boem.gov/final%20reports/BOEM_2019-049.pdf.

Taghon, G. L., P. A. Ramey, C. M. Fuller, R. F. Petrecca, J. P. Grassle, and T. J. Belton. 2017. Benthic invertebrate community composition and sediment properties in Barnegat Bay, New Jersey, 1965–2014. In: Buchanan, G. A., T. J. Belton, and B. Paudel (eds.), A Comprehensive Assessment of Barnegat Bay–Little Egg Harbor, New Jersey. *Journal of Coastal Research*, Special Issue No. 78, pp. 169–183. Coconut Creek (Florida), ISSN 0749-0208.

Tagliabue, A., L. Kwiatkowski, L. Bopp, M. Butenschon, W. Cheung, M. Lengiagne, and J. Vialard. 2021. Persistent uncertainties in ocean net primary production climate change projections at regional scales raise challenges for assessing impacts on ecosystem services. *Frontiers in Climate* 3:738224.

Taormina B., J. Bald, A. Want, G. Thouzeau, M. Lejart, N. Desroy, and A. Carlier. 2018. “A Review of Potential Impacts of Submarine Cables on the Marine Environment: Knowledge Gaps, Recommendations, and Future Directions.” *Renewable and Sustainable Energy Reviews* 96:380–391. Available: https://hal.archives-ouvertes.fr/hal-02405630/document. Accessed: October 11, 2021.

Tougaard, J., L. Hermannsen, and P. T. Madsen. 2020. How loud is the underwater noise from operating offshore wind turbines? *Journal of the Acoustical Society of America* 148(5):2885–2893.

U.S. Environmental Protection Agency (USEPA). 2009. National Estuary Program Booklet. Available: https://www.epa.gov/nep/national-estuary-program-booklet.

U.S. Offshore Wind Synthesis of Environmental Effects Research (SEER). 2022. Benthic Disturbance from Offshore Wind Foundations, Anchors, and Cables.

Van Dalfsen, J. A., and K. Essink. 2001. “Benthic Community Response to Sand Dredging and Shoreface Nourishment in Dutch Coastal Waters.” *Senckenbergiana Maritima* 31(2):329–332.

van der Molen, J., H. C. M. Smith, P. Lepper, S. Limpenny, and J. Rees. 2014. Predicting the large-scale consequences of offshore wind turbine array development on a North Sea ecosystem. *Cont. Shelf Res.* 85:60–72.

Vasslides, J., and K. Able. 2008. Importance of shoreface sand ridges as habitat for fishes off the northeast coast of the United States. *Fishery Bulletin* 106:93–107.

Veirs, S., V. Veirs, and J. D. Wood. 2016. Ship noise extends to frequencies used for echolocation by endangered killer whales. *PeerJ* 4:e1657. Available: https://doi.org/10.7717/peerj.1657.

Virginia Institute of Marine Science (VIMS). 2000. *Environmental survey of potential sand resources sites, offshore Delaware and Maryland*: Final Report. OCS Study 2000-05. Virginia Institute of Marine Science, College of William and Mary. Available: http://dx.doi.org/doi:10.21220/m2-mtx7-mn42.

Waycott, M., C. Duarte, T. Carruthers, R. Orth, et al. 2009. Accelerating loss of seagrasses across the globe threatens coastal ecosystems. *Proceedings of the National Academy of Sciences* 106:12377–12381.

Wilber, D. H., and D. G. Clarke. 2007. Defining and Assessing Benthic Recovery Following Dredging and Dredged Material Disposal. Presentation from the 2007 WODCON XVIII Conference in Lake Buena Vista, FL. Available: https://www.westerndredging.org/phocadownload/ConferencePresentations/2007_WODA_Florida/Session3D-EnvironmentalAspectsOfDredging/3%20-%20Wilber%20-%20Defining%20Assessing%20Benthic%20Recovery%20Following%20Dredged%20Material%20Disposal.pdf. Accessed: October 11, 2021.

Wilding, T. A., A. B. Gill, A. Boon, E. Sheehan, J. Dauvin, J. Pezy, F. O'Beirn, U. Janas, L. Rostin, and I. De Mesel. 2017. Turning of the DRIP ('Data-rich, information-poor') – rationalizing monitoring with a focus on marine renewable energy developments and the benthos. *Renewable and Sustainable Energy Reviews* 74:848–859.

Wong, M., and B. Vercaemer. 2012. Effects of invasive colonial tunicates and a native sponge on the growth, survival, and light attenuation of eelgrass (*Zostera marina*) *Aquatic Invasions* 7(3):315–326. DOI: http://dx.doi.org/10.3391/ai.2012.7.3.003.

Woodruff, D. L., I. R. Schultz, K. E. Marshall, J. A. Ward, and V. Cullinan. 2012. *Effects of Electromagnetic Fields on Fish and Invertebrates*. Task 2.1.3: Effects on Aquatic Organisms – Fiscal Year 2011 Progress Report. PNNL-20813, Pacific Northwest National Laboratory, Richland, Washington.

Woodruff, D. L., I. R. Schultz, K. E. Marshall, J. A. Ward, and V. I. Cullinan. 2013. *Effects of Electromagnetic Fields on Fish and Invertebrates*: Task 2.1.3: Effects on Aquatic Organisms-Fiscal Year 2011 Progress Report- Environmental Effects of Marine and Hydrokinetic Energy (No. PNNL-20813 Final). Pacific Northwest National Laboratory, Richland, Washington.

B.2.3.7. Section 3.7, Birds

Abdulle, S. A., and K. C. Fraser. 2018. Does wind speed and direction influence timing and route of a trans-hemispheric migratory songbird (purple martin) at a migration barrier? *Animal Migration* 5(1):49–58.

Ainley, D. G., E. Porzig, D. Zajanc, and L. B. Spear. 2015. Seabird flight behavior in response to altered wind strength and direction. *Marine Ornithology* 43:25–36.

Avian Power Line Interaction Committee (APLIC). 2012. *Reducing Avian Collisions with Power Lines: The State of the Art in 2012*. Edison Electric Institute and APLIC. Washington D.C. Available: http://www.aplic.org/uploads/files/15518/Reducing_Avian_Collisions_2012watermarkLR.pdf. Accessed: October 20, 2021.

Bayne, E. M., L. Habib, and S. Boutin. 2008. Impacts of Chronic Anthropogenic Noise from Energy-sector Activity on Abundance of Songbirds in the Boreal Forest. *Conservation Biology* 22(5):1186–1193.

Bloch, R., and B. Bruderer. 1982. The Air Speed of Migrating Birds and Its Relationship to the Wind. *Behavioral Ecology and Sociobiology* 11:19–24.

Briggs, K. T., M. E. Gershwin, and D. W. Anderson. 1997. Consequences of petrochemical ingestion and stress on the immune system of seabirds. *ICES Journal of Marine Science* 54:718–725.

Bruderer, B., and A. Boldt. 2001. Flight characteristics of birds. *International Journal of Avian Science* 143:178–204.

Bureau of Ocean Energy Management (BOEM). 2012. *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts: Environmental Assessment*. OCS EIS/EA BOEM 2012-087. Available: https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/BOEM_Newsroom/Library/Publications/2012/BOEM-2012-087.pdf. Accessed: September 1, 2020.

Bureau of Ocean Energy Management (BOEM). 2014a. *Atlantic OCS Proposed Geological and Geophysical Activities: Mid-Atlantic and South Atlantic Planning Areas Final Programmatic Environmental Impact Statement*. Office of Renewable Energy Programs. OCS EIS/EA BOEM 2014-001. February 2014. Available: https://www.boem.gov/oil-gas-energy/atlantic-geological-and-geophysical-gg-activities-programmatic-environmental-impact. Accessed: October 19, 2020.

Bureau of Ocean Energy Management (BOEM). 2014b. *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts: Revised Environmental Assessment*. Office of Renewable Energy Programs. OCS EIS/EA BOEM 2014-603. Available: https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/MA/Revised-MA-EA-2014.pdf. Accessed: September 1, 2020.

Bureau of Ocean Energy Management (BOEM). 2016. *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York: Environmental Assessment*. Office of Renewable Energy Programs. OCS EIS/EA BOEM 2016-042. June 2016. Available: https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/NY/NY-Public-EA-June-2016.pdf. Accessed: September 1, 2020.

Bureau of Ocean Energy Management (BOEM). 2018. *Vineyard Wind Offshore Wind Energy Project Draft Environmental Impact Statement*. OCS EIS/EA BOEM 2018-060. Available: https://www.boem.gov/Vineyard-Wind-EIS/. Accessed: September 21, 2021.

Bureau of Ocean Energy Management (BOEM). 2021a. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2021-0012. Available: https://www.boem.gov/vineyard-wind. Accessed: August 2021.

Bureau of Ocean Energy Management (BOEM). 2021c. *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development*. April 2021.

Bureau of Ocean Energy Management (BOEM). 2022. Ocean Wind Offshore Wind Farm Biological Assessment for the United States Fish and Wildlife Service. May.

Causon, Paul D., and Andrew B. Gill. 2018. Linking Ecosystem Services with Epibenthic Biodiversity Change Following Installation of Offshore Wind Farms. *Environmental Science and Policy* 89:340–347.

Chapman, J. W., C. Nilsson, K. S. Lim, J. Backman, D. R. Reynolds, and T. Alerstam. 2016. Adaptive Strategies in nocturnally migrating insects and songbirds: contrasting responses to wind. *Journal of Animal Ecology* 85(1):115–124. DOI: 10.1111/1365-2656.12420. Epub 2015 Aug 17. PMID: 26147535.

Choi, D. Y., T. W. Wittig, and B. M. Kluever. 2020. An Evaluation of Bird and Bat Mortality at Wind Turbines in the Northeastern United States. *PLOS ONE* 15(8): e0238034. Available: https://doi.org/10.1371/journal.pone.0238034.

Cook, A. S. C. P., and N. H. K. Burton. 2010. A Review of Potential Impacts of Marine Aggregate Extraction on Seabirds. Marine Environment Protection Fund Project 09/P130. Available: https://www.bto.org/sites/default/files/shared_documents/publications/research-reports/2010/rr563.pdf. Accessed: February 25, 2020.

Cornell University. 2019. "Golden Eagle Identification." Available: https://www.allaboutbirds.org/guide/Golden_Eagle/id. Accessed: August 19, 2021.

Desholm, M., and J. Kahlert. 2005. "Avian Collision Risk at an Offshore Wind Farm." *Biology Letters* 1 (3):296–298. DOI:10.1098/rsbl.2005.0336.

Dierschke, V., R. W. Furness, and S. Garthe. 2016. Seabirds and Offshore Wind Farms in European Waters: Avoidance and Attraction. *Biological Conservation* 202:59–68.

Dolbeer, R. A., M. J. Begier, P. R. Miller, J. R. Weller, and A. L. Anderson. 2019. *Wildlife Strikes to Civil Aircraft in the United States, 1990–2018*. Federal Aviation Administration National Wildlife Strike Database Serial Report Number 25. 95 pp. + Appendices.

Drewitt, Allan L., and Rowena H. W. Langston. 2006. "Assessing the Impacts of Wind Farms on Birds." *Ibis* 148:29–42. Available: https://doi.org/10.1111/j.1474-919X.2006.00516.x.

English, P. A., T. I. Mason, J. T. Backstrom, B. J. Tibbles, A. A. Mackay, M. J. Smith, and T. Mitchell. 2017. *Improving Efficiencies of National Environmental Policy Act Documentation for Offshore Wind Facilities Case Studies Report*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2017-026.

Fox, A. D., Mark Desholm, Johnny Kahlert, Thomas Kjaer Christensen, and Ib Krag Peterson. 2006. "Information Needs to Support Environmental Impact Assessment of the Effects of European Marine Offshore Wind Farms on Birds." *Ibis* 148:129–144.

Furness, B., and H. Wade. 2012. *Vulnerability of Scottish Seabirds to Offshore Wind Turbines*. Marine Scotland Report. Available: https://tethys.pnnl.gov/sites/default/files/publications/Furness%20and%20Wade%202012.pdf. Accessed: September 23, 2020.

Furness, R. W., H. M. Wade, and E. Masden. 2013. Assessing Vulnerability of Marine Bird Populations to Offshore Wind Farms. *Journal of Environmental Management* 119:56–66.

Garthe, S., and O. Hüppop. 2004. Scaling Possible Adverse Effects of Marine Wind Farms on Seabirds: Developing and Applying a Vulnerability Index. *Journal of Applied Ecology* 41:724–734.

Goodale, M. Wing, and Anita Millman. 2016. "Cumulative Adverse Effects of Offshore Wind Energy Development on Wildlife." *Journal of Environmental Planning and Management* 59(1):1–29. DOI: 10.1080/09640568.2014.973483.

Goodwin, S. E., and W. G. Shriver. 2010. Effects of Traffic Noise on Occupancy Patterns of Forest Birds. *Conservation Biology* 25(2):406–411.

Haney, J. C., P. G. R. Jodice, W. A. Montevecchi, and D. C. Evers. 2017. Challenges to Oil Spill Assessments for Seabirds in the Deep Ocean. Archives of *Environmental Contamination and Toxicology* 73:33–39.

Hatch, J. M. 2017. Comprehensive Estimates of Seabird-Fishery Interactions for the U.S. Northeast and Mid-Atlantic. *Aquatic Conservation: Marine and Freshwater Ecosystems* 28(1):182–193.

Hodos, W. 2003. *Minimization of Motion Smear: Reducing Avian Collisions with Wind Turbines*. Prepared for the National Renewable Energy Laboratory. NREL/SR-500-33249. Golden, CO.

Hüppop, O., J. Dierschke, K. Exo, E. Frerich, and R. Hill. 2006. Bird Migration and Potential Collision Risk with Offshore Wind Turbines. *Ibis* 148:90–109.

Johnston, A., A. S. C. P. Cook, L. J. Wright, E. M. Humphreys, and N. H. K. Burton. 2014. Modeling Flight Heights of Marine Birds to More Accurately Assess Collision Risk with Offshore Wind Turbines. *Journal of Applied Ecology* 51:31–41.

Kerlinger, P. 1985. Water-crossing behavior of raptors during migration. *Wilson Bulletin* 97:109–113.

Kerlinger, P., J. L. Gehring, W. P. Erickson, R. Curry, A. Jain, and J. Guarnaccia. 2010. Night Migrant Fatalities and Obstruction Lighting at Wind Turbines in North America. *The Wilson Journal of Ornithology* 122(4):744–754.

Leopold, M. F., E. M. Dijkman, and L. Teal. 2011. *Local Birds in and around the Offshore Wind Farm Egmond aan Zee (OWEZ) (T-0 & T-1, 2002-2010)*. Report C187/11. IMARES Wageningen UR, Texel, the Netherlands. Appendices.

Leopold, M. F., R. S. A. van Bemmelen, and A. F. Zuur. 2013. *Responses of Local Birds to the Offshore Wind Farms PAWP and OWEZ off the Dutch mainland coast*. Report C151/12. IMARES Wageningen UR, Texel, the Netherlands.

Lindeboom, H. J., H. J. Kouwenhoven, M. J. N. Bergman, S. Bouma, S. Brasseur, R. Daan, R. C. Fijn, D. de Haan, S. Dirksen, R. van Hal, R. Hille Ris Lambers, R. ter Hofstede, K. L. Krijgsveld, M. Leopold, and M. Scheidat. 2011. Short-term Ecological Effects of an Offshore Wind Farm in the Dutch Coastal Zone; a compilation. *Environmental Research Letters* 6:1–13.

Madsen, A. M., R. Reeve, M. Desholm, A. D. Fox, R. W. Furness, and D. T. Haydon. Assessing the Impact of Marine Wind Farms on Birds Through Movement Modelling. *Journal of the Royal Society Interface*. May 2.

Maggini, I., L. V. Kennedy, A. Macmillan, K. H. Elliot, K. Dean, and C. G. Guglielmo. 2017. Light Oiling of Feathers Increases Flight Energy Expenditure in a Migratory Shorebird. *Journal of Experimental Biology* 220:2372–2379.

McLaughlin, K. E., and H. P. Kunc. 2013. Experimentally Increased Noise Levels Change Spatial and Singing Behavior. *Biology Letters* 9:20120771.

National Audubon Society (Audubon). 2019. “Survival by Degrees: 389 Species on the Brink.” Available: https://www.audubon.org/climate/survivalbydegrees.

New Jersey Audubon Society. Undated. Avalon Seawatch. Available: https://njaudubon.org/watches/avalon-seawatch/. Accessed: January 17, 2023.

New Jersey Bureau of GIS. 2018. “Landscape 3.3 Regions of New Jersey.” Available: https://njogis-newjersey.opendata.arcgis.com/datasets/njdep::landscape-3-3-regions-of-new-jersey/explore?location=39.344761%2C-74.511322%2C11.60. Accessed: August 19, 2021.

New Jersey Department of Environmental Protection (NJDEP). 2018. *New Jersey’s Wildlife Action Plan*. Division of Fish and Wildlife. March. Available: https://www.nj.gov/dep/fgw/ensp/wap/pdf/wap_plan18.pdf. Accessed: July 8, 2021.

North American Bird Conservation Initiative (NABCI), U.S. Committee. 2016. *The State of the Birds 2016: Report on Public Lands and Waters*. U.S. Department of the Interior. Washington, DC. Available: https://www.stateofthebirds.org/2016/wpcontent/uploads/2016/05/SoNAB-ENGLISH-web.pdf. Accessed: September 1, 2020.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Orr, Terry L., Susan M. Herz, and Darrell L. Oakley. 2013. *Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments*. Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2013-0116. Available: https://espis.boem.gov/final%20reports/5298.pdf. Accessed: September 1, 2020.

Ørsted Wind Power North America, LLC (Ørsted). 2022. Personal communications. Email providing information on WTG cut-in speed and rotations per minute.

Paleczny, M., E. Hammill, V. Karpouzi, and D. Pauly. 2015. Population Trend of the World’s Monitored Seabirds, 1950–2010. *PLOS ONE* 10(6): e0129342. Available: https://doi.org/10.1371/journal.pone.0129342.

Panuccio, M., G. Dell’Omo, G. Bogliani, C. Catoni, and N. Sapir. 2019. “Migrating Birds Avoid Flying Through Fog and Low Clouds.” *International Journal of Biometeorology* 63:231–239. January 28, 2019. Available: https://doi.org/10.1007/s00484-018-01656-z.

Paruk, J. D., E. M. Adams, H. Uher-Koch, K .A. Kovach, D. Long, IV, C. Perkins, N. Schoch, and D. C. Evers. 2016. Polycyclic Aromatic Hydrocarbons in Blood Related to Lower Body Mass in Common Loons. *Science of the Total Environment* 565:360–368.

Percival, S. 2010. *Kentish Flats Offshore Wind Farm: Diver Surveys 2009–2010*. Ecology Consulting Report to Vattenfall Wind Energy.

Petersen, Ib Krag, Thomas Kjær Christensen, Johnny Kahlert, Mark Desholm, and Anthony D. Fox. 2006. *Final Results of Bird Studies at the Offshore Wind Farms at Nysted and Horns Rev, Denmark*. National Environmental Research Institute, Ministry of the Environment, Denmark. Available: https://tethys.pnnl.gov/sites/default/files/publications/NERI_Bird_Studies.pdf. Accessed: September 1, 2020.

Pettersson, J. 2005. *The Impact of Offshore Wind Farms on Bird Life in Southern Kalmar Sound, Sweden: a Final Report Based on Studies 1999–2003*. Report for the Swedish Energy Agency, Lund University, Lund, Sweden.

Pezy, J. P., A. Raoux, J. C. Dauvin, and Steven Degraer. 2018. "An Ecosystem Approach for Studying the Impact of Offshore Wind Farms: A French Case Study." *ICES Journal of Marine Science*, fsy125, September 12, 2018.

Plonczikier, P., and I. C. Simms. 2012. Radar Monitoring of Migrating Pink-footed Geese: Behavioral Responses to Offshore Wind Farm Development. *Journal of Applied Ecology* 49:1187–1194.

Raoux, A., S. Tecchio, J. P. Pezy, G. Lassalle, S. Degraer, S. Wilhelmsson, M. Cachera, B. Ernande, C. Le Guen, M. Haraldsson, K. Grangere, F. Le Loc'h, J. C. Dauvin, and N. Niquil. 2017. Benthic and Fish Aggregation Inside an Offshore Wind Farm: Which Effects on the Trophic Web Functioning? *Ecological Indicators* 72:33–46.

Regular, P., W. Montevecchi, A. Hedd, G. Roberson, and S. Wilhelm. 2013. "Canadian Fisheries Closure Provides a Large-scale Test of the Impact of Gillnet Bycatch on Seabird Populations." *Biology Letters* 9(4): 20130088. Available: https://royalsocietypublishing.org/doi/pdf/10.1098/rsbl.2013.0088. Accessed: September 1, 2020.

Roberts, A. J. 2019. *Atlantic Flyway Harvest and Population Survey Data Book*. U.S. Fish and Wildlife Service, Laurel, MD.

Robinson Willmott, J., and G. Forcey. 2014. *Acoustic Monitoring of Temporal and Spatial Abundance of Birds near Outer Continental Shelf Structures: Synthesis Report*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Herndon, VA. BOEM 2014-004. 172 pp. Available: https://espis.boem.gov/final%20reports/5349.pdf. Accessed: September 7, 2020.

Robinson Willmott, J., G. Forcey, and A. Kent. 2013. *The Relative Vulnerability of Migratory Bird Species to Offshore Wind Energy Projects on the Atlantic Outer Continental Shelf: An Assessment Method Database*. Final report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2013-207. Available: https://espis.boem.gov/final%20reports/5319.pdf. Accessed: September 7, 2020.

Roman, L., B. D. Hardesty, M. A. Hindell, and C. Wilcox. 2019. A Quantitative Analysis Linking Seabird Mortality and Marine Debris Ingestion. *Scientific Reports* 9(1):1–7.

Sigourney, D. B., C. D. Orphanides, and J. M. Hatch. 2019. *Estimates of Seabird Bycatch in Commercial Fisheries off the East Coast of the United States from 2015-2016*. NOAA Technical Memorandum NMFS-NE-252. Woods Hole, Massachusetts. 27 pp.

Skov, H., S. Heinanen, T. Norman, R. M. Ward, S. Mendez-Roldan, and I. Ellis. 2018. *ORJIP Bird Collision and Avoidance Study*. Final report. The Carbon Trust. United Kingdom. April 2018.

Stabile, Frank A., Gregory J. Watkins-Colwell, Jon A. Moore, Michael Vecchione, and Edward H. Burtt Jr. 2017. "Observations of Passerines and a Falcon from a Research Vessel in the Western North Atlantic Ocean." *The Wilson Journal of Ornithology* 129(2):349–353.

U.S. Fish and Wildlife Service (USFWS). 2018. "Wind Turbines." Available: https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds/collisions/wind-turbines.php. Accessed: August 20, 2021.

U.S. Fish and Wildlife Service (USFWS). 2021a. Information for Planning and Consultation (IPaC): list of federally listed threatened, endangered, and proposed species in the Ocean Wind offshore and onshore project components. List generated on July 1.

U.S. Fish and Wildlife Service (USFWS). 2021b. Birds of Conservation Concern 2021, Migratory Bird Program. Available: https://www.fws.gov/sites/default/files/documents/birds-of-conservation-concern-2021.pdf. Accessed: March 21, 2022.

U.S. Fish and Wildlife Service (USFWS). 2021c. "Threats to Birds: Migratory Bird Mortality – Questions and Answers." Available: https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds.php. Accessed: August 20, 2021.

Vattenfall. 2023. *AOWFL-Resolving Key Uncertainties of Seabird Flight and Avoidance Behaviours at Offshore Wind Farms*. Final report for the study period 2020–2021. Prepared by RPS. February 20.

Vilela, R., C. Burger, A. Diederichs, F. E. Bachl, L. Szostek, A. Freund, A. Braasch, J. Bellebaum, B. Beckers, W. Piper, and G. Nehls. 2021. Use of an INLA Latent Gaussian Modeling Approach to Assess Bird Population Changes Due to the Development of Offshore Wind Farms. *Front. Mar. Sci.* 8:701332. DOI: 10.3389/fmars.2021.701332.

Wang, J., X. Zou, W. Yu, D. Zhang, and T. Wang. 2019. Effects of Established Offshore Wind Farms on Energy Flow of Coastal Ecosystems: A Case Study of the Rudong Offshore Wind Farms in China. *Ocean & Coastal Management* 171:111–118.

Watts, Bryan D. 2010. *Wind and Waterbirds: Establishing Sustainable Mortality Limits within the Atlantic Flyway*. Center for Conservation Biology Technical Report Series, CCBTR-10-15. College of William and Mary/Virginia Commonwealth University, Williamsburg, VA. 43 pp. Available: https://www.ccbbirds.org/wp-content/uploads/2013/12/ccbtr-10-05_Watts-Wind-and-waterbirds-Establishing-sustainable-mortality-limits-within-the-Atlantic-Flyway.pdf. Accessed: September 1, 2020.

Winship, A. J., B. P. Kinlan, T. P. White, J. B. Leirness, and J. Christensen. 2018. Modeling At-Sea Density of Marine Birds to Support Atlantic Marine Renewable Energy Planning: Final Report. OCS Study BOEM 2018-010. Sterling, VA. 67 pp. Available: https://coastalscience.noaa.gov/data_reports/modeling-at-sea-density-of-marine-birds-to-support-atlantic-marine-renewable-energy-planning-final-report/. Accessed: September 7, 2020.

B.2.3.8. Section 3.8, Coastal Habitat and Fauna

Atlantic Shores Offshore Wind (Atlantic Shores). 2021. *Construction and Operations Plan, Atlantic Shores Offshore Wind*. Volume I. September. Available: https://www.boem.gov/renewable-energy/state-activities/atlantic-shores-offshore-wind-construction-and-operations-plan.

Bureau of Ocean Energy Management. 2022. *Ocean Wind Offshore Wind Farm Biological Assessment for the United States Fish and Wildlife Service.* May.

Carroll, R. P. 2019. Direct and indirect effects of anthropogenic land use on bobcats (*Lynx rufus*) in New England. University of New Hampshire, Durham. Available: https://scholars.unh.edu/cgi/viewcontent.cgi?article=3438&context=dissertation. Accessed: November 24, 2021.

City of Ocean City. 2016. *City of Ocean City Beach Management Plant For the Protection of Federally and State-Listed Species*. January.

Conserve Wildlife Foundation of New Jersey. 2019. *Major Increase of Endangered Seabeach Amaranth South of Sandy Hook*. December 26, 2019. Available: http://www.conservewildlifenj.org/blog/2019/12/26/major-increase-of-endangered-seabeach-amaranth-plants-south-of-sandy-hook/.

Conserve Wildlife Foundation of New Jersey. 2021. *New Jersey Endangered and Threatened Species Field Guide*. Available: http://www.conservewildlifenj.org/species/fieldguide/.

Island Beach State Park. 2017. *Island Beach State Park Beach Management Plan For the Protection of Federally and State-Listed Species*. February.

Kennish, M. J., editor. No date. *The Scientific Characterization of the Barnegat Bay—Little Egg Harbor Estuary and Watershed*. Available: https://www.barnegatbaypartnership.org/wp-content/uploads/wpallimport/files/The%20Scientific%20Characterization%20of%20the%20Barnegat%20Bay-Little%20Egg%20Harbor%20Watershed.pdf. Accessed: October 6, 2021.

New Jersey Department of Environmental Protection (NJDEP). 2020. *New Jersey Scientific Report on Climate Change*, Version 1.0. (Eds. R. Hill, M. M. Rutkowski, L. A. Lester, H. Genievich, N. A. Procopio). Trenton, NJ. 184 pp.

New Jersey Division of Fish and Wildlife (NJDFW). 2017a. NJDEP Species Based Habitat, Atlantic Coastal Region, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Division of Information Technology, Bureau of Geographic Information Systems. Published online at *NJDEP Landscape 3.3 Viewer*. Available: https://www.arcgis.com/apps/webappviewer/index.html?id=0e6a44098c524ed99bf739953cb4d4c7. Accessed: November 22, 2021.

New Jersey Division of Fish and Wildlife (NJDFW). 2017b. NJDEP Species Based Habitat, Pinelands Region, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Division of Information Technology, Bureau of Geographic Information Systems. Published online at *NJDEP Landscape 3.3 Viewer*. Available: https://www.arcgis.com/apps/webappviewer/index.html?id=0e6a44098c524ed99bf739953cb4d4c7. Accessed: November 22, 2021.

New Jersey Sea Grant Consortium. No date. *Dune Manual*. Available: https://njseagrant.org/wp-content/uploads/2016/07/Dune-Manual-Pgs-compressed.pdf. Accessed: September 9, 2021.

Ocean County Planning Department. 1976. *Natural Resource Inventory for Long Beach Island, Ocean County, New Jersey*. Revised May 1976.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Ocean Wind LLC (Ocean Wind). 2023. Citing Atlantic County. 1973. *Atlantic County Environmental Inventory*. Prepared by John G. Reutters Associates.

Sacatelli, R., R. G. Lathrop, and M. Kaplan. 2020. Impacts of Climate Change on Coastal Forests in the Northeast US. Rutgers Climate Institute, Rutgers University, New Brunswick, NJ. 48 p. DOI: https://doi.org/doi:10.7282/t3-n4tn-ah53. Available: https://www.sas.rutgers.edu/cms/climate/images/Impacts_of_Climate_Change_on_Coastal_Forests_in_the_Northeast_US__Sacatelli_R._Lathrop_R.G._and_Kaplan_M_2020_December_FINAL.pdf. Accessed: November 22, 2021.

Save Barnegat Bay. 2019. "Herbarium and Janet's Garden." Available: https://www.savebarnegatbay.org/educate/herbarium-and-janets-garden/. Accessed: October 6, 2021.

Sordello, R., R. Ophélie, F. F. De Lachapelle, C. Leger, A. Dambry, and S. Vanpeene. 2020. *Environmental Evidence* 9(20). Available: https://environmentalevidencejournal.biomedcentral.com/track/pdf/10.1186/s13750-020-00202-y.pdf. Accessed: November 23, 2019

State of New Jersey Pinelands Commission. 2021. Pinelands Interactive Map. Available: https://njpines.maps.arcgis.com/apps/webappviewer/index.html?id=28ef313eb49f4e8f96ca249d871d06fe.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA NRCS). 2006. *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin*. U.S. Department of Agriculture Handbook 296.

U.S. Fish and Wildlife Service (USFWS). 2023. New Jersey Field Office. Featured Species, Federally Listed and Candidate Species Occurring in New Jersey.

Wootton, L., J. Miller, C. Miller, M. Peek, A. Williams, and P. Rowe. 2016. *New Jersey Sea Grant Consortium Dune Manual*. Available: https://secureservercdn.net/198.71.233.83/bge.b67.myftpupload.com/wp-content/uploads/2016/07/Dune-Manual-Pgs-compressed.pdf. Accessed: October 22, 2021.

B.2.3.9. Section 3.9, Commercial Fisheries and For-Hire Recreational Fishing

Andersson, M. H., E. Dock-Åkerman, R. Ubral-Hedenberg, M.C. Öhman, and P. Sigray. 2007. Swimming behavior of roach (*Rutilus rutilus*) and three-spined stickleback (*Gasterosteus aculeatus*) in response to wind power noise and single-tone frequencies. AMBIO 36(8):636–638.

Atlantic States Marine Fisheries Commission (ASMFC). 2021. Fisheries Management. Available: http://www.asmfc.org/fisheries-management/program-overview.

Atlantic States Marine Fisheries Commission (ASMFC). 2023. Atlantic Menhaden. Available: http://www.asmfc.org/species/atlantic-menhaden. Accessed: January 6, 2023.

Bald, J., C. Hernández, A. Uriarte, J. A. Castillo, P. Ruiz, N. Ortega, Y. T. Enciso, and D. Marina. 2015. Acoustic Characterization of Submarine Cable Installation in the Biscay Marine Energy Platform (BIMEP). [Presentation]. Presented at Bilbao Marine Energy Week, Bilbao, Spain.

Barange, M., T. Bahri, M. Beveridge, K. Cochrane, S. Funge-Smith, and F. Poulain. 2018. *Impacts of Climate Change on Fisheries and Aquaculture: Synthesis of Current Knowledge, Adaptation and Mitigation Options*. FAO Fisheries and Aquaculture Technical Paper 627. Rome, Italy.

Barton, B. A. 2002. Stress in fishes: A diversity of responses with particular reference to changes in circulating corticosteroids. *Integrative and Comparative Biology* 42:517–525.

Bureau of Ocean Energy Management (BOEM). 2018. Commercial Fishing Frequently Asked Questions. Wind Energy on the Outer Continental Shelf. Available: https://www.boem.gov/sites/default/files/uploadedFiles/BOEM-Fishing%20FAQs.pdf.

Bureau of Ocean Energy Management (BOEM). 2019. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf*. OCS Study BOEM 2019-036. May 2019. 201 pp. Available: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/IPFs-in-the-Offshore-Wind-Cumulative-Impacts-Scenario-on-the-N-OCS.pdf. Accessed: October 8, 2021.

Bureau of Ocean Energy Management (BOEM). 2021a. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2021-0012. Available: https://www.boem.gov/vineyard-wind. Accessed: August 2021.

Bureau of Ocean Energy Management (BOEM). 2021b. *South Fork Wind Farm and South Fork Export Cable Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2020-057. Available: https://www.boem.gov/renewable-energy/state-activities/sfwf-feis.

Bureau of Ocean Energy Management (BOEM). 2022. Revenue exposure analysis results for Ocean Wind 1 No Action Alternative. Personal communication between Ursula Howson (BOEM) and Spence Smith (WSP). May 8.

Claesson, S., R. Robertson, and M. Hall-Arber. 2006. Fishing Heritage Festivals, Tourism, and Community Development in the Gulf of Maine. *Proceedings of the 2005 Northeastern Recreation Research Symposium.* GTR-NE-341.

Clay, P. M., and Colburn, L. L. 2020. *A Practitioner's Handbook for Fisheries Social Impact Assessment*. U.S. Department of Commerce – National Oceanic and Atmospheric Administration – National Marine Fisheries Service. NOAA Technical Memorandum NMFS-F-SPO-212. December. Available: https://spo.nmfs.noaa.gov/content/tech-memo/practitioners-handbook-fisheries-social-impact-assessment.

Colburn, L. L., M. Jepson, C. Weng, T. Seara, J. Weiss, and J. A. Hare. 2016. Indicators of climate change and social vulnerability in fishing dependent communities along the eastern and Gulf Coasts of the United States. *Marine Policy* 74 (December):323–333.

Curtis, T. 2023. Personal communication between T. Curtis with NMFS and Ursula Howson with BOEM. January 2023.

Debusschere, E., K. Hostens, D. Adriaens, B. Ampre, D. Botteldooren, G. De Boeck, A. De Muynck, A. Kumar Sinha, S. Vandendriessche, L. Van Hoorebeke, M. Vincx, and S. Degraer. 2016. Acoustic stress responses in juvenile sea bass *Dicentrarchus labrax* induced by offshore pile driving. *Environmental Pollution* 208:747–757.

Denes, S. L., D. G. Zeddies, and M. M. Weirathmueller. 2021. *Turbine Foundation and Cable Installation at South Fork Wind Farm: Underwater Acoustic Modeling of Construction Noise*. Appendix J1 in Construction and Operations Plan South Fork Wind Farm. Silver Spring, Maryland: JASCO Applied Sciences.

DNV-GL. 2021. *South Fork Wind Farm Navigation Safety Risk Assessment*. Appendix M in Construction and Operations Plan South Fork Wind Farm. Prepared for Deepwater Wind, LLC. Document No. 10057311-HOU-R-01. Medford, Massachusetts: DNV-GL.

Elliot, J., A. A. Khan, Ying-Tsong, L., T. Mason, J. H. Miller, A. E. Newhall, G. R. Potty, and K. J. Vigness-Raposa. 2019. *Field Observations during Wind Turbine Operations at the Block Island Wind Farm, Rhode Island*. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019-028.

English, P. A., T. I. Mason, J. T. Backstrom, B. J. Tibbles, A. A. Mackay, M. J. Smith, and T. Mitchell. 2017. *Improving Efficiencies of National Environmental Policy Act Documentation for Offshore Wind Facilities Case Studies Report*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2017-026.

Fabrizio, M. C., J. P. Manderson, and J. P. Pessutti. 2014. "Home Range and Seasonal Movements of Black Sea Bass (*Centropristis striata*) During their Inshore Residency at a Reef in the Mid-Atlantic Bight." *Fishery Bulletin* 112:82–97 (2014). DOI: 10.7755/FB.112.1.5.

Hall-Arber, M., C. Dyer, J. Poggie, J. McNally, and R. Gagne. 2001. *New England's Fishing Communities.* MIT Sea Grant College Program (MITSG 01-15). January.

Hare, J. A., W. E. Morrison, M. W. Nelson, M. M. Stachura, E. J. Teeters, R. B. Griffis, M. A. Alexander, J. D. Scott, L. Alade, and R. J. Bell. 2016. *A vulnerability assessment of fish and invertebrates to climate change on the Northeast US Continental Shelf*. *PLOS ONE* 11(2):e0146756.

Hastings, M., and A. Popper. 2005. *Effects of Sound on Fish.* Final Report # CA05-0537 – Project P476 Noise Thresholds for Endangered Fish. California Department of Transportation. January 28, 2005 (August 23, 2005 [Revised Appendix B]).

Hicks, C. C., A. Levine, A. Agrawal, X. Basurto, S. J. Breslow, C. Carothers, S. Charnley, S. Coulthard, N. Dolsak, J. Donatuto, C. Garcia-Quijano, M. B. Mascia, K. Norman, M. B. Poe, T. Satterfield, K. St. Martin, and P. S. Levin. 2016. Social Science and Sustainability: "Engage key social concepts for sustainability – Social indicators, both mature and emerging, are underused." Published by the American Association for the Advancement of Science (AAAS). *Science* 352(6281).

Hiddink, J. G., S. Jennings, M. Sciberrasa, C. L. Szosteka, K. M. Hughes, N. Ellisd, A. D. Rijnsdorpe, R. A. McConnaughey, T. Mazord, R. Hilborng, J. S. Collieh, C. R. Pitcherd, R. O. Amorosoi, A. M. Parmai, P. Suuronenj, and M. J. Kaisera. 2017. Global analysis of depletion and recovery of seabed biota after bottom trawling disturbance. Proceedings of the National Academy of Sciences, 114, 8301–8306. Available: https://doi.org/10.1073/pnas.1618858114.

Jepson, M., and L. L. Colburn. 2013. *Development of Social Indicators of Fishing Community Vulnerability and Resilience in the U.S. Southeast and Northeast Regions*. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. NOAA Technical Memorandum NMFS-F/SPO-129. April.

Jones, I. T., J. A. Stanley, and T. A. Mooney. 2020. Impulsive pile driving noise elicits alarm responses in squid (Doryteuthis pealeii). *Marine Pollution Bulletin* 150:110792. DOI:10.1016/ j.marpolbul.2019.110792.

Kirkpatrick, A. J., S. Benjamin, G. S. DePiper, S. S. T. Murphy, and C. Demarest. 2017. *Socio-Economic Impact of Outer Continental Shelf Wind Energy Development on Fisheries in the U.S. Atlantic*. Vol. II—Appendices. U.S. Department of the Interior, Bureau of Ocean Energy Management, Atlantic OCS Region. Washington, D.C.

Küsel, E. T., M. J. Weirathmueller, K. E. Zammit, S. J. Welch, K. E. Limpert, and D. G. Zeddies. 2022. *Underwater Acoustic and Exposure Modeling*. Document 02109, Version 1.0 DRAFT. Technical report by JASCO Applied Sciences for Ocean Wind LLC.

Madsen, P. T., M. Wahlberg, J. Tougaard, K. Lucke, and P. Tyack. 2006. Wind turbine underwater noise and marine mammals: implications of current knowledge and data needs. *Marine Ecology Progress Series* 309:279–295.

McCauley, R. D., J. Fewtrell, A. J. Duncan, C. Jenner, M. N. Jenner, J. Penrose, R. I. T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000. Marine seismic surveys – a study of environmental implications. *Australian Petroleum Production Exploration Association Journal* 40:692–708.

McClenachan, L., J. Grabowski, M. Marra, C. S. McKeon, B. P. Neal, N. R. Record, and S. B. Scyphers. 2019. Shifting perceptions of rapid temperature changes' effects on marine fisheries, 1945–2017. *Fish and Fisheries* 2019(00):1–13. DOI: 10.1111/faf.12400.

McCreary, S., and B. Brooks. 2019. Atlantic Large Whale Take Reduction Team Meeting: Key Outcomes Meeting. April 23–26, 2019. Providence, Rhode Island. Available: https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-mammal-protection/atlantic-large-whale-take-reduction-plan.

Mid-Atlantic Fishery Management Council (MAFMC). 2021. Fishery Management Plans and Amendments. Available: https://www.mafmc.org/fishery-management-plans.

Moser, J., and G. R. Shepherd. 2009. "Seasonal Distribution and Movement of Black Sea Bass (*Centropristis striata*) in the Northwest Atlantic as Determined from a Mark-Recapture Experiment." *J. Northw. Atl. Fish. Sci.* 40:17–28. DOI:10.2960/J.v40.m638.

Mueller-Blenkle, C., P. K. McGregor, A. B. Gill, M. H. Andersson, J. Metcalfe, V. Bendall, P. Sigray, D. T. Wood, and F. Thomsen. 2010. *Effects of Pile-driving Noise on the Behaviour of Marine Fish*. COWRIE Ref: Fish 06-08; Cefas Ref: C3371. 62 p.

Murray, G., T. Johnson, B. J. McCay, M. Danko, K. St. Martin, and S. Takahashi. 2010. Creeping enclosure, cumulative effects and the marine commons of New Jersey. *International Journal of the Commons* 4(1):367–389.

National Academies of Sciences, Engineering, and Medicine 2022. *Wind Turbine Generator Impacts to Marine Vessel Radar*. Washington, DC: The National Academies Press.

National Marine Fisheries Service (NMFS). 2006. *Consolidated Atlantic Highly Migratory Species Management Plan*. Available: https://www.fisheries.noaa.gov/management-plan/consolidated-atlantic-highly-migratory-species-management-plan. Accessed: January 24, 2023.

National Marine Fisheries Service (NMFS). 2019. Vessel Activity by Vessel Speed and VMS Activity by Course, OCS-A-0498, Ocean Wind, January 2014 to August 2019.

National Marine Fisheries Service (NMFS). 2020. The Economic Importance of Seafood. Available: https://www.fisheries.noaa.gov/feature-story/economic-importance-seafood. Accessed: November 5, 2020.

National Marine Fisheries Service (NMFS). 2021a. Commercial Fisheries Statistics. Available: https://www.fisheries.noaa.gov/national/sustainable-fisheries/commercial-fisheries-landings. Accessed: November 2021.

National Marine Fisheries Service (NMFS). 2021b. *Descriptions of Selected Fishery Landings and Estimates of Vessel Revenue from Areas: A Planning-level Assessment*. Ocean Wind 1. July 6, 2021. Available: https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/WIND/WIND_AREA_REPORTS/Ocean_Wind_1.html. Accessed October 9, 2021.

National Marine Fisheries Service (NMFS). 2021c. Consolidated Atlantic Highly Migratory Species Management Plan. Available: https://www.fisheries.noaa.gov/management-plan/consolidated-atlantic-highly-migratory-species-management-plan. Accessed October 15, 2021.

National Marine Fisheries Service (NMFS). 2021d. Program Glossary. Available: https://www.st.nmfs.noaa.gov/st1/recreational/overview/glossary.html.

National Marine Fisheries Service (NMFS). 2021e. *Socioeconomic Impacts of Atlantic Offshore Wind Development*. Available: https://www.fisheries.noaa.gov/resource/data/socioeconomic-impacts-atlantic-offshore-wind-development.

National Marine Fisheries Service (NMFS). 2022a. Commercial Fisheries Statistics. Available: https://www.fisheries.noaa.gov/national/sustainable-fisheries/commercial-fisheries-landings. Accessed: December 2022.

National Marine Fisheries Service (NMFS). 2022b. *Descriptions of Selected Fisher Landings and Estimates of Vessel Revenue from Areas: A Planning-level Assessment.* Ocean Wind (OCS-A 0498. November 28, 2022. Available: https://www.fisheries.noaa.gov/resource/data/socioeconomic-impacts-atlantic-offshore-wind-development. Accessed: January 26, 2023.

National Oceanic and Atmospheric Administration (NOAA) Fisheries Office of Science and Technology. 2021. NOAA Fisheries Social Indicators for Coastal Communities. (last updated August 19, 2021). Available: https://www.fisheries.noaa.gov/national/socioeconomics/social-indicators-fishing-communities. Accessed: December 11, 2021.

Nedwell, J., and D. Howell. 2004. A *Review of Offshore Windfarm Related Underwater Noise Sources*. Final Report submitted to COWRIE (Collective Offshore Wind Energy Research into the Environment). 57 pp.

New England Fishery Management Council (NEFMC). 2021. Management Plans. Available: https://www.nefmc.org/management-plans.

New Jersey Department of Environmental Protection (NJDEP). 2010. *Ocean/Wind Power Ecological Baseline Studies January 2008–December 2009*. Final Report. Prepared for New Jersey Department of Environmental Protection Office of Science by Geo-Marine, Inc., Plano, Texas. Available: https://tethys.pnnl.gov/sites/default/files/publications/Ocean-Wind-Power-Baseline-Volume1.pdf.

Northeast Ocean Data. 2023. Vessel Activity for Scallop, Surfclam, and Ocean Quahog (2015 to 2019). Available: https://www.northeastoceandata.org/data-explorer/?commercial-fishing|vessel-activity.

O'Farrell, S., I. Chollett, J. N. Sanchirico, and L. Perruso. 2019. Classifying fishing behavioral diversity using high-frequency movement data. *Proceedings of the National Academy of Sciences of the United States of America* 116(34):16811–16816.

Ocean Wind LLC (Ocean Wind). 2021. *Ocean Wind Offshore Wind Farm, Supplemental COP Information.* November.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Ocean Wind LLC (Ocean Wind). 2023. Citing National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries). No date. Commercial Fisheries Statistics. Office of Science and Technology. Available: https://www.st.nmfs.noaa.gov/commercial-fisheries/commercial landings/annual-landings-with-group-subtotals/index.

Ocean Wind LLC (Ocean Wind). 2023. Citing New Jersey Department of Fish and Wildlife (NJDFW). No date. Blue Claws: Crabbing in New Jersey. Available: https://www.njfishandwildlife.com/blueclaw.htm.

Papaioannou, E. A., R. L. Selden, J. Olson, B. J. McCay, M. L. Pinsky, and K. St. Martin. 2021. Not All Those Who Wander Are Lost – Responses of Fishers' Communities to Shifts in the Distribution and Abundance of Fish. *Frontiers in Marine Science* 8 (July):1–25.

Popper, A. N., and M. C. Hastings. 2009. The effects of anthropogenic sources of sound on fishes. *Journal of Fish Biology* 75:455–489.

Purser, J., and A. N. Radford. 2011. Acoustic noise induces attention shifts and reduces foraging performance in three-spined sticklebacks (*Gasterosteus aculeatus*). *PLOS ONE* 6(2):e17478.

Responsible Offshore Development Alliance (RODA). 2021. Comment letter RE: Notice of intent to prepare an Environmental Impact Statement for Ocean Wind, LLC's Proposed Wind Energy Facility Offshore New Jersey; Docket No. BOEM-2021-0652. Dated April 29, 2021.

Roberts, L. and M. Elliott. 2017. Good or bad vibrations? Impacts of anthropogenic vibration on the marine epibenthos. *Science of the Total Environment* 595:255–268.

Rogers, L. A., R. Griffin, T. Young, E. Fuller, K. S. Martin, and M. L. Pinsky. 2019. Shifting habitats expose fishing communities to risk under climate change. *Nature Climate Change* 9 (7):512–516.

Scyphers, S. B., J. S. Picou, and J. H. Grabowski. 2019. Chronic social disruption following a systemic fishery failure. *PNAS* 116(46):22912–22914. November 12.

Secor, D. H., F. Zhang, M. H. P. O'Brien, and M. Li. 2018. "Ocean Destratification and Fish Evacuation Caused by a Mid-Atlantic Tropical Storm." *ICES Journal of Marine Science* 76(2):573–584. Available: https://doi.org/10.1093/icesjms/fsx241.

Shelledy, K., B. Phelan, J. Stanley, and H. Soulen. 2018. *Could Offshore Wind Energy Construction Affect Black Sea Bass Behavior?*

Siddagangaiah, S., C.-F. Chen, W.-C. Hu, R. Danovaro, and N. Pieretti. 2021. Silent winters and rock-and-roll summers: The long-term effects of changing oceans on marine fish vocalization. *Ecological Indicators* 125:107456.

Silva, A., L. E. Gentile, M. J. Cutler, and L. L. Colburn. 2021. *A Comparison of Waves I (2012/2013) and II (2018/2019) of the Survey on the Socio-Economic Aspects of Commercial Fishing Crew in the Northeast U.S*. U.S. Department of Commerce – National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NMFS-NE-274. October.

Skalski, J. R., W. H. Pearson, and C. I. Malme. 1992. Effects of Sound from a Geophysical Survey Device on Catch-Per-Unit-Effort in a Hook-and-Line Fishery for Rockfish (*Sebastes* spp.). *Canadian Journal of Fisheries and Aquatic Sciences* 49:1357–1365.

Slabbekoorn, H., N. Bouton, I. van Opzeeland, A. Coers, C. Ten Cate, and A. N. Popper. 2010. A noisy spring: the impact of globally rising underwater sound levels on fish. *Trends in Ecology and Evolution* 25:419–427.

Steinback, S., and A. Brinson. 2013. The Economics of the Recreational For-hire Fishing Industry in the Northeast United States. US Dept. Commerce, Northeast Fisheries Science Center, Ref Doc. 13-03; 49 p. Available: https://www.savingseafood.org/images/recreational_econ.pdf.

Stöber, U., and F. Thomsen. 2021. How could operational underwater sound from future offshore wind turbines impact marine life? *The Journal of the Acoustical Society of America* 149:1791–1795.

Taormina B., J. Bald, A. Want, G. Thouzeau, M. Lejart, N. Desroy, and A. Carlier. 2018. A Review of Potential Impacts of Submarine Cables on the Marine Environment: Knowledge Gaps, Recommendations, and Future Directions. *Renewable and Sustainable Energy Reviews* 96:380–391.

ten Brink, T. S., and T. Dalton. 2018. Perceptions of Commercial and Recreational Fishers on the Potential Ecological Impacts of the Block Island Wind Farm (US). *Frontiers in Marine Science* 5 (November):1–13.

Thompson, C., T. Johnson, and S. Hanes. 2016. Vulnerability of Fishing Communities Undergoing Gentrification. *Journal of Rural Studies* 45:165–174.

Van Holt, T., W. Weisman, J. C. Johnson, S. Käll, J. Whalen, B. Spear, and P. Sousa. 2016. A Social Wellbeing in Fisheries Tool (SWIFT) to Help Improve Fisheries Performance. *MDPI – Sustainability.* Published 25 July 2016.

Wahlberg, M., and H. Westerberg. 2005. Hearing in fish and their reactions to sounds from offshore wind farms. *Marine Ecology Progress Series* 288:295–309.

Wilson, Alissa. 2022. New Jersey Department of Environmental Protection. Personal communication transmitted via cooperating agency review comments on the Ocean Wind 1 Preliminary Draft EIS.

Wysocki, L. E., S. Amoser, and F. Ladich. 2007. Diversity in ambient noise in European freshwater habitats: Noise levels, spectral profiles, and impact on fishes. *Journal of the Acoustical Society of America* 121(5):2559–2566.

B.2.3.10. Section 3.10, Cultural Resources

Bureau of Ocean Energy Management (BOEM). 2012. *Inventory and analysis of archaeological site occurrence on the Atlantic outer continental shelf*. Prepared by TRC Environmental Corporation for the U.S. Dept. of the Interior, Bureau of Ocean Energy, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2012-008. 324 pp.

Bureau of Ocean and Energy Management (BOEM). 2020. *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585*. May 27. Available: https://www.boem.gov/sites/default/files/documents/about-boem/Archaeology%20and%20Historic%20Property%20Guidelines.pdf. Accessed: November 7, 2021.

Bureau of Ocean Energy Management (BOEM). 2023. *Cumulative Historic Resources Visual Effects Analysis*. February.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

B.2.3.11. Section 3.11, Demographics, Employment, and Economics

American Wind Energy Association (AWEA). 2020. U.S. Offshore Wind Power Economic Impact Assessment. Accessed September 30, 2021. Available: https://supportoffshorewind.org/wp-content/uploads/sites/6/2020/03/AWEA_Offshore-Wind-Economic-ImpactsV3.pdf.

Bureau of Ocean Energy Management (BOEM). 2017. *Socio-Economic Impact of Outer Continental Shelf Wind Energy Development on Fisheries in the U.S. Atlantic.* Volume I—Report Narrative. Available: https://espis.boem.gov/final%20reports/5580.pdf.

Bureau of Ocean Energy Management (BOEM). 2021a. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2021-0012. Available: https://www.boem.gov/vineyard-wind. Accessed: August 2021.

BVG Associates Limited. 2017. U.*S. Job Creation in Offshore Wind: A Report for the Roadmap Project for Multi-State Cooperation on Offshore Wind*. Final Report. Report No. 17-22. Report for New York State Energy Research and Development Authority (NYSERDA). Available: https://tethys.pnnl.gov/sites/default/files/publications/NYSERDA-Report-2017-OSW-Jobs.pdf. Accessed: October 7, 2021.

Cape May County. 2005. *Cape May County Comprehensive Plan 2005*. Available: https://capemaycountynj.gov/DocumentCenter/View/422/Comprehensive-Plan-2002-PDF?bidId.

Cape May County. 2013. Summer Population Estimate: 2013. Available: https://capemaycountynj.gov/DocumentCenter/View/441/Summer-Populations-2013-PDF.

E2. 2018. *Offshore Wind: Generating Economic Benefits on the East Coast*. Prepared by BW Research. August. Available: https://www.e2.org/wp-content/uploads/2018/08/E2-OCS-Report-Final-8.30.18.pdf.

Georgetown Economic Services, LLC. 2020. *Potential Employment Impact from Offshore Wind in the United States: The Mid-Atlantic and New England Region*. July 27, 2020.

Gould, Ross, and Eliot Cresswell. 2017. *New York State and the Jobs of Offshore Wind Energy*. Workforce Development Institute, New York.

Hoagland, P., T. M. Dalton, D. Jin, and J. B. Dwyer. 2015. An Approach for Analyzing the Spatial Welfare and Distributional Effects of Ocean Wind Power Siting: The Rhode Island/Massachusetts Area of Mutual Interest. *Marine Policy* (58):51–59. ISSN 0308-597X. Available: https://doi.org/10.1016/j.marpol.2015.04.010.

Moser, S. C., M. A. Davidson, P. Kirshen, P. Mulvaney, J. F. Murley, J. E. Neumann, L. Petes, and D. Reed. 2014. Ch. 25: *Coastal Zone Development and Ecosystems. Climate Change Impacts in the United States: The Third National Climate Assessment*. J. M. Melillo, Terese (T. C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 579–618. DOI:10.7930/J0MS3QNW. Available: https://nca2014.globalchange.gov/downloads/low/NCA3_Full_Report_25_Coasts_LowRes.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2021a. Quick Report Tool of Socioeconomic Data: Ocean Economy (Employment data). Available: https://coast.noaa.gov/quickreport/#/index.html. Accessed: September 14, 2021.

National Oceanic and Atmospheric Administration (NOAA). 2021b. "NOAA Report on the U.S. Marine Economy." Charleston, SC: NOAA Office for Coastal Management. Available: http://coast.noaa.gov/digitalcoast/training/econreport.html.

National Renewable Energy Laboratory (NREL). 2022. U.S. Offshore Wind Workforce Assessment. Available: https://www.nrel.gov/docs/fy23osti/81798.pdf. Accessed: November 11, 2022.

New Jersey Office of the Governor. 2019. New Jersey Board of Public Utilities Awards Historic 1,100 MW Offshore Wind Solicitation to Ørsted's Ocean Wind Project. Available: https://www.nj.gov/governor/news/news/562019/20190621d.shtml. Accessed: November 11, 2021.

Ocean Wind LLC (Ocean Wind). 2021. Response to the Bureau of Ocean Energy Management, Request for Information #8, Ocean Wind Construction and Operations Plan. September 17.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Parsons, George, and Jeremy Firestone. 2018. *Atlantic Offshore Wind Energy Development: Values and Implications for Recreation and Tourism*. U.S. Department of the Interior, Bureau of Ocean Energy Management. Available: https://www.semanticscholar.org/paper/Atlantic-Offshore-Wind-Energy-Development%3A-Values-Parsons-Firestone/91b0ede146b8701cb44d72c58f09b29533df3cdf.

Parsons, G., J. Firestone, L. Yan, and J. Toussaint. 2020. The effect of offshore wind power projects on recreational beach use on the east coast of the United States: Evidence from contingent-behavior data. *Energy Policy* 144:111659.

The White House. 2021. FACT SHEET: Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs. Available: https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/. Accessed: October 5, 2022.

U.S. Bureau of Economic Analysis. 2021. Current-Dollar Gross Domestic Product (GDP) by State and Region, 2020. Available: https://apps.bea.gov/itable/iTable.cfm?ReqID=70&step=1&acrdn=1. Accessed: September 30, 2021.

U.S. Bureau of Labor Statistics. 2019. Quarterly Census of Employment and wages. Available: https://data.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables. Accessed: April 1, 2022.

U.S. Bureau of Labor Statistics. 2021. Local Area Unemployment Statistics. Available: https://www.bls.gov/lau/#tables. Accessed: September 13, 2021.

U.S. Census Bureau. 2021a. ACS People and Population Estimates. 2015–2019 American Community Survey 5-Year Estimates. Available: https://data.census.gov/cedsci/all?q=&t=Populations%20and%20People. Accessed: September 15, 2021.

U.S. Census Bureau. 2021b. ACS Income and Earnings Estimates. 2015–2019 American Community Survey 5-Year Estimates. Available: https://data.census.gov/cedsci/all?q=&t=Income%20and%20Earnings%3AIncome%20and%20Poverty. Accessed: September 15, 2021.

U.S. Census Bureau. 2021c. ACS Housing Estimates. 2015–2019 American Community Survey 5-Year Estimates. Available: https://data.census.gov/cedsci/advanced?t=Housing. Accessed: September 15, 2021.

U.S. Census Bureau. 2021d. ACS Industry Estimates. 2015–2019 American Community Survey 5-Year Estimates. Available: https://data.census.gov/cedsci/all?q=&t=Industry. Accessed: September 15, 2021.

U.S. Census Bureau. 2021e. ACS Employment and Industry Estimates. 2015–2019 American Community Survey 5-Year Estimates. Available: https://data.census.gov/cedsci/advanced?text=at-place%20employment&t=Industry. Accessed: September 15, 2021.

U.S. Census Bureau. 2021f. ACS Age and Sex Estimates. 2015-2019 American Community Survey 5-Year Estimates. Available: https://data.census.gov/cedsci/all?q=&t=Age%20and%20Sex. Accessed: September 15, 2021.

U.S. Census Bureau. 2022a. ACS Employment Status Estimates. 2015-2019 American Community Survey 5-Year Estimates. Available: https://data.census.gov/cedsci/table?q=s2301&g=0400000US34,45,51_0500000US34001,34009,34011,34015,34029,34033,45019,51710&tid=ACSST5Y2019.S2301. Accessed: March 23, 2022.

U.S. Census Bureau. 2022b. ACS Selected Economic Characteristics. 2015-2019 American Community Survey 5-Year Estimates. Available: https://data.census.gov/cedsci/table?q=dp03&g=0400000US34,45,51_0500000US34001,34009,34011,34015,34029,34033,45019,51710&tid=ACSDP5Y2019.DP03. Accessed: April 13, 2022.

University of Delaware. 2021. *Supply Chain Contracting Forecast for U.S. Offshore Wind Power*. Special Initiative on Offshore Wind. October 2021.

B.2.3.12. Section 3.12, Environmental Justice

Buonocore, Jonathan J., Patrick Luckow, Jeremy Fisher, Willett Kempton, and Jonathan L. Levy. 2016. "Health and Climate Benefits of Offshore Wind Facilities in the Mid-Atlantic United States." Environmental Research Letters 11 074019. July 14, 2016. Available: https://iopscience.iop.org/article/10.1088/1748-9326/11/7/074019/pdf. Accessed: November 2021.

Chesapeake Bay Program. 2021. "Indigenous Peoples of the Chesapeake." Available: https://www.chesapeakebay.net/discover/history/archaeology_and_native_americans. Accessed: October 21, 2021.

Council on Environmental Quality (CEQ). 1997. *Environmental Justice: Guidance Under the National Environmental Policy Act*. Available: https://www.epa.gov/sites/default/files/2015-02/documents/ej_guidance_nepa_ceq1297.pdf. Accessed: September 20, 2021.

Jimenez, R. 2021. Social Indicators of Gentrification Pressure: How Gentrification is Affecting 29 Fishing Communities in the Northeast United States. Available: https://storymaps.arcgis.com/stories/56781eb366f1485e8ffd7c96b16f133f?utm_medium=email&utm_source=govdelivery. Accessed: August 17, 2021.

Nansemond Indian Nation. No date. "History." Available: https://nansemond.org/history/. Accessed: October 21, 2021.

National Oceanic and Atmospheric Administration (NOAA). 2022a. *Social Indicators for Coastal Communities.* Available: https://www.fisheries.noaa.gov/national/socioeconomics/social-indicators-coastal-communities. Accessed: April 1, 2022.

National Oceanic and Atmospheric Administration (NOAA). 2022b. Marine Recreational Information Program. Available: https://www.st.nmfs.noaa.gov/msd/html/siteRegister.jsp. Accessed: September 26, 2022.

New Jersey Department of Environmental Protection (NJDEP). 2021. "Environmental Justice Overburdened Communities." Available: https://www.nj.gov/dep/ej/communities.html. Accessed: 2021-09-20.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Salem County. 2021. "Native Americans in Salem County." Available: https://visitsalemcountynj.com/about-salem-county/salem-county-history-project/native-americans-in-salem-county/. Accessed: October 21, 2021.

Silva, A., L. E. Gentile, M. J. Cutler, and L. L. Colburn. 2021. *Comparison of Waves I (2012/2013) and II (2018/2019) of the Survey on the Socio-Economic Aspects of Commercial Fishing Crew in the Northeast U.S.* NOAA Technical Memorandum NMFS-NE-274. Woods Hole, Massachusetts: National Marine Fisheries Service Northeast Fisheries Science Center. October.

South Carolina Commission for Minority Affairs. 2021. "South Carolina's Recognized Native American Indian Entities." Available: https://cma.sc.gov/minority-population-initiatives/native-american-affairs/south-carolinas-recognized-native-american-indian-entities. Accessed: October 21, 2021.

State of New Jersey. 2021. Department of State. "New Jersey Commission on American Indian Affairs." Available: https://www.nj.gov/state/njcaia.shtml. Accessed: October 21, 2021.

Thind, Maninder P.S., Christopher W. Tessum, Ines L. Azevedo, and Julian D. Marshall. 2019. Fine Particulate Air Pollution from Electricity Generation in the US: Health Impacts by Race, Income, and Geography. *Environmental Science & Technology*. DOI: 10.1021/acs.est.9b02527. Available: https://depts.washington.edu/airqual/Marshall_117.pdf. Accessed: November 7, 2021.

U.S. Census Bureau (USCB). 2000a. 2000 Decennial Census, Summary File 1. Table ID: P004. HISPANIC OR LATINO, AND NOT HISPANIC OR LATINO BY RACE [73]. Available: https://data.census.gov/cedsci/. Accessed: September 21, 2021.

U.S. Census Bureau (USCB). 2000b. 2000 Decennial Census, Summary File 3. Available: https://data.census.gov/cedsci/. Accessed: September 20, 2021.

U.S. Census Bureau (USCB). 2010. Table S1701: POVERTY STATUS IN THE PAST 12 MONTHS. 2010: ACS 1-year Estimates Subject Table. Available: https://data.census.gov/cedsci/.

U.S. Census Bureau (USCB). 2019. Table S1701: POVERTY STATUS IN THE PAST 12 MONTHS. 2019: ACS 5-year Estimates Subject Table. Available: https://data.census.gov/cedsci/.

U.S. Department of Transportation. 2021. National Transportation Statistics 2021. Available: https://www.bts.gov/sites/bts.dot.gov/files/2021-12/NTS-50th-complete-11-30-2021.pdf.

U.S. Environmental Protection Agency (USEPA). 2016. *Promising Practices for EJ Methodologies in NEPA Reviews: Report for the Federal Interagency Working Group on Environmental Justice & NEPA Committee*. Available: https://www.epa.gov/sites/default/files/2016-08/documents/nepa_promising_practices_document_2016.pdf. Accessed: September 20, 2021.

U.S. Environmental Protection Agency (USEPA). 2021a. EJSCREEN: Environmental Justice Screening and Mapping Tool. Available: https://www.epa.gov/ejscreen/download-ejscreen-data. Accessed: August 27, 2021.

U.S. Environmental Protection Agency (USEPA). 2021b. "Federally-Recognized Tribes in EPA's Mid-Atlantic Region." Available: https://www.epa.gov/tribal/federally-recognized-tribes-epas-mid-atlantic-region. Accessed: October 21, 2021.

Wang. Y., I. Kloog, B. A. Coull, A. Kosheleva, A. Zanobetti, and J. D. Schwartz. 2016. Estimating causal effects of long-term $PM_{2.5}$ exposure on mortality in New Jersey. *Environ Health Perspect.* 124:1182–1188. Available: https://ehp.niehs.nih.gov/doi/pdf/10.1289/ehp.1409671. Accessed: November 2021.

Wassamasaw Tribe of Varnertown Indians. 2016. "Community." Available: http://www.wassamasawtribe.com/community/. Accessed: October 21, 2021.

B.2.3.13. Section 3.13, Finfish, Invertebrates, and Essential Fish Habitat

Able, K. W., J. M. Smith, and J. F. Caridad. 2015. American eel supply to an estuary and its tributaries: spatial variation in Barnegat Bay, New Jersey. *Northeastern Naturalist* 22(1):53–68.

Adair, R. K. 1998. Extremely Low Frequency Electromagnetic Fields Do Not Interact Directly with DNA. *Bioelectromagnetics* 19:136–137. Available: http://dx.doi.org/10.1002/(SICI)1521-186X(1998)19:2<136::AID-BEM14>3.0.CO;2-O.

Aimon, C., S. D. Simpson, R. A. Hazelwood, R. Bruintjes, and M. A. Urbina. 2021. Anthropogenic underwater vibrations are sensed and stressful for the shore crab *Carcinus maenas. Environmental Pollution* 285:117148.

Albert, L., F. Deschamps, A. Jolivet, F. Olivier, L. Chauvaud, and S. Chauvaud. 2020. A current synthesis on the effects of electric and magnetic fields emitted by submarine power cables on invertebrates. *Marine Environmental Research* 159:104958. DOI: 10.1016/j.marenvres.2020.104958.

Almeda, R., E. Buskey, and C. J. Hyatt. 2014. Toxicity of dispersant Corexit 9500A and crude oil to marine microzooplankton. Ecotoxicology and Environmental Safety. DOI: 10.1016/ j.ecoserv2014.008.

Alzieu, C., J. Sanjuan, J. P. Deltreil, and B. Borel. 1986. Tin contamination in Aareachon Bay: effects on oyster shell anomalies. *Marine Pollution Bulletin* 17:494–498.

Atlantic States Marine Fisheries Commission (ASMFC). 1997. Atlantic Coastal Submerged Aquatic Vegetation: A Review of its Ecological Role, Anthropogenic Impacts, State Regulation, and Value to Atlantic Coastal Fish Stocks. ASMFC Habitat Management Series #1. Available: http://www.asmfc.org/uploads/file/sav.pdf#page=15.

Atlantic States Marine Fisheries Commission (ASMFC). 2012. *Habitat Addendum IV to Amendment I to the Interstate Fishery Management Plan for Atlantic Sturgeon*. 16 pp. Available: http://www.asmfc.org/uploads/file/sturgeonHabitatAddendumIV_Sept2012.pdf.

Atlantic States Marine Fisheries Commission (ASMFC). 2022. Stock Assessments. Available: http://www.asmfc.org/fisheries-science/stock-assessments#Documents. Accessed: April 2022.

Atlantic Sturgeon Status Review Team (ASSRT). 2007. Status Review of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). Report to National Marine Fisheries Service, Northeast Regional Office. February 23, 2007. 174 pp.

Armstrong, J. D., D. C. Hunter, R. J. Fryer, P. Rycroft, and J. E. Orpwood. 2015. Behavioural responses of Atlantic salmon to mains frequency magnetic fields. *Scottish Marine and Freshwater Science* 6(9):67.

Bachman, M., and J. Coutour. 2022. Habitat Committee report. Staff presentation to the New England Fishery Management Council. June 30, 2022. Portland, Maine.

Balazik, M., K. Reine, A. Spells, C. Fredrickson, M. Fine, G. Garman, and S. McIninch. 2012. The Potential for Vessel Interactions with Adult Atlantic Sturgeon in the James River, Virginia. *North American Journal of Fisheries Management* 32(6):1062–1069.

Balazik, M., M. Barber, S. Altman, K. Reine, A. Katzenmeyer, A. Bunch, and G. Garman. 2020. Dredging activity and associated sound have negligible effects on adult Atlantic sturgeon migration to spawning habitat in a large coastal river. *PLOS ONE* 15(3):e0230029. DOI: 10.1371/journal.pone.0230029. PMID: 32142543; PMCID: PMC7059921.

Basov, B. M. 1999. Behavior of sterlet Acipenser ruthenus and Russian sturgeon A. gueldenstaedtii in low-frequency electric fields. *J Ichthyol* 39(9):782–787.

Beatrice Offshore Windfarm. 2016. *UXO Clearance Marine License* – Environmental Report. 89 pages. Available: https://marine.gov.scot/sites/default/files/00506118.pdf

Bejarano, A., J. Michel, J. Rowe, Z. Li, D. French McCay, and D. Schmidt Etkin. 2013. *Environmental Risks, Fate, and Effects of Chemicals Associated with Wind Turbines on the Atlantic Outer Continental Shelf*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2013-213. Available: https://espis.boem.gov/final%20reports/5330.pdf. Accessed: October 11, 2021.

Bellmann M. A., J. Brinkmann. A. May, T. Wendt, S. Gerlach, and P. Remmers. 2020. *Underwater noise during percussive pile driving: Influencing factors on pile-driving noise and technical possibilities to comply with noise mitigation values*. Supported by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (BMU)), FKZ UM16 881500. Commissioned and managed by the Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie (BSH)), Order No. 10036866. Edited by the itap GmbH. Available: https://www.itap.de/media/experience_report_underwater_era-report.pdf.

Bevelhimer, M. S., G. F. Cada, A. M. Fortner, P. E. Schweizer, and K. Riemer. 2013. Behavioral Responses of Representative Freshwater Fish Species to Electromagnetic Fields. *Transactions of the American Fisheries Society* 142(3):802–813.

Bilinski, J. 2021. *Review of the Impacts to Marine Fauna from Electromagnetic Frequencies (EMF) Generated by Energy Transmitted through Undersea Electric Transmission Cables*. NJDEP Division of Science and Research. Available: https://www.nj.gov/dep/offshorewind/docs/njdep-marine-fauna-review-impacts-from-emf.pdf. Accessed: April 2021.

Bologna, P. A. X., J. J. Gaynor, C. L. Barry, and D. J. Restaino. 2017. Top-down impacts of sea nettles (*Chrysaora quinquecirrha*) on pelagic community structure in Barnegat Bay, New Jersey, U.S.A. In: Buchanan, G. A., T. J. Belton, and B. Paudel (eds.), A Comprehensive Assessment of Barnegat Bay–Little Egg Harbor, New Jersey. *Journal of Coastal Research*, Special Issue No. 78:193–204. Coconut Creek (Florida), ISSN 0749-0208.

Bricelj, V. M., J. N. Kraeuter, and G. Flimlin. 2017. Status and trends of hard clam, *Mercenaria mercenaria*, populations in a coastal lagoon ecosystem, Barnegat Bay–Little Egg Harbor, New Jersey. In: Buchanan, G. A., T. J. Belton, and B. Paudel (eds.), A Comprehensive Assessment of Barnegat Bay–Little Egg Harbor, New Jersey. *Journal of Coastal Research*, Special Issue No. 78:193–204. Coconut Creek (Florida), ISSN 0749-0208.

Brouard, D., C. Harvey, D. Goulet, T. Nguyen, R. Champagne, and P. Dubs. 1996. Technical Notes: Evaluation of potential effects of stray voltage generated by alternating current on hatchery raised rainbow trout. *The Progressive Fish-culturist* 58:47–51.

Brown, J. J., and G. W. Murphy. 2010. Atlantic Sturgeon Vessel-Strike Mortalities in the Delaware Estuary. *Fisheries* 35:72–83.

Bruchet, A., et al. 2014. "Leaching of bisphenol A and F from new and old epoxy coatings: Laboratory and field studies." *Water Science and Technology: Water Supply* 14.3:383–389.

Bureau of Ocean Energy Management (BOEM). 2012. *Effects of Noise on Fish, Fisheries, and Invertebrates in the U.S. Atlantic and Arctic from Energy Industry Sound-Generating Activities*. Prepared under BOEM contract M11PC00031.

Bureau of Ocean Energy Management (BOEM). 2014. *Finding of No Significant Impact: Proposed Geological and Geophysical Activities in the Atlantic OCS to Identify Sand Resources and Borrow Areas*. Available: https://www.boem.gov/sites/default/files/non-energy-minerals/Finding-of-No-Significant-Impact.pdf.

Bureau of Ocean Energy Management (BOEM). 2015. *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia: Revised Environmental Assessment*. OCS EIS/EA BOEM 2015-031. Available: https://www.boem.gov/VOWTAP-EA/. Accessed: October 11, 2021.

Bureau of Ocean Energy Management (BOEM). 2018. *Electromagnetic Field (EMF) Impacts on Elasmobranch (Shark, Rays, and Skates) and American Lobster Movement and Migration from Direct Current Cables*. OCS Study BOEM 2018-003. Prepared by Hutchison, Z. L., P. Sigray, H. He, A. B. Gill, J. King, and C. Gibson. Available: https://espis.boem.gov/final%20reports/5659.pdf.

Bureau of Ocean Energy Management (BOEM). 2021. *South Fork Wind Farm and South Fork Export Cable Project Biological Assessment*. Prepared for the National Marine Fisheries Service. U.S. Department of the Interior Bureau of Ocean Energy Management, Office of Renewable Energy Programs. Washington, D.C.

Bureau of Ocean Energy Management (BOEM). 2022a. *Ocean Wind Offshore Wind Farm Essential Fish Habitat Assessment for National Marine Fisheries Service.* [Month].

Bureau of Ocean Energy Management. 2022b. *Ocean Wind Offshore Wind Farm Biological Assessment for National Marine Fisheries Service.* [Month].

Byrnes, M. R., R. M. Hammer, B. A. Vittor, J. S. Ramsey, D. B. Snyder, J. D. Wood, K. F. Bosma, T. D. Thibaut, and N. W. Phillips. 2000. *Environmental Survey of Potential Sand Resource Sites: Offshore New Jersey*. U.S. Dept. of the Interior, Minerals Management Service, International Activities and Marine Minerals Division (INTERMAR). Herndon, VA. OCS Report MMS 2000-052. Vol I: 380 pp., Vol II: Appendices 291.

Cameron, I. L., K. R. Hunter, and W. D. Winters. 1985. Retardation of embryogenesis by extremely low frequency 60 Hz electromagnetic fields. *Physiol. Chem. Phys. Med*. NMR 17:135–138.

Carpenter, J. R., L. Merckelbach, U. Callies, S. Clark, L. Gaslikova, and B. Baschek. 2016. Potential impacts of offshore wind farms on North Sea stratification. *PLOS ONE* 11(8):e0160830. DOI:10.1371/journal.pone.0160830.

Carreno, A., and J. Lloret. 2021. Environmental impacts of increasing leisure boating activity in Mediterranean coastal waters. *Ocean and Coastal Management* 209:1. Available: https://www.sciencedirect.com/science/article/pii/S0964569121001770#:~:text=Major%20or%20high%20impacts%20include%20anchoring%20impacts%20on,waters%2C%20air%20pollution%2C%20and%20fuel%20and%20oil%20leaks. Accessed: April 2022.

Cazenave, P. W., R. Torres, and J. I. Allen. 2016. Unstructured grid modelling of offshore wind farm impacts on seasonally stratified shelf seas. *Progress in Oceanography* 145:25–41.

Chen, Z. 2018. *Dynamics and spatio-temporal variability of the mid-Atlantic bight cold pool*. Ph.D. dissertation, Rutgers, The State University of New Jersey, Oceanography. Available: https://rucore.libraries.rutgers.edu/rutgers-lib/58963/PDF/1/play/. Accessed: November 2021.

Christiansen, Nils, Ute Daewel, Bughsin Djath, and Corinna Schrum. 2022. Emergence of Large-Scale Hydrodynamic Structures Due to Atmospheric Offshore Wind Farm Wakes. *Frontiers in Marine Science* 9. DOI: 10.3389/fmars.2022.818501.

Collins, M. R., T. I. J. Smith, W. C. Post, and O. Pashuk. 2000. Habitat utilization and biological characteristics of adult Atlantic sturgeon in two South Carolina rivers. *Transactions of the American Fisheries Society* 129:982–988.

Copping, A., N. Sather, L. Hanna, J. Whiting, G. Zydlewski, G. Staines, A. Gill, I. Hutchison, A. O'Hagan, T. Simas, J. Bald, C. Sparling, J. Wood, and E. Masden. 2016. *Annex IV 2016 State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World*.

CSA Ocean Sciences, Inc. and Exponent. 2019. *Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England*. OCS Study BOEM 2019-049. Sterling, Virginia: U.S. Department of the Interior, Bureau of Ocean Energy Management.

Cutter, G. R. Jr., and R. J. Diaz. 2000. Benthic resource mapping and resource evaluation of potential sand mining areas, 1998–1999. In *Environmental survey of potential sand resource sites offshore Delaware and Maryland*, part 1. Final Report to the Minerals Management Service, International Activities and Marine Minerals Division, contract 1435-01-97-CT-30853, Herdon, Virginia. Available: http://gomr.mms.gov/homepg/espis/espismaster.asp?appid=-1. Accessed: November 2021.

Dadswell, M. J. 2006. A review of the status of Atlantic sturgeon in Canada, with comparisons to populations in the United States and Europe. *Fisheries* 31:218–229.

Daewel, U., N. Akhtar, N. Christiansen, et al. 2022. Offshore wind farms are projected to impact primary production and bottom water deoxygenation in the North Sea. *Commun Earth Environ* 3:292. https://doi.org/10.1038/s43247-022-00625-0.

Dannheim, J., L. Bergström, S. N. R. Birchenough, R. Brzana, A. R. Boon, J. W. P. Coolen, J. Dauvin, I. De Mesel, J. Derweduwen, A. B. Gill, Z. L. Hutchison, A. C. Jackson, U. Janas, G. Martin, A. Raoux, J. Reubens, L. Rostin, J. Vanaverbeke, T. A. Wilding, D. Wilhelmsson, and S. Degraer. 2020. Benthic effects of offshore renewables: identification of knowledge gaps and urgently needed research. *ICES Journal of Marine Science* 77:1092–1108.

Dawe, E., L. Hendrickson, E. Colbourne, K. Drinkwater, and M. Showell. 2007. Ocean climate effects on the relative abundance of short-finned (*Illex illecebrosus*) and long-finned (*Loligo ealeii*) squid in the northwest Atlantic Ocean. *Fisheries Oceanography* 16(4):303–316.

Degraer, S., D. Carey, J. Coolen, Z. Hutchison, F. Kerckhof, B. Rumes, and J. Vanaverbeke. 2020. Offshore Wind Farm Artificial Reefs Affect Ecosystem Structure and Functioning: A Synthesis. *Oceanography* 33(4):48–57.

Donahue, M. J., A. Nichols, C. A. Santamaria, P. E. League-Pike, C. J. Krediet, K. O. Perez, and M. J. Shulman. 2009. Predation risk, prey abundance, and the vertical distribution of three Brachyuran crabs on Gulf of Maine shores. *Journal of Crustacean Biology* 29:523–531.

Dorrell, R. M., C. J. Lloyd, B. J. Lincoln, T. P. Rippeth, J. R. Taylor, C. P. Caulfield, J. Sharples, J. A. Polton, B. D. Scannell, D. M. Greaves, R. A. Hall, and J. H. Simpson. 2022. Anthropogenic mixing in seasonally stratified shelf seas by offshore wind farm infrastructure. *Frontiers in Marine Science* 9:830927.

Duarte, C. M. 2002. The future of seagrass meadows. *Environmental Conservation* 29:192–206.

Dunton, K. J., A. Jordaan, K. A. McKown, D. O. Conover, and M. G. Frisk. 2010. Abundance and distribution of Atlantic sturgeon (Acipenser oxyrinchus) within the Northwest Atlantic Ocean, determined from five fishery-independent surveys. *Fisheries Bulletin* 108:450–465.

Ecosystem Assessment Program. 2012. *Ecosystem Status Report for the Northeast Shelf Large Marine Ecosystem - 2011*. Northeast Fisheries Science Center Reference Document 12-07.

Erickson, D. L., A. Kahnle, M. J. Millard, E. A. Mora, M. Bryja, A. Higgs, J. Mohler, M. DuFour, G. Kenney, J. Sweka, and E. K. Pikitch. 2011. Use of pop-up satellite archival tags to identify oceanic-migratory patterns for adult Atlantic Sturgeon, Acipenser oxyrinchus Mitchell, 1815. *Journal of Applied Ichthyology* 27:356–365.

Essink, K. 1999. "Ecological Effects of Dumping of Dredged Sediments; Options for Management." *Journal of Coastal Conservation* 5:69–80.

Eyler, S., M. Mangold, and S. Minkkien. 2009. *Atlantic coast sturgeon tagging database*. U.S. Fish and Wildlife Service, Maryland Fishery Resources Office, Summary Report, Annapolis, Maryland.

Fantasia, R. L., V. M. Bricelj, and L. Ren. 2017. Phytoplankton community structure based on photopigment markers in a mid-Atlantic U.S. coastal lagoon: Significance for hard-clam production. In: Buchanan, G. A., T. J. Belton, and B. Paudel (eds.), A Comprehensive Assessment of Barnegat Bay–Little Egg Harbor, New Jersey. *Journal of Coastal Research*, Special Issue No. 78:193–204. Coconut Creek (Florida), ISSN 0749-0208.

Farr, E. R., M. R. Johnson, M. W. Nelson, J. A. Hare, W. E. Morrison, M. D. Lettrich, B. Vogt, C. Meaney, U. A. Howson, P. J. Auster, and F. A. Borsuk. 2021. *An assessment of marine, estuarine, and riverine habitat vulnerability to climate change in the Northeast U.S*. *PLOS ONE* 9; 16(12): e0260654.

Field, C. B., M. J. Behrenfeld, J. T. Randerson, and P. Falkowski. 1998. Primary production to the biosphere: Integrating terrestrial and oceanic components. *Science* 281:237–240.

Fisheries Hydroacoustic Working Group (FHWG). 2008. *Agreement in principle for interim criteria for injury to fish from pile driving activities*. Prepared for FHWG Agreement in Principle Technical/Policy Meeting, June 11, 2008, Vancouver, WA. Available: http://www.dot.ca.gov/hq/env/bio/files/fhwgcriteria_agree.pdf.

Floeter, J., J. E. E. van Beusekom, D. Auch, U. Callies, J. Carpenter, T. Dudeck, S. Eberle, A. Eckhardt, D. Gloe, K. Hänselmann, M. Hufnagl, S. Janßen, H. Lenhart, K. O. Möller, R. P. North, T. Pohlmann, R. Riethmüller, S. Schulz, S. Spreizenbarth, A. Temming, B. Walter, O. Zielinski, and C. Möllmann. 2017. Pelagic effects of offshore wind farm foundations in the stratified North Sea. *Progress in Oceanography* 156:154–173.

Fromentin, J. M. and B. Planque. 1996. *Calanus* and environment in the eastern North Atlantic. II. Influence of the North Atlantic Oscillation on *C. finmarchicus* and *C. helgolandicus*. *Marine Ecology Progress Series* 134:111–118.

Gill, A. B. and M. Desender. 2020. Risk to Animals from Electromagnetic Fields Emitted by Electric Cables and Marine Renewable Energy Devices. In A.E. Copping and L.G. Hemery (Eds.), *OES-Environmental 2020 State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World.* Report for Ocean Energy Systems (OES). (pp. 86–103). DOI:10.2172/1633088.

Greene, J. K., M. G. Anderson, J. Odell, and N. Steinberg, eds. 2010. *The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems*. Phase One. The Nature Conservancy, Eastern U.S. Division, Boston, MA. Available: https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/Documents/namera-phase1-fullreport.pdf.

Guida, V., A. Drohan, H. Welch, J. McHenry, D. Johnson, V. Kentner, J. Brink, D. Timmons, and E. Estela-Gomez. 2017. *Habitat Mapping and Assessment of Northeast Wind Energy Areas*. U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-088. November 1, 2013. Prepared in Collaboration between Gulf of Maine Research Institute and University of Maine.

Hannay, D. E., and M. Zykov. 2022. *Underwater Acoustic Modeling of Detonations of Unexploded Ordnance (UXO) for Orsted Wind Farm Construction, US East Coast*. Document 02604, Version 4.4. Report by JASCO Applied Sciences for Ørsted.

Hare, J. A., W. E. Morrison, M. W. Nelson, M. M. Stachura, E. J. Teeters, R. B. Griffis, M. A. Alexander, J. D. Scott, L. Alade, R. J. Bell, A. S. Chute, K. L. Curti, T. H. Curtis, and C. A. Griswold. 2016. A vulnerability assessment of fish and invertebrates to climate change on the northeast U.S. Continental Shelf. *PLOS ONE* 11(2):e0146756.

Hastings, M. C., and A. N. Popper. 2005. *Effects of Sound on Fish*. California Department of Transportation Contract 43A0139.

Hawkins, Anthony D. 2020. The Potential Impact of Offshore Wind Farms on Fishes and Invertebrates. *Ad Oceanogr & Marine Biol.* 2(3). AOMB.MS.ID.000539. DOI: 10.33552/AOMB.2020.02.000539.

Hemery, L. G. 2020. Changes in Benthic and Pelagic Habitats Caused by Marine Renewable Energy Devises. *OES – Environmental 2020 State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World*. Report for Ocean Energy Systems (OES).

Howson, U. A., G. A. Buchanan, and J. A. Nickels. 2017. Zooplankton community dynamics in a western mid-Atlantic lagoonal estuary. In: Buchanan, G. A., T. J. Belton, and B. Paudel (eds.), A Comprehensive Assessment of Barnegat Bay–Little Egg Harbor, New Jersey. *Journal of Coastal Research*, Special Issue No. 78:193–204. Coconut Creek (Florida), ISSN 0749-0208.

Hutchison, Z. L., A. B. Gill, P. Sigray, H. He, and J. W. King. 2020. Anthropogenic electromagnetic fields (EMF) influence the behaviour of bottom-dwelling marine species. *Scientific Reports* 10(1):4219. DOI:10.1038/s41598-020-60793-x. Available: https://www.nature.com/articles/s41598-020-60793-x.pdf.

Ingram, E. C., R. M. Cerrato, K. J. Dunton, and M. G. Frisk. 2019. Endangered Atlantic sturgeon in the New York Wind Energy Area: Implications for future development in an offshore wind energy site. *Scientific Reports*,(2019)9:12432. Available: https://doi.org/10.1038/s41598-019-48818-6.

Inspire Environmental (Inspire). 2021. *Ocean Wind Offshore Wind Farm Benthic Habitat Mapping and Benthic Assessment to Support Essential Fish Habitat Consultation*. Prepared for HDR Engineering. June 2021. Ocean Wind COP Appendix E Supplement.

Inspire Environmental (Inspire). 2022a. *Ocean Wind Offshore Wind Farm Benthic Habitat Mapping and Benthic Assessment to Support Essential Fish Habitat Consultation*. Prepared for HDR Engineering.

Inspire Environmental (Inspire). 2022b. *Ocean Wind Offshore Wind Farm Submerged Aquatic Vegetation Monitoring Plan*. Prepared for Ocean Wind, Ørsted US. Submitted by Inspire Environmental. June 15, 2022.

Jakubowska, M., B. Urban-Malinga, Z. Otremba, and E. Andrulewicz. 2019. Effect of low frequency electromagnetic field on the behavior and bioenergetics of the polychaete Hediste diversicolor. *Marine environmental research* 150:104766.

Jézéquel, Y, I. T. Jones, J. Bonnel, L. Chauvaud, J. Atema, and T. A. Mooney. 2021. Sound detection by the American lobster (*Homarus americanus*). *Journal of Experimental Biology* 224, jeb240747. DOI:10.1242/jeb.240747.

Jivoff, P. R., L. Moritzen, J. Kels, J. McCarthy, A. Young, A. Barton, P. Ferdinando, F. Pandolfo, and C. Tighe. 2017. The relative importance of the Sedge Island Marine Conservation Zone for adult blue crabs in Barnegat Bay, New Jersey. In: Buchanan, G. A., T. J. Belton, and B. Paudel (eds.), A Comprehensive Assessment of Barnegat Bay–Little Egg Harbor, New Jersey. *Journal of Coastal Research*, Special Issue No. 78:193–204. Coconut Creek (Florida), ISSN 0749-0208.

Johnson, J. H., D. S. Dropkin, B. E. Warkentine, J. W. Rachlin, and W. D. Andrews. 1997. Food habits of Atlantic sturgeon off the Central New Jersey Coast. *Trans. Am. Fish. Soc.* 126:166–170.

Jones, I. T., J. A. Stanley, and T. A. Mooney. 2020. Impulsive pile driving noise elicits alarm responses in squid (*Doryteuthis pealeii*). *Marine Pollution Bulletin* 150:110792. doi.org/10.1016/ j.marpolbul.2019.110792.

Jones, I. T., J. F. Peyla, H. Clark, Z. Song, J. A. Stanley, and T. A. Mooney. 2021. Changes in Feeding Behavior of Longfin Squid (*Doryteuthis pealeii*) during Laboratory Exposure to Pile Driving Noise. *Marine Environmental Research* 165:105250.

Kahnle, A. W., K. A. Hattala, and K. McKown. 2007. Status of Atlantic Sturgeon of the Hudson River estuary, New York, USA. Page 347–363 in J. Munro, D. Hatin, J. E. Hightower, K. McKown, K. J. Sulak, A. W. Kahnle, and F. Caron, editors. *Anadromous sturgeons: habitats, threats, and management*. American Fisheries Society, Symposium 56, Bethesda, Maryland. Available: https://hero.epa.gov/hero/index.cfm/reference/details/reference_id/7253621.

Katranitsas, A., J. Castritsi-Catharios, and G. Persoone. 2003. "The effects of a copper-based antifouling paint on mortality and enzymatic activity of a non-target marine organism." *Marine Pollution Bulletin* 46.11:1491–1494.

Kirchgeorg, T., I. Weinberg, M. Hornig, R. Baier, M. J. Schmid, and B. Brockmeyer. 2018. Emissions from corrosion protection systems of offshore wind farms: evaluation of the potential impact on the marine environment. *Marine Pollution Bulletin* 136:257–268.

Küsel, E. T., M. J. Weirathmueller, K. E. Zammit, S. J. Welch, K. E. Limpert, and D. G. Zeddies. 2021. *Underwater Acoustic and Exposure Modeling*. Document 02109, Version 1.0 DRAFT. Technical report by JASCO Applied Sciences for Ocean Wind LLC.

Küsel, E. T., M. J. Weirathmueller, K. E. Zammit, S. J. Welch, K. E. Limpert, and D. G. Zeddies. 2022. *Underwater Acoustic and Exposure Modeling*. Document 02109, Version 1.0 DRAFT. Technical report by JASCO Applied Sciences for Ocean Wind LLC.

Lefcheck, J. S., B. B. Hughes, A. J. Johnson, B. W. Pfirrmann, D. B. Rasher, A. R. Smyth, B. L. Williams, M. W. Beck, and R. J. Orth. 2019. Are coastal habitats important nurseries? A meta-analysis. *Conservation Letters* 12(4):e12645.

Lentz, S. J. 2017. Seasonal warming of the Middle Atlantic Bight Cold Pool. *Journal of Geophysical Research – Ocean* 122(2):941–954.

Li, X., L. Chi, X. Chen, Y. Ren, and S. Lehner. 2014. SAR observation and numerical modeling of tidal current wakes at the East China Sea offshore wind farm. *Journal of Geophysical Research*: Oceans 119(8):4958–4971.

Lloret, J., A. Turiel, J. Sole, E. Berdalet, A. Sabates, A. Olivares, J. Gili, J. Vila-Subiros, and R. Sarda. 2022. Unravelling the ecological impacts of large-scale offshore wind farms in the Mediterranean Sea. *Science of the Total Environment* 824:153803.

Long Island Sound Study. 2003. *Sound Health. A Report on Status and Trends in the Health of the Long Island Sound*. Available: https://longislandsoundstudy.net/wp-content/uploads/2010/03/sound_health_2003.pdf.

Longcore, T. and C. Rich. 2004. Ecological light pollution. *Front Ecol Environ*. 2:191–198.

Love, M. S., M. M. Nishimoto, S. Clark, M. McCrea, and A. S. Bull. 2017. Assessing potential impacts of energized submarine power cables on crab harvests. *Continental Shelf Research* 151:23–29. DOI:10.1016/j.csr .2017.10.002.

Lovell, J. M., M. M. Findlay, R. M. Moate, J. R. Nedwell, and M. A. Pegg. 2005. The inner ear morphology and hearing abilities of the paddlefish (*Polyodon spathula*) and the lake sturgeon (*Acipenser fulvescens*). *Comparative Biochemistry and Physiology Part A: Molecular Integrative Physiology* 142:286–289.

Lyon, Stuart B., R. Bingham, and Douglas J. Mills. 2017. "Advances in corrosion protection by organic coatings: What we know and what we would like to know." *Progress in Organic Coatings* 102:2–7.

Marchesan, M., M. Spoto, L. Verginella, and E. A. Ferrero. 2005. Behavioral effects of artificial light on fish species of commercial interest. *Fisheries Research* 73 (1 and 2):171–185.

Mesel, I. D., F. Kerckhof, A. Norro, and B. Rumes. 2015. Succession and seasonal dynamics of the epifauna community on offshore wind farm foundations and their role as stepping stones for non-indigenous species. *Hydrobiologia* 756(1). DOI: 10.1007/210750-014-2157-1.

Meyer, M., R. R. Fay, and A. N. Popper. 2010. Frequency tuning and intensity coding of sound in the auditory periphery of the lake sturgeon, Acipenser fulvescens. *Journal of Experimental Biology* 213:1567–1578.

Michel, P., and B. Averty. 1999. Contamination of French coastal waters by organotins compounds: 1997 update. *Marine Pollution Bulletin* 38:268–275.

Mid-Atlantic Fishery Management Council (MAFMC). 2016. *Regional use of the habitat area of particular concern (HAPC) designation*. Prepared by the Fisheries Leadership & Sustainability Forum for the MAFMC. 1–43.

Mid-Atlantic Fishery Management Council (MAFMC). 2020. *Fishery Management Plans and Amendments*. Available: https://www.mafmc.org/fishery-management-plans. Accessed October 4, 2021.

Miller, T., and G. Shepard. 2011. *Summary of Discard Estimates for Atlantic sturgeon, August 19, 2011*. Northeast Fisheries Science Center, Population Dynamics Branch.

Minerals Management Service (MMS). 2009. Cape Wind Farm Energy Project Final Environmental Impact Statement. OCS Publication No. 2008-040. U.S. Department of the Interior, Bureau of Ocean Energy Management. Available: https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Renewable_Energy_Program/Studies/Cape%20Wind%20Energy%20Project%20FEIS.pdf. Accessed: September 2021.

Mooney T. A., M. H. Andersson, and J. Stanley. 2020. Acoustic impacts of offshore wind energy on fishery resources. An evolving source and varied effects across a wind farm's lifetime. *Oceanography* 33:82–95. Available: https://doi.org/10.5670/oceanog.2020.408.

Morley, J. W., R. L. Selden, R. J. Latour, T. L. Frolicher, R. J. Seagraves, and M. L. Pinsky. 2018. *Projecting shifts in thermal habitat for 686 species on the North American continental shelf*. *PLOS ONE* 13(5): e0196127.

Moser, M. L., and S. W. Ross. 1995. Habitat use and movements of shortnose and Atlantic sturgeons in the lower Cape Fear River, North Carolina. *Transactions of the American Fisheries Society* 24:225–234.

Moser, M. L., M. Bain, M. R. Collins, N. Haley, B. Kynard, J. C. O'Herron II, G. Rogers, and T. S. Squiers. 2000. *A Protocol for Use of Shortnose and Atlantic Sturgeons*. NOAA Technical Memorandum-NMFS-PR-18.

Nascimento, J. A., M. Dahl, D. Deyanova, L. D. Lyimo, H. M. Bik, T. Schuelke, T. J. Pereira, M. Bjork, S. Creer, and M. Gullstrom. 2019. Above-below surface interactions mediate effects of seagrass disturbance on meiobenthic diversity, nematode and polychate trophic structure. *Communications Biology* 2:362.

National Marine Fisheries Service (NMFS). 2014. *Draft Programmatic Environmental Assessment for Fisheries Research Conducted and Funded by the Northeast Fisheries Science Center*. December 2014. Prepared by URS Group, Anchorage, Alaska. 657 pp.

National Marine Fisheries Service (NMFS). 2016. Endangered Species Act Section 7 Consultation on the Continued Prosecution of Fisheries and Ecosystem Research Conducted and Funded by the Northeast Fisheries Science Center and the Issuance of a Letter of Authorization under the Marine Mammal Protection Act for the Incidental Take of Marine Mammals Pursuant to those Research Activities PCTS ID: NER-2015-12532. Available: https://media.fisheries.noaa.gov/dam-migration/nefsc_rule2016_biop.pdf.

National Marine Fisheries Service (NMFS). 2021a. Endangered Species Act Section 7 Consultation: Biological Opinion for Construction, Operation, Maintenance, and Decommissioning of the South Fork Offshore Energy Project. October. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/SF-BiOp-Final_0.pdf.

National Marine Fisheries Service (NMFS). 2021b. *Atlantic HMS Fishery Management Plans and Amendments*. Last updated by Office of Sustainable Fisheries on 08/19/2021. Available: https://www.fisheries.noaa.gov/atlantic-highly-migratory-species/atlantic-hms-fishery-management-plans-and-amendments. Accessed: November 23, 2021.

National Marine Fisheries Service (NMFS). 2021c. Essential Fish Habitat Mapper: New England / Mid-Atlantic. Available: https://www.habitat.noaa.gov/apps/efhmapper/?page=page_3. Accessed: November 23, 2021.

National Marine Fisheries Service (NMFS). 2021d. Letter of Concurrence for Offshore Wind Site Assessment Programmatic ESA Consultation. Silver Springs, Maryland. Available: https://media.fisheries.noaa.gov/2021-12/OSW%20surveys_NLAA%20programmatic_rev%201_2021-09-30%20%28508%29.pdf.

National Marine Fisheries Service (NMFS). 2022. Chesapeake Bay Distinct Population Segment of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) 5-Year Review: Summary and Evaluation. Silver Spring, Maryland: National Marine Fisheries Service. Available: https://media.fisheries.noaa.gov/2022-02/Atlantic%20sturgeon%20CB%205-year%20review_FINAL%20SIGNED.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2004. *Essential Fish Habitat Consultation Guidance*, Version 1.1. Silver Spring, Maryland: National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Habitat Conservation. Available: https://repository.library.noaa.gov/view/noaa/4187. Accessed: October 4, 2021.

National Oceanic and Atmospheric Administration (NOAA). 2009. *Ecosystem status report for the Northeast U.S. Continental Shelf large marine ecosystem*. Available: https://www.st.nmfs.noaa.gov/Assets/iea/documents/NEFSC-ESR-2009.pdf. Accessed: November 2021.

National Oceanic and Atmospheric Administration (NOAA). 2013. *Guide to Essential Fish Habitat Designations in the Northeastern United States*. Available: https://www.nrc.gov/docs/ML1409/ML14090A199.pdf. Accessed: October 5, 2021.

National Oceanic and Atmospheric Administration (NOAA). 2019. *U.S. National Bycatch Report First Edition Update 3*. Available: https://media.fisheries.noaa.gov/dam-migration/nbr_update_3.pdf. Accessed: October 2021.

National Oceanic and Atmospheric Administration (NOAA). 2021. *2021 State of the Ecosystem Mid-Atlantic*. April 2021.

National Oceanic and Atmospheric Administration (NOAA). 2022. *2021 State of the Ecosystem Mid-Atlantic*. April 2022.

Nedwell, J. R., A. W. H. Turnpenny, J. Lovell, S. J. Parvin, R. Workman, J. A. L. Spings, and D. Howell. 2007. *A validation of the dBht as a measure of the behavioural and auditory effects of underwater noise*. Subacoustech Report No. 534R1231. Available: https://tethys.pnnl.gov/sites/default/files/publications/Nedwell-et-al-2007.pdf. Accessed: April 2022.

New England Fishery Management Council (NEFMC). 2021. *Fishery Management Plans and Amendments*. Available: https://www.nefmc.org/management-plans. Accessed: October 4, 2021.

New England Fishery Management Council (NEFMC). 2022a. Southern New England Habitat Area of Particular Concern Framework, Northeast Multispecies Fishery Management Plan Framework Adjustment 64, Atlantic Sea Scallop Fishery Management Plan Framework Adjustment 35, Monkfish Fishery Management Plan Framework Adjustment 14, Northeast Skate Complex Fishery Management Plan Framework Adjustment 10, Atlantic Herring Fishery Management Plan Framework Adjustment 10. Draft. Prepared by the New England Fishery Management Council and the National Marine Fisheries Service. March.

New England Fishery Management Council (NEFMC). 2022b. Council Approves HAPC for Southern New England; Previews Northeast Regional Habitat Assessment Data Explorer. Press Release. 18 July. Press contact: J. Plante/ jplante@nefmc.org.

New Jersey Department of Environmental Protection (NJDEP). 2010. *Ocean/Wind Power Ecological Baseline Studies. January 2008–December 2009*. Volume I: Overview Summary, and Application; Volume IV: Fish and Fisheries Studies. Final Report. Prepared by Geo-Marine Inc.

New York State Energy Research and Development Authority (NYSERDA). 2019. *Geotechnical and Geophysical Desktop Study to Support Offshore Wind Energy Development in the New York Bight*. April. NYSERDA Report 19-19. Available: https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Programs/Offshore-Wind/19-19-Geotechnical-and-Geophysical-Desktop-Study-to-Support-Offshore-Wind-Energy-Development.pdf.

Newcombe, C. P. and D. D. Macdonald. 1991. Effects of Suspended Sediments on Aquatic Ecosystems. *North American Journal of Fisheries Management* 11:72–82.

Normandeau Associates, Inc., Exponent, Inc., T. Tricas, and A. Gill. 2011. *Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species*. Final Report. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09. Available: https://espis.boem.gov/final%20reports/5115.pdf. Accessed: October 11, 2021.

Northeast Fisheries Science Center (NEFSC). 2021. Stock Assessment Review Index (SARI) Search. Available: https://apps-nefsc.fisheries.noaa.gov/saw/reviews_report_options.php.

Northeast Regional Planning Body. 2016. *Northeast Ocean Plan: Full Plan*. Available: https://neoceanplanning.org/wp-content/uploads/2018/01/Northeast-Ocean-Plan_Full.pdf. Accessed: September 2021.

Novak, A., A. Carlson, C. Wheeler, G. wippelhauser, and J. Sulikowski. 2017. Critical Foraging Habitat of Atlantic Sturgeon Based on Feeding Habits, Prey Distribution, and Movement Patterns in the Saco River Estuary, Maine. *Transactions of the American Fisheries Society* 146(2):308–317. Available: https://doi.org/10.1080/00028487.2016.1264472.

Ocean Wind LLC (Ocean Wind). 2022. *Ocean Wind Submerged Aquatic Vegetation Preliminary Mitigation Plan*. December 2022.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Orpwood, J. E., R. J. Fryer, P. Rycroft, and J. D. Armstrong. 2015. Effects of AC magnetic fields (MFs) on swimming activity in European eels Anguilla anguilla. *Scottish Marine and Freshwater Science* 6(8):1–22.

Orr, M. A. 2016. *The Potential Impacts of Submarine Power Cables on Benthic Elasmobranchs*. PhD Thesis. Institute of Marine Science. University of Auckland, New Zealand. 180 pages.

Pederson, J. R. Bullock, J. T. Carlton, J. Dijkstra, N. Dobroski, P. Dyrynda, R. Fishers, L. Harris, N. Hobbs, G. Lambert, E. Lazo-Wasem, A. Mathieson, M. Miglietta, J. Smith, J. Smith III, and M. Tyrrell. 2005. Marine invaders in the northeast: Rapid assessment survey of non-native and naïve marine species of floating dock communities. Publication No. 05-03. Cambridge: Massachusetts Institute of Technology, Sea Grand College Program, 40 pp.

Pickens, B. A., J. C. Taylor, and D. Hansen. 2020. Volume 1: Fish habitat associations and the potential effects of dredging on the Atlantic and Gulf of Mexico Outer Continental Shelf, literature synthesis and gap analysis. In: Pickens, B. A., and J. C. Taylor, editors. *Regional Essential Fish Habitat geospatial assessment and framework for offshore sand features*. Sterling (VA): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2020-002 and NOAA NCCOS Technical Memorandum 270. Available: https://doi.org/10.25923/akzd-8556.

Plante, J. 2022. Council Approves HAPC for Southern New England; Previews Northeast Regional Habitat Assessment Data Explorer. Press release. New England Fishery Management Council. July 18. Available: https://www.nefmc.org/news. Accessed: July 25, 2022.

Popper, A., L. Hiice-Dunton, E. Jenkins, et al. 2022. Offshore wind energy development: Research priorities for sound and vibration effects on fishes and aquatic invertebrates. *The Journal of the Acoustical Society of America* 151:205–215. Available: https://doi.org/10.1121/10.0009237.

Popper, A. N., A. D. Hawkins, R. R. Fay, D. Mann, S. Bartol, T. H. Carlson, S. Coombs, W. T. Ellison, R. Gentry, M. B. Halvorsen, S. Løkkeborg, P. Rogers, B. L. Southall, D. G. Zeddies, and W. N. Tavolga. 2014. *Sound Exposure Guidelines for Fishes and Sea Turtles*. A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI.

Popper, A. N., and A. Hawkins. 2018. The importance of particle motion to fishes and invertebrates. *Journal of the Acoustical Society of America* 143:470.

Popper, A. N., M. Salmon, and K. W. Horch. 2001. Acoustic detection and communication by decapod crustaceans. *Journal of Comparative Physiology* 187:83–89.

Price, Seth J., and Rita B. Figueira. 2017. “Corrosion protection systems and fatigue corrosion in offshore wind structures: current status and future perspectives.” *Coatings* 7.2:25.

Radford, A. N., E. Kerridge, and S. D. Simpson. 2014. Acoustic communication in a noisy world: can fish compete with anthropogenic noise? *Behavioral Ecology* 25(5):1022–1030.

Rajasärkkä, Johanna, et al. 2016. “Drinking water contaminants from epoxy resin-coated pipes: A field study.” *Water research* 103:133–140.

Reine, K., D. Dickerson, and D. Clarke. 1998. “Environmental windows associated with dredging operations in aquatic systems.” Technical Note DOER-E2, U.S. Army Corps of Engineers, Environmental Laboratory, Vicksburg, MS. Available: https://erdc-library.erdc.dren.mil/jspui/bitstream/11681/8735/1/TN-DOER-E2.pdf.

Rezek, R., B. Furman, R. Jung, M. Hall, and S. Bell. 2019. Long-term performance of seagrass restoration projects in Florida, USA. *Nature* 9:15514. https://doi.org/10.1038/s41598-019-51856-9.

Rheuban, J. E., M. T. Kavanaugh, and S. C. Doney. 2017. Implications of future northwest Atlantic bottom temperatures on the American Lobster (*Homarus americanus*) fishery. *Journal of Geophysical Research: Oceans* 122: 9387–9398. DOI: 10.1002/2017JC012949.

Rico-Martinez, R., T. W. Snell, and T. L. Shearer. 2013. Synergistic toxicity of Macondo crude oil and dispersant Corexit 9500A to the Brachionus plicatilis species complex (Rotifera). *Environmental Pollution* 173:5–10.

Roberts, L., and M. Elliott. 2017. Good or bad vibrations? Impacts of anthropogenic vibration on the marine epibenthos. *Science of the Total Environment* 595 (2017):255–268.

Russel, D. J. F., S. M. J. M. Brasseur, D. Thompson, G. D. Hastie, V. M. Janik, G. Aarts, B. T. McClintock, J. Matthiopoulos, S. E. W. Moss, and B. McConnel. 2014. Marine mammals trace anthropogenic structures at sea. *Current Biology* 24(14):R638–R639.

Rutecki, D., T. Dellapenna, E. Nestler, F. Scharf, J. Rooker, C. Glass, and A. Pembroke. 2014. *Understanding the Habitat Value and Function of Shoals and Shoal Complexes to Fish and Fisheries on the Atlantic and Gulf of Mexico Outer Continental Shelf*. Literature Synthesis and Gap Analysis. Prepared for the U.S. Department of the Interior, Bureau of Ocean Energy Management. Contract # M12PS00009. BOEM 2015-012.

Savarese, M. No date. Habitats: Southwest Florida Shelf Coastal Marine Ecosystem – Habitats; Inshore Flats. Available: https://www.aoml.noaa.gov/ocd/ocdweb/docs/MARES/MARES_SWFS_ICEM_20130913_Appendix_InshoreFlats.pdf. Accessed: April 2022.

Schultz, I. R., D. L. Woodruff, K. E. Marshall, W. J. Pratt, and G. Roesijadi. 2010. *Effects of Electromagnetic Fields on Fish and Invertebrates*. Task 2.1. 3: Effects on Aquatic Organisms-Fiscal Year 2010 Progress Report- Environmental Effects of Marine and Hydrokinetic Energy (No. PNNL-19883 Final). Pacific Northwest National Laboratory, Richland, Washington.

Schultze, L. K. P., L. M. Merckelbach, J. Horstmann, S. Raasch, and J. R. Carpenter. 2020. Increased mixing and turbulence in the wake of offshore wind farm foundations. *Journal of Geophysical Research: Oceans* 125(8).

Siddagangaiah, S., C.-F. Chen, W.-C. Hu, and N. Pieretti. 2021. Impact of pile-driving and offshore windfarm operational noise on fish chorusing. *Remote Sensing in Ecology and Conservation* 8:1–16. Available: https://www.researchgate.net/publication/353472018_Impact_of_pile-driving_and_offshore_windfarm_operational_noise_on_fish_chorusing.

Sigray, P., and M. H. Andersson. 2011. Particle motion measured at an operational wind turbine in relation to hearing sensitivity in fish. *J Acoust Soc Am.* 130(1):200–207. DOI: 10.1121/1.3596464. PMID: 21786890.

Slacum, H. W., W. H. Burton, E. T. Methratta, E. D. Weber, R. J. Llanso, and J. Dew-Baxter. 2010. Assemblage Structure in Shoal and Flat-Bottom Habitats on the Inner Continental Shelf of the Middle Atlantic Bight, USA. *Marine and Coastal Fisheries* 2:1, 277–298. DOI: 10.1577/C09-012.1.

Smith, T. I. J. 1985. The fishery, biology, and management of Atlantic sturgeon, *Acipenser oxyrhynchus*, in North America. *Environ. Biol. Fishes* 14:61–72.

Snyder, D. B., W. H. Bailey, K. Palmquist, B. R. T. Cotts, and K. R. Olsen. 2019. *Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England.* BOEM report 2019-049. Available: https://espis.boem.gov/final%20reports/BOEM_2019-049.pdf.

Solé, M., S. De Vreese, J. Fortuño, M. Schaar, A. Sánchez, and M. André. 2022. Commercial cuttlefish exposed to noise from offshore windmill construction show short-range acoustic trauma. *Environmental Pollution* 312:119853. ISSN 0269-7491. Available: https://doi.org/10.1016/j.envpol.2022.119853.

Stanley, J. A., P. E. Caiger, B. Phelan, K. Shelledy, T. A. Mooney, and S. M. Van Parijs. 2020. Ontogenetic variation in the auditory sensitivity of black sea bass (Centropristis striata) and the implications of anthropogenic sound on behavior and communication. *The Journal of Experimental Biology* 223.

Staudinger, M. D., H. Goyert, J. J. Suca, K. Coleman, L. Welch, J. K. Llopiz, D. Wiley, I. Altman, A. Applegate, P. Auster, H. Baumann, J. Beaty, D. Boelke, L. Kaufman, P. Loring, J. Moxley, S. Paton, K. Powers, D. Richardson, J. Robbins, J. Runge, B. Smith, C. Spiegel, and H. Steinmetz. 2020. The role of sand lances (*Ammodytes* sp.) in the Northwest Atlantic Ecosystem: A synthesis of current knowledge with implications for conservation and management. *Fish and Fisheries* 21(3):522–556. DOI 10.1111/faf.12445.

Stein, B. S., K. D. Friedland, and M. R. Sutherland. 2004. Atlantic sturgeon marine distribution and habitat use along the northeastern coast of the United States. *Transactions of the American Fisheries Society* 133:527–537.

Stöber, U., and F. Thomsen. 2021. How could operational underwater sound from future offshore wind turbines impact marine life? *Journal of the Acoustical Society of America* 149(3):1791–1795.

Tagliabue, A., L. Kwiatkowski, L. Bopp, M. Butenschon, W. Cheung, M. Lengiagne, and J. Vialard. 2021. Persistent uncertainties in ocean net primary production climate change projections at regional scales raise challenges for assessing impacts on ecosystem services. *Frontiers in Climate* 3:738224.

Tamsett, A., K. B. Heinonen, and P. J. Auster. 2010. *Dynamics of hard substratum communities inside and outside of a fisheries habitat closed area in Stellwagen Bank National Marine Sanctuary (Gulf of Maine, NW Atlantic)*. DU.S. Department of Commerce, NOAA. Available: https://nmssanctuaries.blob.core.windows.net/sanctuaries-prod/media/archive/science/conservation/pdfs/tamsett.pdf. Accessed: April 2022.

Taormina B., J. Bald, A. Want, G. Thouzeau, M. Lejart, N. Desroy, and A. Carlier. 2018. "A Review of Potential Impacts of Submarine Cables on the Marine Environment: Knowledge Gaps, Recommendations, and Future Directions." *Renewable and Sustainable Energy Reviews* 96:380–391. Available: https://hal.archives-ouvertes.fr/hal-02405630/document. Accessed: October 11, 2021.

Taylor, A. H. and J. A. Stephens. 1998. The North Atlantic Oscillation and the latitude of the Gulf Stream. *Tellus* 50A:134–142.

Thomsen, F., A. B. Gill, M. Kosecka, M. Andersson, M. André, S. Degraer, T. Folegot, J. Gabriel, A. Judd, T. Neumann, A. Norro, D. Risch, P. Sigray, D. Wood, and B. Wilson. 2015. "MaRVEN—Environmental Impacts of Noise, Vibrations and Electromagnetic Emissions from Marine Renewable Energy." DOI:10.2777/272281. Luxembourg: Publications Office of the European Union, 2015. Available: https://www.researchgate.net/publication/301296662_MaRVEN_-_Environmental_Impacts_of_Noise_Vibrations_and_Electromagnetic_Emissions_from_Marine_Renewable_Energy. Accessed: October 11, 2021.

Tougaard, J., L. Hermannsen, and P. T. Madsen. 2020. How loud is the underwater noise from operating offshore wind turbines? *Journal of the Acoustical Society of America* 148(5):2885–2893.

U.S. Army Corps of Engineers (USACE). 2015. New York and New Jersey Harbor Deepening Project. *Dredge Plume Dynamics in New York/New Jersey Harbor*. Summary of Suspended Sediment Plume Surveys Performed During Harbor Deepening. April 2015. New York.

U.S. Army Corps of Engineers (USACE). 2020. *South Atlantic Regional Biological Opinion for Dredging and Material Placement Activities in the Southeast United States*. 646 pp. Available: https://media.fisheries.noaa.gov/dam-migration/sarbo_acoustic_revision_6-2020-opinion_final.pdf. Accessed: November 16, 2021.

U.S. Environmental Protection Agency (USEPA). 2003. Brayton Point Station Fact Sheet: Final National Pollutant Discharge Elimination System (NPDES) Permit.

U.S. Offshore Wind Synthesis of Environmental Effects Research (SEER). 2022. *Benthic Disturbance from Offshore Wind Foundations, Anchors, and Cables*.

Valenti, J. L., T. M. Grothues, and K. W. Able. 2017. Estuarine Fish Communities along a Spatial Urbanization Gradient. *Journal of Coastal Research* SI 78:254–268.

van Berkel, J., H. Burchard, A. Christensen, L. O. Mortensen, O. S. Petersen, and F. Thomsen. 2020. The effects of offshore wind farms on hydrodynamics and implications for fishes. *Oceanography* 33(4):108–117.

van der Molen, J., H. C. M. Smith, P. Lepper, S. Limpenny, and J. Rees. 2014. Predicting the large-scale consequences of offshore wind turbine array development on a North Sea ecosystem. *Cont. Shelf Res.* 85:60–72.

Vanhellemont, Q., and K. Ruddick. 2014. Turbid wakes associated with offshore wind turbines observed with Landsat 8. *Remote Sensing of Environment* 145:105–115.

Vasslides, J. M. 2007. *Fish assemblages and habitat use across a shoreface sand ridge in southern New Jersey*. M.S. thesis, 106 pp. Rutgers University, New Brunswick, NJ.

Vasslides, J. M., and K. W. Able. 2008. Importance of shoreface sand ridges as habitat for fishes off the northeast coast of the United States. *Fish Bull.* 106:93–107.

Virginia Institute of Marine Science (VIMS). 2000. *Environmental survey of potential sand resources sites, offshore Delaware and Maryland*: Final Report. OCS Study 2000-05. Virginia Institute of Marine Science, College of William and Mary. Available: http://dx.doi.org/doi:10.21220/m2-mtx7-mn42.

Washington State Department of Transportation (WSDOT). 2020. Construction noise impact assessment. In *Biological Assessment Preparation Manual.* August. Available: https://wsdot.wa.gov/sites/default/files/2021-10/Env-FW-BA_ManualCH07.pdf.

Waycott, M., C. M. Duarte, T. J. B. Carruthers, R. J. Orth, W. C. Dennison, S. Olyarnik, A. Calladine, J. W. Fourqurean, K. L Heck, Jr., R. Hughes, G. A. Kendrick, W. J. Kenworthy, F. T. Short, and S. L. Williams. 2022. Accelerated loss of seagrasses across the globe threatens coastal ecosystems. *PNAS* 106(30):12377–12381.

Weilgart, L. 2018. *The Impact of Ocean Noise Pollution on Fish and Invertebrates*. Oceancare and Dalhousie University. Available: https://www.oceancare.org/wp-content/uploads/2017/10/OceanNoise_FishInvertebrates_May2018.pdf. Accessed: September 2021.

Wilber, D. H., and D. G. Clarke. 2007. Defining and Assessing Benthic Recovery Following Dredging and Dredged Material Disposal. Presentation from the 2007 WODCON XVIII Conference in Lake Buena Vista, FL. Available: https://www.westerndredging.org/phocadownload/ConferencePresentations/2007_WODA_Florida/Session3D-EnvironmentalAspectsOfDredging/3%20-%20Wilber%20-%20Defining%20Assessing%20Benthic%20Recovery%20Following%20Dredged%20Material%20Disposal.pdf. Accessed: October 11, 2021.

Woodruff, D. L., I. R. Schultz, K. E. Marshall, J. A. Ward, and V. Cullinan. 2012. *Effects of Electromagnetic Fields on Fish and Invertebrates*. Task 2.1.3: Effects on Aquatic Organisms – Fiscal Year 2011 Progress Report. PNNL-20813, Pacific Northwest National Laboratory, Richland, Washington.

Woodruff, D. L., I. R. Schultz, K. E. Marshall, J. A. Ward, and V. I. Cullinan. 2013. *Effects of Electromagnetic Fields on Fish and Invertebrates*: Task 2.1. 3: Effects on Aquatic Organisms-Fiscal Year 2011 Progress Report- Environmental Effects of Marine and Hydrokinetic Energy (No. PNNL-20813 Final). Pacific Northwest National Laboratory, Richland, Washington.

Zhang, X., H. Guo, J. Chen, K. Xu, J. Lin, and S. Zhang. 2021. Potential effects of underwater noise from wind turbines on the marbled rockfish (Sebasticus marmoratus). *J Appl Ichthyol.* 2021(00):1–9. https://doi.org/10.1111/jai.14198.

B.2.3.14. Section 3.14, Land Use and Coastal Infrastructure

Atlantic City. 2006. Atlantic City Municipal Zoning Boundaries, Atlantic City, NJ. Available: https://www.atlantic-county.org/gis/pdfs/SmartGrowth/ATC_ZoneBuildout.pdf.

Atlantic Shores Offshore Wind (Atlantic Shores). 2021. *Construction and Operations Plan, Atlantic Shores Offshore Wind*. Volume I. September. Available: https://www.boem.gov/renewable-energy/state-activities/atlantic-shores-offshore-wind-construction-and-operations-plan.

Borough of Paulsboro. 2010. Zoning Map, Borough of Paulsboro. Available: https://taxmaps.info/docs/zoning/0814_Zoning_Map.pdf.

City of Charleston. 2012. Interactive Zoning Map. Available: https://gis.charleston-sc.gov/interactive/zoning/.

City of Elizabeth. 2000. Zone Map. Available: https://elizabethnj.org/DocumentCenter/View/1351/Elizabeth-Zoning-Map-?bidId=.

City of Norfolk. 2021. Zoning Ordinance. Available: https://www.norfolk.gov/DocumentCenter/View/35581/Adopted-Zoning-Ordinance?bidId=.

Kleiner, A. 2021. Island Beach State Park and Sea Level Rise. December 19. Available: https://storymaps.arcgis.com/stories/b02bf0aaef62464ab17b5d8621d7497c. Accessed: October 7, 2022.

New Jersey Department of Environmental Protection (NJDEP). 2015. Land Use/Land Cover 2012 Update (Generalized), Edition 20150217 (Land_lu_2012_gen). Available: https://njdep.maps.arcgis.com/apps/webappviewer/index.html?id=02251e521d97454aabadfd8cf168e44d. Accessed: March 30, 2022.

New Jersey Pinelands Commission. 2021. Pinelands Interactive Map. Available: https://njpines.maps.arcgis.com/apps/webappviewer/index.html?id=28ef313eb49f4e8f96ca249d871d06fe. Accessed: October 18, 2021.

New Jersey Pinelands Commission. 2022. Pinelands Comprehensive Management Plan. Available: https://www.nj.gov/pinelands/cmp/CMP.pdf.

New Jersey Wind Port. 2021. "About the New Jersey Wind Port." Available: https://nj.gov/windport/about/index.shtml. Accessed: July 16, 2021.

Ocean City. 2014. Zoning Map. Available: https://imageserv11.team-logic.com/mediaLibrary/242/Zoning_Map_eff_10_15_14.pdf.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Parsons, George, and Jeremy Firestone. 2018. *Atlantic Offshore Wind Energy Development: Values and Implications for Recreation and Tourism*. U.S. Department of the Interior, Bureau of Ocean Energy Management. Available: https://www.semanticscholar.org/paper/Atlantic-Offshore-Wind-Energy-Development%3A-Values-Parsons-Firestone/91b0ede146b8701cb44d72c58f09b29533df3cdf.

State of New Jersey. 2020. Governor Murphy Announces $250 Million Total Investment in State-of-the-Art Manufacturing Facility to Build Wind Turbine Components to Serve Entire U.S. Offshore Wind Industry. December 21. Available: https://www.nj.gov/governor/news/news/562020/20201222a.shtml. Accessed: July 22, 2021.

Township of Lacey. 2009. Part II, General Legislation / Zoning: Article IX: Zone Regulations. § 335-65.1 M-100 Industrial Zone. Added 12-22-2009 by Ord. No. 2009-23. Available: https://ecode360.com/14253903.

Township of Lower Alloways Creek. 2014. Zoning Map. Available: https://www.lowerallowayscreek-nj.gov/sites/g/files/vyhlif3381/f/uploads/p_28000-28499_28081.00_cadd_dwg_28081.00_zoning_map_color_1.pdf.

Township of Upper. 2020. Chapter 20: Zoning. § 20-4.22 "WTC" Waterfront Town Center. Added 5-26-2020 by Ord. No. 005-2020. Available: https://ecode360.com/36660451.

Township of Upper. 2021. Zoning Map. Available: https://uppertownship.com/wp-content/uploads/2021/08/UT-Zoning-Map-2021.pdf.

U.S. Army Corps of Engineers (USACE). No date. Charleston District. Charleston Harbor Post 45 Overview. Available: https://www.sac.usace.army.mil/Missions/Civil-Works/Charleston-Harbor-Post-45/

U.S. Army Corps of Engineers (USACE). 2021. *Newark Bay, New Jersey Federal Navigation Project Maintenance Dredging*. Public Notice No. Newark Bay, NJ FY21. May.

U.S. Fish and Wildlife Service (USFWS). 2014. John H. Chafee Coastal Barrier Resources System, Island Beach Unit NJ-05P. Available: https://www.fws.gov/cbra/maps/effective/34-006A.pdf. Accessed: March 30, 2022.

U.S. Fish and Wildlife Service (USFWS). 2021. FWS National Realty Approved Acquisition Boundaries. Available: https://www.arcgis.com/home/item.html?id=dae48a3dcd654e7ea09d386cae052eab. Accessed: March 30, 2022.

U.S. National Park Service (USNPS). 2016. Great Egg Harbor River. Available: https://www.nps.gov/greg/index.htm. Accessed: April 1, 2022.

Virginia Port Authority. 2021. Dredging to Make Virginia the East Coast's Deepest Port is Underway. Port of Virginia Press Release. Contact Joseph D. Harris. Available: https://www.portofvirginia.com/who-we-are/newsroom/dredging-to-make-virginia-the-east-coasts-deepest-port-is-underway/. Accessed: July 22, 2021.

B.2.3.15. Section 3.15, Marine Mammals

Allen, M. C., A. J. Read, J. Gaudet, and L. S. Sayigh. 2001. Fine-scale habitat selection of foraging bottlenose dolphins Tursiops truncates near Clearwater, Florida. *Marine Ecology Progress Series* 222:253–264.

Arveson, P., and D. Vendittis. 2000. Radiated noise characteristics of a modern cargo ship. *Journal of the Acoustical Society of America* 2000(107):118–129.

Atlantic Shores Offshore Wind (Atlantic Shores). 2021. *Construction and Operations Plan, Atlantic Shores Offshore Wind*. Volume I. September. Available: https://www.boem.gov/renewable-energy/state-activities/atlantic-shores-offshore-wind-construction-and-operations-plan.

Atlantic Shores Offshore Wind (Atlantic Shores). 2022. *Application for Marine Mammal Protection Act (MMPA) Rulemaking and Letter of Authorization*. September.

Au, W. W. L., and M. C. Hastings. 2008. *Principles of Marine Bioacoustics*. New York: Springer.

Austin, M. E., D. E. Hannay, and K. C. Bröker. 2018. Acoustic characterization of exploration drilling in the Chukchi and Beaufort seas. *Journal of the Acoustical Society of America* 144:115–123. DOI: 10.1121/1.5044417.

Azzara, A., W. M. von Zharen, and J. Newcomb. 2013. Mixed-methods analytic approach for determining potential impacts of vessel noise on sperm whale click behavior. *Journal of the Acoustical Society of America*. 2013(136):4566–4574. October.

Balcomb, K. C., and D. E. Claridge. 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. *Bahamas J. Sci.* 8:1–12.

Baulch, S., and C. Perry. 2014. Evaluating the impacts of marine debris on cetaceans. *Marine Pollution Bulletin* 80:210–221.

Bejarano, Adriana, Jacqueline Michel, Jill Rowe, Zhengkai Li, Deborah French McCay, and Dagmar Schmidt Etkin. 2013. *Environmental Risks, Fate, and Effects of Chemicals Associated with Wind Turbines on the Atlantic Outer Continental Shelf*. OCS Study BOEM 2013-213.

Bellmann, M. A., A. May, T. Wendt, S. Gerlach, P. Remmers, and J. Brinkmann. 2020. *Underwater noise during percussive pile driving: Influencing factors on pile-driving noise and technical possibilities to comply with noise mitigation values*. Supported by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (BMU)), FKZ UM16 881500. Commissioned and managed by the Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie (BSH)), Order No. 10036866. Edited by the itap GmbH. Available: https://www.itap.de/media/experience_report_underwater_era-report.pdf.

Benhemma-Le Gall, A., I. Graham, N. Merchant, and P. Thompson. 2021. Broad-Scale Responses of Harbor Porpoises to Pile-Driving and Vessel Activities During Offshore Windfarm Construction. *Frontiers in Marine Science* 8:664724. DOI: 10.3389/fmars.2021.664724.

Benjamins, S., V. Harnois, H. C. M. Smith, L. Johanning, L. Greenhill, C. Carter, and B. Wilson. 2014. *Understanding the potential for marine megafauna entanglement risk from marine renewable energy developments*. Scottish Natural Heritage Commissioned Report No. 791.

Bilinski, J. 2021. *Review of the Impacts to Marine Fauna from Electromagnetic Frequencies (EMF) Generated by Energy Transmitted through Undersea Electric Transmission Cables*. NJDEP Division of Science and Research. Available: https://www.nj.gov/dep/offshorewind/docs/njdep-marine-fauna-review-impacts-from-emf.pdf.

Blackwell, S. B., C. S. Nations, A. M. Thode, M. E. Kauffman, A. S. Conrad, R. G. Norman, and K. H. Kim. 2017. Effects of tones associated with drilling activities on bowhead whale calling rates. *PLOS ONE* 12(11):e0188459. Available: https://doi.org/10.1371/journal.pone.0188459.

Blackwell, S. B., C. S. Nations, T. L. McDonald, C. R. Greene, A. M. Thode, M. Guerra, and A. M. Macrander. 2013. Effects of airgun sounds on bowhead whale calling rates in the Alaskan Beaufort Sea. *Marine Mammal Science* 29(4):E342-E365. DOI:10.1111/mms.12001.

Blackwell, S. B., C. S. Nations, T. L. McDonald, A. M. Thode, D. Mathias, K. H. Kim, C. R. Greene, and A. M. Macrander. 2015. Effects of Airgun Sounds on Bowhead Whale Calling Rates: Evidence for Two Behavioral Thresholds. *PLOS ONE* 10(6): e0125720. DOI:10.1371/journal.pone.0125720.

Brandt, M. J., A. Diederichs, K. Betke, and G. Nehls. 2011. Responses of harbour porpoises to pile driving at the Horns Rev II offshore wind farm in the Danish North Sea. *Marine Ecology Progress Series* 421(2011):205–216.

Brandt, M. J., A. Dragon, A. Diederichs, A. Schubert, V. Kosarev, G. Nehls, V. Wahl, A. Michalik, A. Braasch, C. Hinz, C. Ketzer, D. Todeskino, M. Gauger, M. Laczny, and W. Piper. 2016. *Effects of offshore pile driving on harbour porpoise abundance in the German Bight: Assessment of Noise Effects Final Report.* Prepared for Offshore Forum Windenergie. June.

Branstetter, B. K, V. F. Bowman, and D. S. Houser. 2018. Effects of Vibratory pile driver noise on echolocation and vigilance in bottlenose dolphins (Tursiops truncates). *The Journal of Acoustical Society of America* 143:429. DOI: 10.1121/1.5021555.

Broström, G. 2008. On the influence of large wind farms on the upper ocean circulation. *J. Mar. Syst.* 74:585–591. DOI: 10.1016/j.jmarsys.2008.05.001.

Brown, D. M., P. L. Sieswerda, and E. C. M. Parsons. 2019. Potential encounters between humpback whales (*Megaptera novaeangliae*) and vessels in the New York Bight apex, USA. *Marine Policy* 106:103527.

Browne, M. A., A. J. Underwood, M. G. Chapman, R. Williams, R. C. Thompson, and J. A. van Franeker. 2015. "Linking Effects of Anthropogenic Debris to Ecological Impacts." *Proceedings of the Royal Society* B 282:20142929.

Bryant P. J., C. M. Lafferty, and S. K. Lafferty. 1984. 15 - Reoccupation of Laguna Guerrero Negro, Baja California, Mexico, by Gray Whales. In: Mary Lou Jones, Steven L. Swartz, Stephen Leatherwood (eds.), *The Gray Whale: Eschrichtius Robustus*, Academic Press. Pages 375–387. Available: https://doi.org/10.1016/B978-0-08-092372-7.50021-2.

Buckstaff, Kara. 2004. Effects of Watercraft Noise on the Acoustic Behavior of Bottlenose Dolphins, Tursiops Truncatus, in Sarasota Bay, Florida. *Marine Mammal Science* 20(4):709–725.

Bureau of Ocean Energy Management (BOEM). 2014. *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts: Revised Environmental Assessment*. Office of Renewable Energy Programs. OCS EIS/EA BOEM 2014-603. Available: https://www.boem.gov/sites/default/files/renewable-energyprogram/State-Activities/MA/Revised-MA-EA-2014.pdf.

Bureau of Ocean Energy Management (BOEM). 2021a. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement, Volume 1*. OCS EIS/EA BOEM 2021-0012.

Bureau of Ocean Energy Management (BOEM). 2021b. *South Fork Wind Farm and South Fork Export Cable Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2020-057. Available: https://www.boem.gov/renewable-energy/state-activities/sfwf-feis.

Bureau of Ocean Energy Management (BOEM). 2021c. *Project Design Criteria and Best Management Practices for Protected Species Associated with Offshore Wind Data Collection*. Revised November 22, 2021. Available: https://www.boem.gov/sites/default/files/documents//PDCs%20and%20BMPs%20for%20Atlantic%20Data%20Collection%2011222021.pdf.

Carpenter, J. R., L. Merckelbach, U. Callies, S. Clark, L. Gaslikova, and B. Baschek. 2016. *Potential Impacts of Offshore Wind Farms on North Sea Stratification*. *PLOS ONE* 11:e0160830. DOI: 10.1371/journal.pone.016 0830.

Castellote, M., C. W. Clark, and M. O. Lammers. 2012. Acoustic and behavioral changes by fin whales (Balaenoptera physalus) in response to shipping and airgun noise. *Biological Conservation* 157:115–122. DOI: 10.1016/j.biocon.2011.12.021.

Cerchio, S., S. Strindberg, T. Collins, C. Bennett, and H. Rosenbaum. 2014. Seismic surveys negatively affect humpback whale singing activity off northern Angola. *PLOS ONE* 9(3):e86464. DOI:10.1371/journal.pone.0086464.

Cholewiak, D., A. I. DeAngelis, D. Palka, P. J. Corkeron, and S. M. Van Parijs. 2017. "Beaked Whales Demonstrate a Marked Acoustic Response to the Use of Shipboard Echosounders." *R Soc Open Sci* 4(12):170940. DOI: https://doi.org/10.1098/rsos.170940. Available: https://www.ncbi.nlm.nih.gov/pubmed/29308236.

Christiansen, N., U. Daewel, B. Djath, and C. Schrum. 2022. Emergence of Large-Scale Hydrodynamic Structures Due to Atmospheric Offshore Wind Farm Wakes. *Front. Mar. Sci.* 9:818501. DOI: 10.3389/fmars.2022.818501.

Clark, C. W., W. T. Ellison, B. L. Southall, L. Hatch, S. M. Van Parijs, A. Frankel, and D. Ponirakis. 2009. Acoustic masking in marine ecosystems: institutions, analysis, and implication. *Marine Ecology Progress Series* 395:201–222. DOI: 10.3354/meps08402.

Conn, P. B., and G. K. Silber. 2013. Vessel speed restrictions reduce risk of collision mortality for North Atlantic right whales. *Ecosphere* 4.4 (2013):1–16.

Conserve Wildlife Foundation of New Jersey (CWF). 2023. Harbor Seals in New Jersey. Available: https://conservewildlife.maps.arcgis.com/apps/MapJournal/index.html?appid=d2266f32c36449e0b9630453e56c3888&webmap=564588c5cff04fa990aab644400475f9.

Corkeron, P., P. Hamilton, J. Bannister, P. Best, C. Charlton, K. R. Groch, K. Findlay, V. Rowntree, E. Vermeulen, and R. M. Pace. 2018. The recovery of North Atlantic right whales, Eubalaena glacialis, has been constrained by human-caused mortality. *Royal Society Open Science* 5:180892.

Costello, C., L. Cao, S. Gelcich, M. A. Cisneros-Mata, C. M. Free, H. E. Froehlich, C. D. Golden, G. Ishimura, J. Maier, I. Macadam-Somer, T. Mangin, M. C. Melnychuk, M. Miyahara, C. L. de Moor, R. Naylor, L. Nøstbakken, E. Ojea, E. O'Reilly, A. M. Parma, A. J. Plantinga, S. H. Thilsted, and J. Lubchenco. 2020. The future of food from the sea. *Nature*. 588:95–100.

Cox, T. M., T. J. Ragen, A. J. Read, E. Vos, R. W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'Amico, G. D'Spain, A. Fernández, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hildebrand, D. Houser, T. Hullar, P. D. Jepson, D. Ketten, C. D. MacLeod, P. Miller, S. Moore, D. Mountain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead, and L. Benner. 2006. Understanding the impacts of anthropogenic sound on beaked whales. *J. Cetacean Res. Manage.* 7(3):177–187.

Cranford, T. W., and P. Krysl. 2015. Fin Whale Sound Reception Mechanisms: Skull Vibration Enables Low-Frequency Hearing. *PLOS ONE* 10(1): e0116222.

Crocker, S. E., and F. D. Fratantonio. 2016. *Characteristics of Sounds Emitted During High-Resolution Marine Geophysical Surveys*. NUWC-NPT Technical Report 12,203. Report by Naval Undersea Warfare Center Division, Newport, RI, USA. 266 p. Available: https://apps.dtic.mil/dtic/tr/fulltext/u2/1007504.pdf.

CSA Ocean Sciences, Inc. 2021. *Assessment of Impacts to Marine Mammals, Sea Turtles, and Sturgeon*. Appendix P1 in Construction and Operations Plan South Fork Wind Farm. Stuart, Florida.

D'Amico, A. D., R. C. Gisiner, D. R. Ketten, J. A. Hammock, C. Johnson, P. L. Tyack, and J. Mead. 2009. Beaked whale strandings and naval exercises. *Aquatic Mammals* 35:452–472.

Dahlheim, M. E., and D. K. Ljungblad. 1990. Preliminary hearing study on gray whales (*Eschrichtius robustus*) in the field. In: J. A. Thomas, editor; and R. A. Kastelein, editor, *Sensory Abilities of Cetaceans/Laboratory and Field Evidence*. Plenum, New York. pp. 335–346.

Dahne, M., J. Tougaard, J. Carstensen, A. Rose, and J. Nabe-Nielsen. 2017. Bubble curtains attenuate noise from offshore wind farm construction and reduce temporary habitat loss for harbour porpoises. *Marine Ecology Progress Series* 580:221–237. Available: https://doi.org/10.3354/meps12257.

Dam, M., and D. Bloch. 2000. Screening of mercury and persistent organochlorine pollutants in long-finned pilot whale (*Globicephala melas*) in the Faroe Islands. *Marine Pollution Bulletin* 40(12):1090–1099.

Davis, G. E., M. F. Baumgartner, J. M. Bonnell, J. Bell, C. Berchok, J. B. Thornton, S. Brault, G. Buchanan, R. A. Charif, D. Cholewiak, and C. W. Clark. 2017. Long-term passive acoustic recordings track the changing distribution of North Atlantic right whales (*Eubalaena glacialis*) from 2004 to 2014. *Scientific Reports* 7:13460.

Davis, G. E., M. F. Baumgartner, P. J. Corkeron. 2020. Exploring movement patterns and changing distributions of baleen whales in the western North Atlantic using a decade of passive acoustic data. *Global Change Biology* 26:4812–4840.

Degraer, S., D. Carey, J. Coolen, Z. Hutchison, F. Kerckhof, B. Rumes, and J. Vanaverbeke. 2020. Offshore Wind Farm Artificial Reefs Affect Ecosystem Structure and Functioning: A Synthesis. *Oceanography* 33(4):48–57.

Denes, S. L., D. G. Zeddies, and M. M. Weirathmueller. 2021. *Turbine Foundation and Cable Installation at South Fork Wind Farm: Underwater Acoustic Modeling of Construction Noise*. Appendix J1 in Construction and Operations Plan South Fork Wind Farm. Silver Spring, Maryland: JASCO Applied Sciences.

Di Iorio, L., and C. W. Clark. 2010. Exposure to seismic survey alters blue whale acoustic communication. *Biology Letters* 6(1):51–54.

Diederichs, A., M. Brandt, and G. Nehls. 2010. Does sand extraction near Sylt affect harbour porpoises? *Wadden Sea Ecosystem* 26:199–203.

Discovery of Sound in the Sea (DOSITS). 2019. Homepage. Available: https://dosits.org/.

Dolman,, S. J., E. Pinna, R. J. Reid, J. P. Barleya, R. Deaville, P. D. Jepson, M. O'Connell, S. Berrow, R. S. Penrose, P. T. Stevick, S. Calderan, K. P. Robinson, R. A. Brownell, Jr., M. P. and Simmonds. 2010. A note on the unprecedented strandings of 56 deep-diving whales along the UK and Irish coast. *Marine Biodiversity Records* 3:e16.

Dolman, S., V. Williams-Grey, R. Asmutis-Silvia, and S. Isaac. 2006. *Vessel collisions and cetaceans: what happens when they don't miss the boat*. A WDCS Science Report.

Dominion Energy. 2022a. *Coastal Virginia Offshore Wind Commercial Project, Request for Rulemaking and Letter of Authorization for Taking of Marine Mammals Incidental to Construction Activities on the Outer Continental Shelf within Lease OCS-A 0483 and the Associated Offshore Export Cable Route Corridor.*

Dominion Energy. 2022b. *Coastal Virginia Offshore Wind Commercial Project, Construction and Operations Plan.* May. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Public_Sec%201-3.pdf.

Dorrell, R. M., C. J. Lloyd, B. J. Lincoln, T. P. Rippeth, J. R. Taylor, C. C. P. Caulfield, J. Sharples, J. A. Polton, B. D. Scannell, D. M. Greaves, R. A. Hall, and J. H. Simpson. 2022. Anthropogenic Mixing in Seasonally Stratified Shelf Seas by Offshore Wind Farm Infrastructure. *Front. Mar. Sci.* 9:830927. DOI: 10.3389/fmars.2022.830927.

Dunlop, R. A., M. J. Noad, R. D. McCauley, L. Scott-Hayward, E. Kniest, R. Slade, D. Paton, and D. H. Cato. 2017. Determining the behavioural dose-response relationship of marine mammals to air gun noise and source proximity. *Journal of Experimental Biology* 220(16):2878–2886. Available: https://doi.org/10.1242/jeb.160192.

Elliot, J., K. Smith, D. R. Gallien, and A. Khan. 2017. *Observing Cable Laying and Particle Settlement During the Construction of the Block Island Wind Farm*. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2017-027. 225 pp. Available: https://tethys.pnnl.gov/sites/default/files/publications/Elliot-et-al-2017.pdf. Accessed: August 28, 2020.

Elliott, J., A. A. Khan, L. Ying-Tsong, T. Mason, J. H. Miller, A. E. Newhall, G. R. Potty, and K. J. Vigness-Raposa. 2019. *Field Observations during Wind Turbine Operations at the Block Island Wind Farm, Rhode Island*. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019-028. Available: https://espis.boem.gov/final%20reports/BOEM_2019-028.pdf.

Empire Offshore Wind, LLC (Empire). 2022. *Empire Offshore Wind: Empire Wind Project (EW1 and EW2), Construction and Operations Plan*. May. Available: https://www.boem.gov/renewable-energy/empire-wind-construction-and-operations-plan.

Erbe, C. 2013. International Regulation of Underwater Noise. Acoustics Australia 41(1):12–19. Available: https://search.ebscohost.com/login.aspx?direct=true&db=asx&AN=90475142&site=eds-live.

Erbe, C., A. MacGillivray, and R. Williams. 2012. Mapping cumulative noise from shipping to inform marine spatial planning. *The Journal of the Acoustical Society of America* 132:EL423–EL428.

Erbe, C., C. Reichmuth, K. Cunningham, K. Lucke, and R. Dooling. 2016. Communication masking in marine mammals: A review and research strategy. *Marine Pollution Bulletin* 103:15–38.

Erbe, C., S. A. Marley, R. P. Schoeman, J. N. Smith, L. E. Trigg, and C. B. Embling. 2019. The Effects of Ship Noise on Marine Mammals—A Review. *Frontiers in Marine Science* 6:606. DOI: 10.3389/fmars.2019.00606.

Evans, P. G., and A. Bjørge. 2013. Impacts of climate change on marine mammals. *Marine Climate Change Impacts Partnership Science Review 2013*:134–148.

Evans, P., and J. Waggitt. 2020. Impacts of climate change on marine mammals, relevant to the coastal and marine environment around the UK. *Marine Climate Change Impacts Partnership Science Review* 2020:421–455. DOI: 10.14465/2020.arc19.mmm.

Exponent Engineering, P.C. 2018. *Deepwater Wind South Fork Wind Farm Onshore Electric and Magnetic Field Assessment*. Appendix K2 in Construction and Operations Plan South Fork Wind Farm. New York, New York: Exponent Engineering, P.C.

Fernández, A., J. F. Edwards, F. Rodríguez, A. Espinosa de los Monteros, P. Herráez, P. Castro, J. R. Jaber, V. Martín, and M. Arbelo. 2005. ‘Gas and fat embolic syndrome’ involving a mass stranding of beaked whales (family Ziphiidae) exposed to anthropogenic sonar signals. *Vet. Pathol.* 42:446–457.

Finley, K. J. 1990. *The Impacts of Vessel Traffic on the Behavior of Belugas.* International Forum for the Future of the Beluga. pgs. 113–140.

Finneran, J. J. 2015. Noise-induced hearing loss in marine mammals: A review of temporary threshold shift studies from 1996–2015. *The Journal of the Acoustical Society of America* 138(3):1702–1726.

Gerstein, E., J. Blue, and S. Forsythe. 2006. Ship strike acoustics: A paradox and parametric solution. *Journal of the Acoustical Society of America* 119(5):3289–3289.

Gill, A. B., I. Gloyne-Phillips, K. J. Neal, and J. A. Kimber. 2005. *The Potential Effects of Electromagnetic Fields Generated by Sub-Sea Power Cables Associated with Offshore Wind Farm Developments on Electrically and Magnetically Sensitive Marine Organisms – A Review*. Report No. COWRIE-EM FIELD 2-06-2004. Final report. Prepared for Collaborative Offshore Wind Energy Research Into the Environment. Cranfield University and the Centre for Marine and Coastal Studies Ltd.

Graham, I. M., E. Pirotta, N. D. Merchant, A. Farcas, T. R. Barton, B. Cheney, G. D. Hastie, and P. M. Thompson. 2017. Responses of bottlenose dolphins and harbor porpoises to impact and vibration piling noise during harbor construction. *Ecosphere* 8(5):e01793. DOI: 10.1002/ecs2.1793.

Grashorn, S., and E. V. Stanev. 2016. Kármán vortex and turbulent wake generation by wind park piles. *Ocean Dyn*. 66:1543–1557. DOI: 10.1007/s10236-016-0995-2.

Gray, L., and D. Greeley. 1980. Source level model for propeller blade rate radiation for the world's merchant fleet. *Journal of the Acoustical Society of America* 67:516–522.

Guerra, M., S. M. Dawson, T. E. Brough, and W. J. Rayment. 2014. Effects of boats on the surface of an endangered population of bottlenose dolphins. *Endangered Species Research* 24:221–236. DOI: 10.3354/esr00598.

Hall, A. J., B. J. McConnell, L. H. Schwacke, G. M. Ylitalo, R. Williams, and T. K. Rowles. 2018. Predicting the effects of polychlorinated biphenyls on cetacean populations through impacts on immunity and calf survival. *Environmental Pollution* 233:407–418.

Hannay, D., and M. Zykov. 2022. *Underwater acoustic modeling of detonations of unexploded ordnance (UXO) for Ørsted wind farm construction, US East Coast*. Document 02604, Version 3.0. Report by JASCO Applied Sciences for Ørsted.

Harnois, V., H. C. Smith, S. Benjamins, and L. Johanning. 2015. Assessment of entanglement risk to marine megafauna due to offshore renewable energy mooring systems. *International Journal of Marine Energy* 11:27–49.

Hastie, G., B. Wilson, and L. Tufft. 2003. Bottlenose Dolphins Increase Breathing Synchrony in Response to Boat Traffic. *Marine Mammal Science* 19(1):74–84.

Hayes, S. A., E. Josephson, K. Maze-Foley, and P. E. Rosel. 2020. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2019*. NOAA Tech Memo NMFS-NE 264.

Hayes, S. A., E. Josephson, K. Maze-Foley, P. E. Rosel, and J. Turek. 2021. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2020*. NOAA Tech Memo NMFS-NE 271.

Hayes, S. A., E. Josephson, K. Maze-Foley, P. E. Rosel, and J. Wallace. 2022a. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2021*. NOAA Tech Memo NMFS-NE 288. May 2022.

Hayes, S. A., E. Josephson, K. Maze-Foley, P. E. Rosel, and J. Wallace. 2022b. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2022. Draft*. June 2022.

Heinis, F., C. de Jong, M. Ainslie, W. Borst, and T. Vellinga. 2013. Monitoring programme for the Maasvlakte 2, Part III - The effects of underwater sound. *Terra et Aqua* 132:2132.

Hoffman, Christopher A. 2012. Mitigating Impacts of Underwater Noise From Dredging on Beluga Whales in Cook Inlet, Alaska. *Adv Exp Med Biol.* 2012;730:617–619. DOI: 10.1007/978-1-4419-7311-5_140. PMID: 22278577.

Holt, M. M., D. P. Noren, V. Veirs, C. K. Emmons, and S. Veirs. 2009. Speaking up: Killer whales (Orcinus orca) increase their call amplitude in response to vessel noise. *The Journal of the Acoustical Society of America* 125(1):EL27–EL32. Available: https://doi.org/10.1121/1.3040028.

Holt, M. M., J. B. Tennessen, M. Bradley Hanson, C. K. Emmons, D. A. Giles, J. T. Hogan, and M. J. Ford. 2021. Vessels and their sounds reduce prey capture effort by endangered killer whales (Orcinus orca). *Marine Environmental Research* 170 (2021):105429. Available: https://doi.org/10.1016/j.marenvres.2021.105429.

Houser D. S., R. Howard, and S. Ridgway. 2001. Can diving-induced tissue nitrogen supersaturation increase the chance of acoustically driven bubble growth in marine mammals? *Journal of Theoretical Biology* 213:183–195.

Inspire Environmental (Inspire). 2019. *Sediment Profile and Plan View Imaging Benthic Assessment Survey in Support of the South Fork Wind Farm Site Assessment*. Appendix N in Construction and Operations Plan South Fork Wind Farm. Newport, Rhode Island: Inspire Environmental.

Jansen, E., and C. de Jong. 2016. Underwater noise measurements in the North Sea in and near the Princess Amalia Wind Farm in operation. 45th International Congress and Exposition on Noise Control Engineering: Towards a Quieter Future, INTER-NOISE 2016. 21 August 2016 through 24 August 2016, 7846–7857.

JASCO Applied Sciences (JASCO). 2011. *Underwater Acoustics: Noise and the Effects on Marine Mammals*. A Pocket Handbook, 3rd Ed. Available: http://oalib.hlsresearch.com/PocketBook%203rd%20ed.pdf.

JASCO Applied Sciences Inc. (JASCO). 2022a. *Distance to behavioral threshold for vibratory pile driving of sheet piles*. Technical Memorandum by JASCO Applied Sciences for Ocean Wind LLC. March 21.

JASCO Applied Sciences Inc. (JASCO). 2022b. New England Wind Offshore Wind Farm Application for Marine Mammal Protection Act (MMPA) Rulemaking and Letter of Authorization. July. Available: https://media.fisheries.noaa.gov/2022-08/NewEnglandWind_2023LOA_App_OPR1_508.pdf.

Jensen, A. S., G. K. Silber, and J. Calambokidis. 2003. Large whale ship strike database. U.S. Department of Commerce (p. 37). NOAA Technical Memorandum. NMFS-ORP. Available: https://repository.library.noaa.gov/view/noaa/23127/noaa_23127_DS1.pdf.

Jepson, P. D., M. Arbelo, R. Deaville, I. A. P. Patterson, P. Castro, J. R. Baker, E. Degollada, H. M. Ross, P. Herraez, A. M. Pocknell, F. Rodriguez, F. E. Howie, A. Espinosa, R. J. Reid, J. R. Jaber, V. Martin, A. A. Cunningham, and A. Fernández. 2003. Gas-bubble lesions in stranded cetaceans. *Nature* 425:575–576.

Jepson, P. D., R. Deaville, L. J. Barber, A. Aguilar, A. Borrell, S. Murphy, J. Barry, A. Brownlow, J. Barnett, S. Berrow, and A. A. Cunningham. 2016. PCB pollution continues to impact populations of orcas and other dolphins in European waters. *Scientific reports* 6(1):1–17.

Johansson T., and M. Andersson. 2012. *FOI Ambient Underwater Noise Levels at Norra Midsjöbanken during Construction of the Nord Stream Pipeline*. FOI Report.

Johnson, A., G. Salvador, J. Kenney, J. Robbins, S. Kraus, S. Landry, and P. Clapham. 2005. “Fishing Gear Involved in Entanglement of Right and Humpback Whales.” *Marine Mammal Science* 21(4):635–645.

Johnson, S. R., W. J. Richardson, S. B. Yazvenko, S. A. Blokhin, G. Gailey, M. R. Jenkerson, S. K. Meier, H. R. Melton, M. W. Newcomer, A. S. Perlov, S. A. Rutenko, B. Wursig, C. R. Martin, and D. E. Egging. 2007. A western gray whale mitigation and monitoring program for a 3-D seismic survey, Sakhalin Island, Russia. *Environ Monit Assess* 134:1–19. DOI 10.1007/s10661-007-9813-0.

Josephson, E., F. Wenzel, and M. C. Lyssikatos. 2021. *Serious injury determinations for small cetaceans and pinnipeds caught in commercial fisheries off the Northeast US coast, 2014–2018*. US Department of Commerce, Northeast Fisheries Science Center Reference Document 21-04. Washington, DC: US Department of Commerce.

Kastelein, R. A., L. A. E. Huijser, S. Cornelisse, L. Helder-Hoek, N. Jennings, and C. A. F. de Jong. 2019. Effect of Pile-Driving Playback Sound Level on Fish-Catching Efficiency in Harbor Porpoises (Phocoena phocoena). *Aquatic Mammals* 45(4):398–410. DOI 10.1578/AM.45.4.2019.398.

Kates Varghese, H., J. Miksis-Olds, N. DiMarzio, K. Lowell, E. Linder, L. Mayer, and D. Moretti. 2020. “The Effect of Two 12 Khz Multibeam Mapping Surveys on the Foraging Behavior of Cuvier's Beaked Whales Off of Southern California.” *J Acoust Soc Am* 147(6):3849. DOI: https://doi.org/10.1121/10.0001385. Available: https://www.ncbi.nlm.nih.gov/pubmed/32611139.

Kates Varghese, Hilary, Kim Lowell, Jennifer Miksis-Olds, Nancy DiMarzio, David Moretti, and Larry Mayer. 2021. “Spatial Analysis of Beaked Whale Foraging During Two 12 Khz Multibeam Echosounder Surveys.” *Frontiers in Marine Science* 8. DOI: https://doi.org/10.3389/fmars.2021.654184.

Kellar, N. M., T. R. Speakman, C. R. Smith, S. M. Lane, B. C. Balmer, M. L. Trego, K. N. Catelani, M. N. Robbins, C. D. Allen, R. S. Wells, E. S. Zolman, T. K. Rowles, and L. H. Schwacke. 2017. “Low Reproductive Success Rates of Common Bottlenose Dolphins Tursiops truncatus in the Northern Gulf of Mexico Following the Deepwater Horizon Disaster (2010–2015).” *Endangered Species Research* 33:143–158.

Ketten, D. R. 1991. The marine mammal ear: specializations for aquatic audition and echolocation. Pp. 717–750 in: Webster. D., R. Fay, and A. Popper (Eds), *The Biology of Hearing*. Berlin: Springer-Verlag.

Ketten, D. R. 1998. *Marine Mammal Auditory Systems: A Summary of Audiometric and Anatomical Data and its Implications for Underwater Acoustic Impacts*. NOAA Tech Memo NMFS: NOAA-TM-NMFS-SWFSC-256.

Ketten, D. R. and D. C. Mountain. 2011. *Final Report: Hearing in Minke Whales*. Joint Industry Program. 26 pp.

Ketten, D. R., and D. C. Mountain. 2014. Inner ear frequency maps: First stage audiograms of low to infrasonic hearing in mysticetes. Presentation at ESOMM 2014, Amsterdam, Netherlands in Southall, B. L., J. J. Finneran, C. Reichmuth, P. E. Nachtigall, D. R. Ketten, A. E. Bowles, W. T. Ellison, D. P. Nowacek, and P. L. Tyack. 2019. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. *Aquatic Mammals* 2019, 45(2):125–232. DOI 10.1578/AM.45.2.2019.125.

Kilfoyle, A. K., R. F. Jermain, M. R. Dhanak, J. P. Huston, and R. E. Speiler. 2018. Effects of EMF emissions from undersea electric cables on coral reef fish. *Bioelectromagnetics* 39:35–52.

Knowlton, A. R., P. K. Hamilton, M. K. Marx, H. P. Pettis, and S. D. Kraus. 2012. Monitoring North Atlantic right whale Eubalaena glacialis entanglement rates: A 30 year retrospective. *Marine Ecology Progress Series* 466:293–302.

Küsel, E. T., M. J. Weirathmueller, K. E. Zammit, S. J. Welch, K. E. Limpert, and D. G. Zeddies. 2022. *Underwater Acoustic and Exposure Modeling*. Document 02109, Version 1.0 DRAFT. Technical report by JASCO Applied Sciences for Ocean Wind LLC.

Laist D. W., A. R. Knowlton, and D. Pendleton. 2014. Effectiveness of mandatory vessel speed limits for protecting North Atlantic Right whales. *Endangered Species Research* 23:133–147.

Laist, D. W., A. R. Knowlton, J. G. Mead, A. S. Collet, and M. Podesta. 2001. Collisions between ships and whales. *Marine Mammal Science* 17(1):35–75.

Learmonth, J. A., C. D. MacLeod, M. B. Santos, G. J. Pierce, H. Q. P. Crick, and R. A. Robinson. 2006. Potential effects of climate change on marine mammals. *Oceanography and Marine Biology: An Annual Review* 44:431–464.

Lefcheck, J. S., B. B. Hughes, A. J. Johnson, B. W. Pfirrmann, D. B. Rasher, A. R. Smyth, B. L. Williams, M. W. Beck, and R. J. Orth. 2019. Are coastal habitats important nurseries? A meta-analysis. *Conservation Letters* 12(4):e12645.

Lesage, V., C. Barrette, M. C. S. Kingsley, and B. Sjare. 1999. The effect of vessel noise on the vocal behavior of belugas in the St. Lawrence River estuary, Canada. *Marine Mammal Science* 15(1):65–84. DOI:10.1111/j.1748-7692.1999.tb00782.x.

Lewiston, R. L., L. B. Crowder, B. P. Wallace, J. E. Moore, T. Cox, R. Zydelis, S. McDonald, A. DiMatteo, D. C. Dunn, C. Y. Kot, R. Bjorkland, S. Kelez, C. Soykan, K. R. Stewart, M. Sims, A. Boustany, A. J. Read, P. Halpin, W. J. Nichols, and C. Safina. 2014. "Global Patterns of Marine Mammal, Seabird, and Marine Mammal Bycatch Reveal Taxa-Specific and Cumulative Megafauna Hotspots." *Proceeding of the National Academy of Sciences of the United States of America* 111(14):5271–8276. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3986184/pdf/pnas.201318960.pdf.

Ljungblad, D. K., B. Wursig, S. L. Swartz, and J. M. Keene. 1988. Observations on the Behavioral Responses of Bowhead Whales (Balaena mysticetus) to Active Geophysical Vessels in the Alaskan Beaufort Sea. *Arctic* 41(3):183–194.

Long, C. 2017. *Analysis of the Possible Displacement of Bird and Marine Mammal Species Related to the Installation and Operation of Marine Energy Conversion Systems*. Scottish Natural Heritage Commissioned Report No. 947.

Love, M., A. Baldera, C. Young, and C. Robbins. 2013. *The GoM Ecosystem: A Coastal and Marine Atlas*. New Orleans, LA: Ocean Conservancy, Gulf Restoration Center.

Lucke, K., P. A. Lepper, B. Hoeve, E. Everaarts, N. van Elk, and U. Siebert. 2007. Perception of Low-Frequency Acoustic Signals by a Harbour porpoise (*Phocoena phocoena*) in the Presence of Simulated Offshore Wind Turbine Noise. *Aquatic Mammals* 33 (1):55–68.

Ludewig, E. 2015. *On the Effect of Offshore Wind Farms on the Atmosphere and Ocean Dynamics*. Cham: Springer International Publishing.

Lyssikatos, M. C. 2015. *Estimates of cetacean and pinniped bycatch in Northeast and Mid-Atlantic bottom Trawl Fisheries, 2008–2013*. Woods Hole, Massachusetts, U.S. Department of Commerce. Northeast Fisheries Science Center Reference Document 15-19.

Madsen, P. T., M. Wahlberg, J. Tougaard, K. Lucke, and P. Tyack. 2006. "Wind Turbine Underwater Noise and Marine Mammals: Implications of Current Knowledge and Data Needs." *Marine Ecology Progress Series*, Vol. 309:279–295. Available: https://www.researchgate.net/publication/236156710_Wind_turbine_underwater_noise_and_marine_mammals_Implications_of_current_knowledge_and_data_needs.

Malme, C. I., B. Würsig, J. E. Bird, and P. Tyack. 1986. *Behavioral responses of gray whales to industrial noise: feeding observations and predictive modeling*. BBN Rep. 6265. OCS Study MMS 88-0048. Outer Contin. Shelf Environ. Assess. Progr., Final Rep. Princ. Invest., NOAA, Anchorage 56(1988):393–600. NTIS PB88-249008.

Martin, J., Q. Sabatier, T. A. Gowan, C. Giraud, E. Gurarie, C. S. Calleson, J. G. Ortega-Ortiz, C. J. Deutsch, A. Rycyk, and S. M. Koslovsky. 2016. A quantitative framework for investigating risk of deadly collisions between marine wildlife and boats. *Methods in Ecology and Evolution* 7(1):42–50.

Martins, M. C. I., L. Sette, E. Josephson, A. Bogomolni, K. Rose, S. M. Sharp, M. Niemeyer, and M. Moore. 2019. Unoccupied aerial system assessment of entanglement in Northwest Atlantic gray seals (*Halichoerus grypus*). *Marine Mammal Science* 35(4):1613–1624.

Mazet, J. A. K., I. A. Gardner, D. A. Jessup, and L. J. Lowenstine. 2001. "Effects of Petroleum on Mink Applied as a Model for Reproductive Success in Sea Otters." *Journal of Wildlife Diseases* 37(4):686–692.

McCauley, R. 1998. *Radiated Underwater Noise Measured from the Drilling Rig Ocean General, Rig Tenders Pacific Ariki and Pacific Frontier, Fishing Vessel Reef Venture and Natural Sources in the Timor Sea, Northern Australia.* Prepared for Shell Australia. Project Centre for Marine Science and Technology Report C98-20.

McIntosh, R. R., R. Kirkwood, D. R. Sutherland, and P. Dann. 2015. Drivers and annual estimates of marine wildlife entanglement rates: a long-term case study with Australian fur seals. *Marine Pollution Bulletin* 101(2):716–725.

McMahon, K., P. Lavery, and M. Mulligan. 2011. Recovery from the impact of light reduction on the seagrass *Amphibolis griffithii*, insights for dredging management. *Marine Pollution Bulletin* 62(2):270–283.

Methratta, E. T., and W. R. Dardick. 2019. Meta-Analysis of Finfish Abundance at Offshore Wind Farms. *Reviews in Fisheries Science & Aquaculture* 27:2:242–260.

Mid-Atlantic Fishery Management Council (MAFMC). 2023. *Mid-Atlantic Artificial Reefs*. Available: https://www.mafmc.org/artificial-reefs. Accessed: March 3, 2023.

Mikkelsen, L., M. Johnson, D. M. Wisniewska, A. van Neer, U. Siebert, P. T. Madsen, and J. Teilmann. 2019. Long-term sound and movement recording tags to study natural behavior and reaction to ship noise of seals. *Ecology and Evolution* 9:2588–2601. DOI: 10.1002/ece3.4923

Miller, J. H., and G. R. Potty. 2017. "Overview of Underwater Acoustic and Seismic Measurements of the Construction and Operation of the Block Island Wind Farm." *Journal of the Acoustical Society of America* 141(5):3993. DOI:10.1121/1.4989144. Available: https://asa.scitation.org/doi/10.1121/1.4989144.

Mitson, R. B. 1995. *Underwater noise of research vessels – review and recommendations*. Cooperative Research Report. 209. ACOUSTEC, prepared for the International Council for the Exploration of the Sea. Copenhagen, Denmark.

Mohr, F. C., B. Lasely, and S. Bursian. 2008. "Chronic Oral Exposure to Bunker C Fuel Oil Causes Adrenal Insufficiency in Ranch Mink." *Archive of Environmental Contamination and Toxicology* 54:337–347.

Moore, M. J., and J. M. van der Hoop. 2012. "The Painful Side of Trap and Fixed Net Fisheries: Chronic Entanglement of Large Whales." *Journal of Marine Biology* 2012. Article 230653, 4 pp.

Moore, M. J., J. van de Hoop, S. G. Barco, et al. 2013. Criteria and case definitions for serious injury and death of pinnipeds and cetaceans caused by anthropogenic trauma. *Diseases of Aquatic Organisms* 103:229–264.

Moulton, V. D., W. J. Richardson, M. T. Williams, and S. B. Blackwell. 2003. Ringed seal densities and noise near an icebound artificial island with construction and drilling. *Acoustics Research Letters Online* 4:112–117. DOI: 10.1121/1.1605091.

Muir, D. C. G., R. Wagemann, N. P. Grift, R. J. Norstrom, M. A. Simon, and J. Lien. 1988. Organochlorine chemical and heavy metal contaminants in white-beaked dolphins (*Lagenorhynchus albirostris*) and pilot whales (*Globicephala melaena*) from the coast of Newfoundland, Canada. *Archives of Environmental Contamination and Toxicology* 17(5):613–629.

Murphy, S., R. J. Law, R. Deaville, J. Barnett, M. W. Perkins, A. Brownlow, R. Penrose, N. J. Davison, J. L. Barber, and P. D. Jepson. 2018. Organochlorine contaminants and reproductive implication in cetaceans: a case study of the common dolphin. *Marine Mammal Ecotoxicology* 3-38.

Nabe-Nielsen, J., J. Tougaard, J. Teilmann, and S. Sveegaard. 2011. *Effects of Wind Farms on Harbour Porpoise Behavior and Population Dynamics*. Report commissioned by the Environmental Group under the Danish Environmental Monitoring Programme. Scientific Report from Danish Centre for Environment and Energy No. 1. Denmark: Aarhus University. September.

National Aeronautics and Space Administration (NASA). 2019. *The Effects of Climate Change*. Available: https://climate.nasa.gov/effects/. Accessed: November 2021.

National Marine Fisheries Service (NMFS). 2016. Endangered Species Act Section 7 Consultation on the Continued Prosecution of Fisheries and Ecosystem Research Conducted and Funded by the Northeast Fisheries Science Center and the Issuance of a Letter of Authorization under the Marine Mammal Protection Act for the Incidental Take of Marine Mammals Pursuant to those Research Activities PCTS ID: NER-2015-12532. Available: https://media.fisheries.noaa.gov/dam-migration/nefsc_rule2016_biop.pdf.

National Marine Fisheries Service (NMFS). 2018a. *2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts*. National Oceanic and Atmospheric Administration Technical Memorandum NMFS-OPR-59. U.S. Department of Commerce, National Oceanographic and Atmospheric Administration.

National Marine Fisheries Service (NMFS). 2018b. Greater Atlantic Regional Fisheries Office: Section 7 Pile Driving Acoustics Tool. Updated 09/14/2020. Available: http://www.greateratlantic.fisheries.noaa.gov/protected/section7/guidance/consultation/index.html. Accessed: February 2021.

National Marine Fisheries Service (NMFS). 2018c. NOAA Fisheries' User Spreadsheet tool. Available: https://www.fisheries.noaa.gov/action/user-manual-optional-spreadsheet-tool-2018-acoustic-technical-guidance. Accessed: September 2019.

National Marine Fisheries Service (NMFS). 2020. North Atlantic Right Whale *(Eubalaena glacialis)* Vessel Speed Rule Assessment. June 2002. Available: https://media.fisheries.noaa.gov/2021-01/FINAL_NARW_Vessel_Speed_Rule_Report_Jun_2020.pdf?null. Accessed: April 2023.

National Marine Fisheries Service (NMFS). 2021a. *Endangered Species Act Section 7 Consultation Biological Opinion for the Construction, Operation, Maintenance, and Decommissioning of the South Fork Offshore Energy Project (Lease OCS-A 0517)* GARFO-2021-00353 – [Corrected]. Available: https://media.fisheries.noaa.gov/2021-12/SFW_BiOp_OPR1.pdf.

National Marine Fisheries Service (NMFS). 2021b. *Endangered Species Act Section 7 Consultation Biological Opinion for the Construction, Operation, Maintenance, and Decommissioning of the Vineyard Wind Offshore Energy Project (Lease OCS-A 0501)* GARFO-2021-01265 – [Corrected]. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/2021-Vineyard-Wind-1-BiOp-Final_0.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2013. *Draft guidance for assessing the effects of anthropogenic sound on marine mammals: Acoustic threshold levels for onset of permanent and temporary threshold shifts*. December 2013, 76 pp. Silver Spring, Maryland: NMFS Office of Protected Resources. Available: http://www.nmfs.noaa.gov/pr/acoustics/draft_acoustic_guidance_2013.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2020a. *North Atlantic Right Whale (Eubalaena glacialis) Vessel Speed Rule Assessment*. June. NOAA Fisheries, Office of Protected Resources. Available: https://media.fisheries.noaa.gov/2021-01/FINAL_NARW_Vessel_Speed_Rule_Report_Jun_2020.pdf?null.

National Oceanic and Atmospheric Administration (NOAA). 2020b. *Draft Environmental Impact Statement, Regulatory Impact Review, and Initial Regulatory Flexibility Analysis for Amending the Atlantic Large Whale Take Reduction Plan: Risk Reduction Rule*. Vol. 1. Available at: https://www.greateratlantic.fisheries.noaa.gov/public/nema/PRD/DEIS_RIR_ALWTRP_RiskReductionRule_VolumeI.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2022. 2017–2022 North Atlantic Right Whale Unusual Mortality Event. Available: https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2022-north-atlantic-right-whale-unusual-mortality-event.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2020. *2018–2020 Pinniped Unusual Mortality Event along the Northeast Coast*. National Oceanic and Atmospheric Administration. Available: https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-lifedistress/2018-2020-pinniped-unusual-mortality-event-along. Accessed: April 11, 2022.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2022a. *2016–2022 Humpback Whale Unusual Mortality Event along the Atlantic Coast*. National Oceanic and Atmospheric Administration. Available: https://www.fisheries.noaa.gov/national/marine-life-distress/2016-2022-humpback-whale-unusual-mortality-event-along-atlantic-coast. Accessed: April 11, 2021.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2022b. *2017–2022 Minke Whale Unusual Mortality Event along the Atlantic Coast*. National Oceanic and Atmospheric Administration. Available: https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2022-minke-whale-unusual-mortality-event-along-atlantic-coast. Accessed: April 11, 2022.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2022c. *Rule to Amend the North Atlantic Right Whale Vessel Speed Regulations Closed for Comment*. National Oceanic and Atmospheric Administration. Updated November 7, 2022. Available: https://www.fisheries.noaa.gov/feature-story/rule-amend-north-atlantic-right-whale-vessel-speed-regulations-closed-comment. Accessed: January 13, 2023.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2022d. Ecology of the Northeast Continental Shelf. Available: http://archive.nefmc.org/ecosystems/eco_northeast_shelf.pdf.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2023a. *2017–2023 North Atlantic Right Whale Unusual Mortality Event*. National Oceanic and Atmospheric Administration. Updated January 10, 2023. Available: https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2022-north-atlantic-right-whale-unusual-mortality-event. Accessed: January 11, 2023.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2023b. *2022 Pinniped Unusual Mortality Event along the Main Coast*. National Oceanic and Atmospheric Administration. Updated December 21, 2022. Available: https://www.fisheries.noaa.gov/2022-2023-pinniped-unusual-mortality-event-along-maine-coast. Accessed: January 12, 2023.

Nedwell J., J. Langworthy, and D. Howell. 2003. *Assessment of Sub-Sea Acoustic Noise and Vibration from Offshore Wind Turbines and its Impact on Marine Wildlife; Initial Measurements of Underwater Noise during Construction of Offshore Windfarms, and Comparison with Background Noise* (Report No. 544 R 0424). Report by Subacoustech Ltd. Report for The Crown Estate.

New England Wind. 2022. *New England Wind Offshore Wind Farm, Application for Marine Mammal Protection Act Rulemaking and Letter of Authorization.* July.

New Jersey Department of Environmental Protection (NJDEP). 2010. *Ocean/Wind Power Ecological Baseline Studies* January 2008–December 2009. Final Report. July 2010. Prepared for New Jersey Department of Environmental Protection Office of Science by Geo-Marine, Inc., Plano, Texas. Available: http://www.nj.gov/dep/dsr/ocean-wind/report.htm.

Nielsen, J. B., F. Nielsen, P. J. Jørgensen, and P. Grandjean. 2000. Toxic metals and selenium in blood from pilot whales (*Globicephala melas*) and sperm whales (*Physeter catodon*). *Marine Pollution Bulletin* 40(4):348–351.

Normandeau, Exponent, T. Tricas, and A. Gill. 2011. *Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species*. OCS Study BOEMRE 2011-09. Camarillo, California: U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region.

Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2011. *2010 Annual Report to the Inter-Agency Agreement M10PG00075/0001: A Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean*. Prepared by NMFS-NEFSC, Woods Hole, Massachusetts and NMFS-SEFSC, Miami, Florida.

Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2012. *2011 Annual Report to the Inter-Agency Agreement M10PG00075/0001: A Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean*. Prepared by NMFS-NEFSC, Woods Hole, Massachusetts and NMFS-SEFSC, Miami, Florida.

Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2013. *2012 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean*. Prepared by NMFS-NEFSC, Woods Hole, Massachusetts and NMFS-SEFSC, Miami, Florida.

Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2014. *2013 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean*. Prepared by NMFS-NEFSC, Woods Hole, Massachusetts and NMFS-SEFSC, Miami, Florida.

Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2015. *2014 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean*. Prepared by NMFS-NEFSC, Woods Hole, Massachusetts and NMFS-SEFSC, Miami, Florida.

Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2016. *2016 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean - AMAPPS II*. Prepared by NMFS-NEFSC, Woods Hole, Massachusetts and NMFS-SEFSC, Miami, Florida.

Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2018. *2017 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean - AMAPPS II*. Prepared by NMFS-NEFSC, Woods Hole, Massachusetts and NMFS-SEFSC, Miami, Florida.

Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2020. *2019 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean - AMAPPS II*. Prepared by NMFS-NEFSC, Woods Hole, Massachusetts and NMFS-SEFSC, Miami, Florida.

Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2022. *2021 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean - AMAPPS III*. Prepared by NMFS-NEFSC, Woods Hole, Massachusetts and NMFS-SEFSC, Miami, Florida.

Nowacek, S. M., R. S. Wells, and A. R. Solow. 2001. Short-term Effects of Boat Traffic on Bottlenose Dolphins, Tursiops Truncatus, in Sarasota Bay, Florida. *Marine Mammal Science* 17(4):673–688.

Nowacek, D., M. P. Johnson, and P. L. Tyack. 2004. North Atlantic right whales (Eubalaena glacialis) ignore ships but respond to alerting stimuli. Proceedings of the Royal Society of London. *Series B, Biological Sciences* 271:227–231.

Ocean Wind LLC (Ocean Wind). 2019. *Aerial Seal Haul-Out Survey: Ocean Wind Offshore Windfarm.* Prepared by Normandeau Associates, Inc. and APEM Ltd. July 16, 2019.

Ocean Wind LLC (Ocean Wind). 2022. *Application for Marine Mammal Protection Act (MMPA) Rulemaking and Letter of Authorization*: DRAFT. Prepared by HDR. February.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Olson, J. K., D. M. Lambourn, J. L. Huggins, S. Raverty, A. A. Scott, and J. K. Gaydos. 2021. Trends in propeller strike-induced mortality in harbor seals (*Phoca vitulina*) of the Salish Sea. *Journal of Wildlife Diseases* 57(3):689–693.

Orphanides, C. D. 2020. *Estimates of Cetacean and Pinniped Bycatch in the 2017 New England Sink and Mid-Atlantic Gillnet Fisheries*. Northeast Fisheries Science Center Reference Document 20-03. Available: https://repository.library.noaa.gov/view/noaa/23650.

Orr, T., S. Herz, and D. Oakley. 2013. *Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments*. OCS Study BOEM 2013-0116. Herndon, Virginia: U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs.

Osiecka, A. N., O. Jones, and M. Wahlberg. 2020. The diel pattern in harbour porpoise clicking behavior is not a response to prey activity. *Nature Scientific Reports* 10:14876. Available: https://doi.org/10.1038/s41598-020-71957-0.

OSPAR Commission. 2009. *Overview of the impacts of anthropogenic underwater sound in the marine environment*. London, UK: OSPAR Commission.

Pace, R. M. 2021. *Revisions and Further Evaluations of the Right Whale Abundance Model: Improvements for Hypothesis Testing*. NOAA Technical Memorandum NMFS-NE 269. Available: https://apps-nefsc.fisheries.noaa.gov/rcb/publications/tm269.pdf.

Pace, R. M. III, R. Williams, S. D. Kraus, A. R. Knowlton, and H. M. Pettis. 2021. Cryptic mortality of North Atlantic right whales. *Conservation Science and Practice* 2021(3):e346. Available: https://doi.org/10.1111/csp2.346.

Pace, R. M., and G. K. Silber. 2005. Simple Analysis of Ship and Large Whale Collisions: Does Speed Kill? Presentation at the Sixteenth Biennial Conference on the Biology of Marine Mammals, San Diego, CA, December 2005.

Pacific Marine Environmental Laboratory (PMEL). 2020. Ocean Acidification: The Other Carbon Dioxide Problem. Available: https://www.pmel.noaa.gov/CO_2/story/Ocean+Acidification. Accessed: February 11, 2020.

Palka, D. L., S. Chavez-Rosales, E. Josephson, D. Cholewiak, H. L. Haas, L. Garrison, M. Jones, D. Sigourney, G. Waring, M. Jech, E. Broughton, M. Soldevilla, G. Davis, A. DeAngelis, C. R. Sasso, M. V. Winton, R. J. Smolowitz, G. Fay, E. LaBrecque, J. B. Leiness, K. Dettloff, M. Warden, K. Murray, and C. Orphanides. 2017. *Atlantic Marine Assessment Program for Protected Species: 2010–2014*. OCS Study BOEM 2017-071. Bureau of Ocean Energy Management, Washington, DC. Available: https://espis.boem.gov/final%20reports/5638.pdf.

Parks, S. E., C. W. Clark, and P. L. Tyack. 2007. Short- and long-term changes in right whale calling behavior: the potential effects of noise on acoustic communication. *Journal of the Acoustical Society of America* 122(6):3725–3731. DOI:10.1121/1.2799904.

Parsons, E. C. M., D. Dolman, A. J. Wright, N. A. Rose, and W. C. G. Burns. 2008. Navy sonar and cetaceans: just how much does the gun need to smoke before we act? *Mar. Pollut. Bull.* 56:1248–1257.

Paskyabi, M. B., I. and Fer. 2012. "Upper Ocean Response to Large Wind Farm Effect in the Presence of Surface Gravity Waves," in Selected papers from Deep Sea Offshore Wind R&D Conference, Vol. 24, (Trondheim):45–254. DOI: 10. 1016/j.egypro.2012.06.106.

Patenaude, N. J., W. J. Richardson, M. A. Smultea, W. R. Koski, G. W. Miller, B. Würsig, and C. R. Greene, Jr. 2002. Aircraft sound and disturbance to bowhead and beluga whales during spring migration in the alaskan Beaufort sea. *Marine Mammal Science* 18(2):309–335. Available: https://doi.org/10.1111/j.1748-7692.2002.tb01040.x.

Pfleger, M., P. Mustain, M. Valentine, E. Gee, W. Webber, and B. Fenty. 2021. Vessel Strikes Threaten North Atlantic Right Whales. *Oceana*. DOI: 10.5281/zenodo.5120727.

Pierce, G. J., M. B. Santos, S. Murphy, J. A. Learmonth, A. F. Zuur, E. Rogan, P. Bustamante, F. Caurant, V. Lahaye, V. Ridoux, and B. N. Zegers. 2008. Bioaccumulation of persistent organic pollutants in female common dolphins (*Delphinus delphis*) and harbour porpoises (*Phocoena phocoena*) from western European seas: Geographical trends, causal factors and effects on reproduction and mortality. *Environmental Pollution* 153(2):401–415.

Pirotta E., B. V. Laesser, A. Hardaker, N. Riddoch, and M. Marcoux. 2013. Dredging displaces bottlenose dolphins rom an urbanized foraging patch. *Marine Pollution Bulletin* 74(1):396–402. SSN 0025-326X. Available: https://doi.org/10.1016/j.marpolbul.2013.06.020.

Putland, R. L., N. D. Merchant, A. Farcas, and C. A. Radford. 2017. Vessel noise cuts down commercial space for vocalizing fish and marine mammals. *Glob Change Biol.* 2017:1–14. DOI: 10.1111/gcb.13996.

Quick, Nicola, Lindesay Scott-Hayward, Dina Sadykova, Doug Nowacek, and Andrew Read. 2017. "Effects of a Scientific Echo Sounder on the Behavior of Short-Finned Pilot Whales (Globicephala Macrorhynchus)." *Canadian Journal of Fisheries and Aquatic Sciences* 74(5):716–726. DOI: https://doi.org/10.1139/cjfas-2016-0293.

Raoux, A., S. Tecchio, J.-P. Pezy, G. Lassalle, S. Degraer, D. Wilhelmsson, M. Cachera, B. Ernande, C. Le Guen, M. Haraldsson, K. Grangeré, F. Le Loc'h, J.-C. Dauvin, and N. Niquil. 2017. Benthic and fish aggregation inside an offshore wind farm: Which effects on the trophic web functioning? *Ecological Indicators* 72:33–46.

Read A. J., P. Drinker, and S. Northridge. 2006. "Bycatch of Marine Mammals in U.S. and Global Fisheries." *Conservation Biology* 20(1):163–169. Available: https://conbio.onlinelibrary.wiley.com/doi/abs/10.1111/j.1523-1739.2006.00338.x?sid=nlm%3Apubmed.

Rees, D. R., D. V. Jones, and B. A. Bartlett. 2016. *Haul-out Counts and Photo-Identification of Pinnipeds in Chesapeake Bay, Virginia: 2015/16 Annual Progress Report*. Final Report. Prepared for U.S. Fleet Forces Command, Norfolk, Virginia. November 2016.

Reichmuth, C. 2007. Assessing the hearing capabilities of mysticete whales. A proposed research strategy for the Joint Industry Programme on Sound and Marine Life on 12 September. Available: http://www.soundandmarinelife.org/Site/Products/MysticeteHearingWhitePaper-Reichmuth.pdf.

Revolution Wind LLC (Revolution Wind). 2022a. *Petition for Incidental Take Regulations for the Construction and Operation of the Revolution Wind Offshore Wind Farm*. February.

Revolution Wind LLC (Revolution Wind). 2022b. *Construction and Operations Plan, Revolution Wind Farm Project.* July. Available: https://www.boem.gov/renewable-energy/state-activities/revolution-wind-farm-construction-and-operations-plan.

Richardson, W. J., B. Würsig, and C. R. Greene, Jr. 1990. Reactions of bowhead whales, Balaena mysticetus, to drilling and dredging noise in the Canadian Beaufort Sea. Marine Environmental Research 29(2):135–160. Available: https://doi.org/10.1016/0141-1136(90)90032-J.

Richardson, W. J., C. R. Greene, Jr., C. I. Malme, and D. H. Thomson. 1995. *Marine Mammals and Noise*. San Diego, CA: Academy Press. Available: https://www.elsevier.com/books/marine-mammals-and-noise/richardson/978-0-08-057303-8. Accessed: September 9, 2020.

Richardson, W. J., B. Wursig, and C. R. Greene. 1986. Reactions of bowhead whales, *Balaena mysticetus*, to seismic exploration in the Canadian Beaufort Sea. *J. Acoust. Soc. Am.* 79(4):1117–1128. DOI: 0001-4966 / 86 / 041117-12500.80.

Richardson, W. J., G. W. Miller, and C. R. Greene. 1999. Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. *J. Acoust. Soc. Am.* 106:2281. Available: http://dx.doi.org/10.1121/1.427801.

Ridgway, S. H., and D. A. Carder. 2001. Assessing hearing and sound production in cetaceans not available for behavioural audiograms: Experiences with sperm, pygmy sperm, and gray whales. *Aquatic Mammals* 27:267–276.

Robbins, J. 2012. *Scar-based inference into Gulf of Maine Humpback whale entanglement*: 2010. Report to the Northeast Fisheries Science Center, National Marine Fisheries Service, Woods Hole, Massachusetts. Available: http://www.nefsc.noaa.gov/psb/docs/HUWHScarring%28Robbins2012%29.pdf.

Robbins, J., and D. K. Mattila. 2001. *Monitoring entanglements of humpback whales (Megaptera novaeangliae) in the Gulf of Maine on the basis of caudal peduncle scarring*. Scientific Committee meeting document SC/53/NAH25. International Whaling Commission, Cambridge, UK.

Roberts, J. J., and P. N. Halpin. 2022. *Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico*. Available: https://seamap.env.duke.edu/models/Duke/EC/ in HDR Inc. 2022. Ocean Wind 1 Offshore Wind Farm Updates to the Application for Marine Mammal Protection Act (MMPA) Rulemaking and Letter of Authorization – Provided in Provided in Attachment J-1 of Appendix J.

Roberts J. J., R. S. Schick, and P. N. Halpin. 2020. *Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2018–2020 (Option Year 3)*. Document version 1.4. Report prepared for Naval Facilities Engineering Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, NC.

Roberts, J. J., B. D. Best, L. Mannocci, E. Fujioka, P. N. Halpin, D. L. Palka, L. P. Garrison, K. D. Mullin, T. V. Cole, C. B. Khan, and W. A. McLellan. 2016a. Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico. *Scientific Reports* 6:22615.

Roberts, J. J., L. Mannocci, and P. N. Halpin. 2016b. *Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2015-2016 (Base Year)*. Version 1.0. Report by the Duke University Marine Geospatial Ecology Lab for Naval Facilities Engineering Command, Atlantic Durham, NC.

Roberts, J. J., L. Mannocci, and P. N. Halpin. 2017. *Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2016–2017 (Opt. Year 1)*. Document version 1.4. Report prepared for Naval Facilities Engineering Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, NC.

Roberts, J. J., L. Mannocci, R. S. Schick, and P. N. Halpin. 2018. *Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2017–2018 (Opt. Year 2)*. Document version 1.2 - 2018-09-21. Report prepared for Naval Facilities Engineering Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, NC.

Roberts, J. J., R. S. Schick, and P. N. Halpin. 2021a. *Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2020 (Option Year 4)*. Report prepared for Naval Facilities Engineering Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, NC.

Roberts, J. J., B. McKenna, L. Ganley, and C. Mayo. 2021b. *Right Whale Abundance Estimates for Cape Cod Bay in December*. Document version 3. Duke University Marine Geospatial Ecology Lab, Durham, NC.

Rolland, R. M., S. E. Parks, K. E. Hunt, M. Castellote, P. J. Corkeron, D. P. Nowacek, S. K. Wasser, and S. D. Kraus. 2012. Evidence that ship noise increases stress in right whales. *Proc. R. Soc. B.* DOI: 10.1098/rspb.2011.2429.

Ruppel, C. D., T. C. Weber, E. R. Staaterman, S. J. Labak, and P. E. Hart. 2022. Categorizing Active Marine Acoustic Sources Based on Their Potential to Affect Marine Animals. *J. Mar. Sci. Eng.* 10:1278. Available: https://doi.org/10.3390/jmse10091278.

Russel, D. J. F., S. M. J. M. Brasseur, D. Thompson, G. D. Hastie, V. M. Janik, G. Aarts, B. T. McClintock, J. Matthiopoulos, S. E. W. Moss, and B. McConnel. 2014. Marine mammals trace anthropogenic structures at sea. *Current Biology* 24(14):R638–R639.

Russell, D. J. F., G. D. Hastie, D. Thompson, V. M. Janik, P. S. Hammond, L. A. S. Scott-Hayward, J. Matthiopoulos, E. L. Jones, and B. J. McConnell. 2016. Avoidance of wind farms by harbour seals is limited to pile driving activities. *Journal of Applied Ecology* DOI:10.1111/1365-2664.12678.

Schakner, Z. A., and D. T. Blumstein. 2013. Behavior biology of marine mammal deterrents: A review and prospectus. *Biological Conservation* 167: 380–389. Available: http://dx.doi.org/10.1016/j.biocon.2013.08.024.

Scheifele, P. M., S. Andrew, R. A. Cooper, M. Darre, F. E. Musiek, and L. Max. 2004. Indication of a Lombard vocal response in the St. Lawrence River beluga. *Journal of the Acoustical Society of America* 17:1486–1492. DOI:10.1121/1.1835508.

Schofield, O., R. Chant, B. Cahill, R. Castelo, D. Gong, A. Kahl, J. Kohut, M. Montes-Hugo, R. Ramadurai, P. Ramey, X. Yi, and S. Glenn. 2008. The Decadal View of the Mid-Atlantic Bight from the COOLroom: Is Our Coastal System Changing? *Oceanography* 21(4):108–117.

Schultze, L. K. P., L. M. Merckelbach, J. Horstmann, S. Raasch, and J. R. Carpenter. 2020. Increased Mixing and Turbulence in the Wake of Offshore Wind Farm Foundations. J. *Geophys. Res. Oceans* 125:e2019JC015858. DOI: 10.1029/ 2019JC015858.

Slocum, C. J., A. Ferland, N. Furina, and S. Evert. 2005. What do harbor seals eat in New Jersey? A first report from the Mid-Atlantic region (USA). Page 262 in Abstracts, 16th Biennial Conference on the Biology of Marine Mammals. San Diego, CA, 12–16 December 2005.

Smith, C. R., T. K. Rowles, L. B. Hart, F. I. Townsend, R. S. Wells, E. S. Zolman, B. C. Balmer, B. Quigley, M. Ivnacic, W. McKercher, M. C. Tumlin, K. D. Mullin, J. D. Adams, Q. Wu, W. McFee, T. K. Collier, and L. H. Schwacke. 2017. "Slow Recovery of Barataria Bay Dolphin Health Following the Deepwater Horizon Oil Spill (2013–2014) with Evidence of Persistent Lung Disease and Impaired Stress Response." *Endangered Species Research* 33:127–142.

Southall, B. L., A. E. Bowles, W. T. Ellison, J. J. Finneran, R. L. Gentry, C. R. Greene, Jr., D. Kastak, D. R. Ketten, J. H. Miller, P. E. Nachtigall, W. J. Richardson, J. A. Thomas, and P. L Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals* 33(4):411–521.

Southall, B. L., D. P. Nowacek, A. E. Bowles, V. Senigaglia, L. Bejder, and P. L. Tyack. 2021. Marine Mammal Noise Exposure Criteria: Assessing the Severity of Marine Mammal Behavioral Responses to Human Noise. *Aquatic Mammals* 47(5):421–464.

Southall, B. L., J. J. Finneran, C. Reichmuth, P. E. Nachtigall, D. R. Ketten, A. E. Bowles, W. T. Ellison, D. P. Nowacek, and P. L. Tyack. 2019. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. *Aquatic Mammals* 45(2):125–232.

Sprogis, K. R., S. Videsen, and P. T. Madsen. 2020. Vessel noise levels drive behavioural response of humpack whales with implications for whale-watching. *eLife.* Available: https://doi.org/10.7554/eLife.5676.

Stöber, U. and F. Thomsen. 2021. How could operational underwater sound from future offshore wind turbines impact marine life? *Journal of the Acoustical Society of America* 149(3):1791–1795.

Sullivan, L., T. Brosnan, T. K. Rowles, L. Schwacke, C. Simeone, and T. K. Collier. 2019. *Guidelines for Assessing Exposure and Impacts of Oil Spills on Marine Mammals*. NOAA Tech. Memo. NMFS-OPR62, 82 pp.

Sunrise Wind LLC (Sunrise Wind). 2022a. *Petition for Incidental Take Regulations for the Construction and Operation of the Sunrise Wind Offshore Wind Farm.* May.

Sunrise Wind LLC (Sunrise Wind). 2022b. *Construction and Operations Plan, Sunrise Wind Farm Project.* August. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/SRW01_COP_Rev3_2022-08-19_508_0.pdf.

Takeshita, R., L. Sullivan, C. Smith, T. Collier, A. Hall, T. Brosnan, T. Rowles, and L. Schwacke. 2017. "The Deepwater Horizon Oil Spill Marine Mammal Injury Assessment." *Endangered Species Research* 33:96–106.

Taormina, B., J. Bald, A. Want, G. Thouzeau, M. Lejart, N. Desroy, and A. Carlier. 2018. A review of potential impacts of submarine power cables on the marine environment: Knowledge gaps, recommendations and future directions. Renewable and Sustainable Energy Reviews, Elsevier, 2018, 96, pp. 380–391. 10.1016/j.rser.2018.07.026. hal-02405630.

Taruski, A. G., C. E. Olney, and H. E. Winn. 1975. Chlorinated hydrocarbons in cetaceans. *Journal of the Fisheries Board of Canada* 32(11):2205–2209. In Hayes, S. A., E. Josephson, K. Maze-Foley, and P. E. Rosel. 2020. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2019*. NOAA Tech Memo NMFS-NE 264.

Teilmann, J., and J. Cartensen. 2012. "Negative Long-term Effects on Harbour Porpoises from a Large Scale Offshore Wind Farm in the Baltic—Evidence of Slow Recovery." *Environmental Resource Letters* 7(4):045101.

Todd, V. L. G., I. B. Todd, J. C. Gardiner, E. C. N. Morrin, N. A. MacPherson, N. A. DiMarzio, and F. Thomsen. 2015. A review of direct and indirect impacts of marine dredging activities on marine mammals. *ICES Journal of Marine Science* 72(2):328–340. Available: https://doi.org/10.1093/icesjms/fsu187.

Todd, V. L. G., L. D. Williamson, J. Jiang, S. E. Cox, I. B. Todd, and M. Ruffert. 2020. Proximate underwater soundscape of a North Sea offshore petroleum exploration jack-up drilling rig in the Dogger Bank. *Journal of the Acoustical Society of America* 148:3971. DOI: 10.1121/10.0002958.

Todd, V. L. G., W. D. Pearse, N. C. Tregenza, P. A. Lepper, and I. B. Todd. 2009. Diel echolocation activity of harbour porpoises (*Phocoena phocoena*) around North Sea offshore gas installations. *ICES Journal of Marine Science* 66:734–745.

Tougaard, J., J. Carstensen, J. Teilmann, H. Skov, and P. Rasmussen. 2009b. Pile driving zone of responsiveness extends beyond 20 km for harbour porpoises (Phocoena phocoena). *Journal of the Acoustical Society of America* 126:11–14.

Tougaard, J., L. Hermannsen, and P. T. Madsen. 2020. How loud is the underwater noise from operating offshore wind turbines? *Journal of the Acoustical Society of America* 148(5):2885–2893.

Tougaard, J., O. D. Henriksen, and Lee A. Miller. 2009a. Underwater noise from three types of offshore wind turbines: Estimation of impact zones for harbor porpoises and harbor seals. *Journal of the Acoustical Society of America* 125(6):3766–3773. DOI:10.1121/1.3117444.

Tricas, T., and A. Gill. 2011. *Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species*. Normandeau Associates, Inc. and Exponent Inc., Final Report submitted to the U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09. 426 pp.

Tsujii, K., T. Akamatsu, R. Okamoto, K. Mori, Y. Mitani, N. Umeda. 2018. Change in singing behavior of humpback whales cause by shipping noise. *PLOS ONE* 13(10): e0204112. Available: https://doi.org/10.1371/journal.pone.0204112.

Urick, R. J. 1983. *Principles of underwater sound* (3rd ed.). Los Altos Hills (CA): Peninsula Publishing.

U.S. Army Corps of Engineers (USACE). 2020. *Final Environmental Assessment National Regional Sediment Management (RSM) Program, WRDA 2016 Section 1122 Beneficial Use Pilot Project: Oyster Creek Channel Barnegat Inlet Federal Navigation Project Ocean County, New Jersey*. November. Available: https://www.nap.usace.army.mil/Portals/39/docs/Civil/Reports/Final-EA-Barn-Inlet-Section-1122-Oyster-Creek-November-2020.pdf?ver=SrZ2PrKeCtXGydSRoGZKzw%3d%3d. Accessed November 10, 2022.

U.S. Army Corps of Engineers (USACE). 2021. *Newark Bay, New Jersey Federal Navigation Project Maintenance Dredging*. Public Notice No. Newark Bay, NJ FY21. May.

U.S. Department of the Navy (Navy). 2017. *Technical Report: Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)*. San Diego, California: SSC Pacific. Available: https://www.nwtteis.com/portals/nwtteis/files/technical_reports/Criteria_and_Thresholds_for_U.S._Navy_Acoustic_and_Explosive_Effects_Analysis_June2017.pdf.

U.S. Environmental Protection Agency (USEPA). 2016. *Climate Change Indicators: Oceans*. Available online: https://www.epa.gov/climate-indicators/oceans. Accessed: November 2021.

Vallejo, G. C., K. Grellier, E. J. Nelson, R. M. McGregor, S. J. Canning, F. M. Caryl, and N. McLean. 2017. Responses of two marine top predators to an offshore wind farm. *Ecology and Evolution* 7(21):8698–8708. doi.org/10.1002/ece3.3389.

van Berkel, J., H. Burchard, A. Christensen, L. O. Mortensen, O. S. Petersen, and F. Thomsen. 2020. The effects of offshore wind farms on hydrodynamics and implications for fishes. *Oceanography* 33(4):108–117.

van der Hoop, J., A. Vanderlaan, and C. Taggart. 2012. Absolute probability estimates of lethal vessel strikes to North Atlantic right whales in Roseway Basin, Scotian Shelf. *Ecological applications: a publication of the Ecological Society of America* 22:2021–2033. 10.2307/41723112.

Van Parjis, S. M., C. Curtice, and M. C. Ferguson. 2015. Biologically Important Areas for Cetaceans within U.S. Waters. *Aquatic Mammals* (Special Issue), 41(1).

Van Waerebeek, K., A. Baker, F. Felix, J. Gedamke, M. Iniguez, G. P. Sanino, E. D. Secchi, D. Sutaria, A. N. van Helden, and Y. Wang. 2007. Vessel Collisions with Small Cetaceans Worldwide and with Large Whales in the Southern Hemisphere, an Initial Assessment. *LAJAM* 6(1):43–49.

Vanderlaan, A. S. M., and C. T. Taggart. 2007. Vessel Collisions with Whales: The Probability of Lethal Injury Based on Vessel Speed. *Marine Mammal Science* 23(1):144–156. Available: https://www.phys.ocean.dal.ca/~taggart/Publications/Vanderlaan_Taggart_MarMamSci23_2007.pdf.

Veirs, S., V. Veirs, and J. D. Wood. 2016. Ship noise extends to frequencies used for echolocation by endangered killer whales. PeerJ 4:e1657; DOI 10.7717/peerj.1657.

Vires, G. 2011. *Echosounder Effects on Beaked Whales in the Tongue of the Ocean, Bahamas*. Masters of Environmental Management, Duke University.

Wang, J. W., and S. C. Yang. 2006. Unusual stranding events of Taiwan in 2004 and 2005. *J. Cetacean Res. Manage.* 8(3):283–292.

Waring, G. T., E. Josephson, K. Maze-Foley, and P. E. Rosel (eds.). 2011. *US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2010*. NOAA Technical Memorandum NMFS-NE-219. National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA.

Waring, G. T., E. Josephson, K. Maze-Foley, and P. E. Rosel (Editors). 2015. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments-2014*. NOAA Technical Memorandum NMFS-NE-231, Northeast Fisheries Science Center, Woods Hole, MA.

Wartzok, D., and D. R. Ketten. 1999. “Marine mammal sensory systems,” in *Biology of Marine Mammals*, J, Reynolds and S. Rommel (Eds). Washington, DC: Smithsonian Institution Press. Pp. 117–175.

Weilgart, L. S. 2007. “The Impacts of Anthropogenic Ocean Noise on Cetaceans and Implications for Management.” *Canadian Journal of Zoology* 85:1091–1116. Available: http://whitelab.biology.dal.ca/lw/publications/Weilgart%202007%20CJZ%20noise%20review.pdf.

Weisbrod, A. V., D. Shea, M. J. Moore, and J. J. Stegeman. 2000. Bioaccumulation patterns of polychlorinated biphenyls and chlorinated pesticides in northwest Atlantic pilot whales. *Environmental Toxicology and Chemistry: An International Journal* 19(3):667–677.

Wells, R. S., and M. D. Scott. 1997. Seasonal Incidence of Boat Strikes on Bottlenose Dolphins Near Sarasota, Florida. *Marine Mammal Science* 3:475–480.

Werner, S., A. Budziak, J. van Franeker, F. Galgani, G. Hanke, T. Maes, M. Matiddi, P. Nilsson, L. Oosterbaan, E. Priestland, R. Thompson, J. Veiga, and T. Vlachogianni. 2016. *Harm Caused by Marine Litter*. MSFD GES TG Marine Litter - Thematic Report; JRC Technical report; EUR 28317 EN. DOI:10.2788/690366.

Wilber, D. H., and D. G. Clarke. 2001. Biological effects of suspended sediments: A review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries. *North American Journal of Fisheries Management* 21:855–875.

Williams, T. M., S. B. Blackwell, O. Tervo, E. Garde, M. S. Sinding, B. Richter, and M. P. Heide-Jorgensen. 2022. Physiological responses of narwhals to anthropogenic noise: A case study with seismic airguns and vessel traffic in the Arctic. *Functional Ecology* 2022;00:1–16. DOI: 10.1111/1365-2435.14119.

Wisehart, L. A., B. R. Dumbauld, J. L. Reusink, and S. D. Hacker. 2007. Importance of eelgrass early life history stages in response to aquaculture disturbance. *Marine Ecology Progress Series* 344:71–80. August 23, 2007.

Wisniewska, D. M., M. Johnson, J. Teilmann, U. Siebert, A. Galatius, R. Dietz, and P. T. Madsen. 2018. High rates of vessel noise disrupt foraging in wild harbour porpoises (Phocoena phocoena). *Proc. R. Soc. B* 285:20172314. Available: http://dx.doi.org/10.1098/rspb.2017.2314.

Würsig, B., C. R. Greene Jr., and T. A. Jefferson. 2000. Development of an air bubble curtain to reduce underwater noise of percussive piling. *Marine Environmental Research* 49(1):79–93.

Wynne, K., and M. Schwartz. 1999. *Guide to Marine Mammals & Turtles of the U.S. Atlantic & Gulf of Mexico*. Fairbanks: University of Alaska Press.

B.2.3.16. Section 3.16, Navigation and Vessel Traffic

Atlantic Shores Offshore Wind (Atlantic Shores). 2021. *Construction and Operations Plan, Atlantic Shores Offshore Wind*. Volume I. September. Available: https://www.boem.gov/renewable-energy/state-activities/atlantic-shores-offshore-wind-construction-and-operations-plan.

Bureau of Ocean Energy Management (BOEM). 2022. Ocean Wind Memo to File: Calculation for New Jersey Inter-array Buffer Distance. April 18.

Mid-Atlantic Regional Council of the Ocean (MARCO). 2020. Mid-Atlantic Ocean Data Portal [MARCO]. Available: http://portal.midatlanticocean.org/visualize/#x=-73.24&y=38.93&z=7&logo=true&controls=true&basemap=Ocean&tab=data&legends=false&layers=true. Accessed: January 17, 2019.

National Academies of Sciences, Engineering, and Medicine 2022. *Wind Turbine Generator Impacts to Marine Vessel Radar*. Washington, DC: The National Academies Press. https://doi.org/10.17226/26430.

National Oceanic and Atmospheric Administration (NOAA). 2023. *Coast Pilot Volume 2, Chapter 11, New York Harbor and Approaches – 52nd Edition.* January 15.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Ocean Wind LLC (Ocean Wind). 2023. citing MarineTraffic. 2020. Automatic Identification System data acquired from MarineTraffic, Historical AIS-T data (vessel positions) for TIMESTAMP between ‘2019-03-01 00:00’ and ‘2020-02-29 23:59’ UTC, LAT between 38.0 and 40.0 and LON between -75.2 and -73.0.

Sharples, Malcolm. 2011. *Offshore Electrical Cable Burial for Offshore Wind Farms on the OCS*. Prepared for Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) by Risk & Technology Consulting, Inc. November. Available: https://www.bsee.gov/sites/bsee.gov/files/tap-technical-assessment-program/final-report-offshore-electrical-cable-burial-for-wind-farms.pdf.

U.S. Coast Guard (USCG). 2016. *Atlantic Coast Port Access Route Study*. USCG-2011-0351. February 2016. Available: https://www.navcen.uscg.gov/?pageName=PARSReports. Accessed: October 12, 2021.

U.S. Coast Guard (USCG). 2019. *Navigation and Vessel Inspection Circular 01-19*. Available: https://www.mafmc.org/s/190801-Nav-Vess-Insp-Circ-01-19.pdf. Accessed: August 1, 2019.

U.S. Coast Guard (USCG). 2020a. Proposed Rule: "Shipping Safety Fairways Along the Atlantic Coast" 85 Federal Register 37034-37040 published Friday, June 19. Available: https://www.regulations.gov/document/USCG-2019-0279-0001. Accessed: October 11, 2022.

U.S. Coast Guard (USCG). 2020b. *The Areas Offshore of Massachusetts and Rhode Island Port Access Route Study. USCG 2019-0131*. May 14. Available: https://www.navcen.uscg.gov/pdf/PARS/FINAL_REPORT_PARS_May_14_2020.pdf. Accessed: October 13, 2021.

U.S. Coast Guard (USCG). 2021a. Draft *Port Access Route Study: Seacoast of New Jersey Including Offshore Approaches to the Delaware Bay, Delaware*. USCG-2020-0172. Available: https://downloads.regulations.gov/USCG-2020-0172-0044/content.pdf. Accessed: October 12, 2021.

U.S. Coast Guard (USCG). 2021b. U.S. Coast Guard Scoping Comments for the Ocean Wind Notice of Intent to Prepare an Environmental Impact Statement. Docket No. BOEM-2021-0024. May 6.

U.S. Coast Guard (USCG). 2021c. Search and Rescue Operations Near Offshore Wind Energy Projects. Fiscal Year 2020 Report to Congress. June 16.

U.S. Coast Guard (USCG). 2022a. Final *Port Access Route Study: Seacoast of New Jersey Including Offshore Approaches to the Delaware Bay, Delaware*. USCG-2020-0172. Available: https://www.federalregister.gov/documents/2022/03/24/2022-06228/port-access-route-study-seacoast-of-new-jersey-including-offshore-approaches-to-the-delaware-bay. Accessed: April 29, 2022.

U.S. Coast Guard (USCG). 2022b. *Consolidated Port Approaches and International Entry and Departure Transit Areas Port Access Route Studies (PARS) Integral to Efficiency of Possible Atlantic Coast Fairways*. USCG-2022-19546. Available: https://www.regulations.gov/document/USCG-2011-0351-0173. Accessed: November 13, 2022.

West, Stephen. 2022. Commander, USCG. Marine Transportation Specialist, Navigation Standards Division (CG-NAV-2), Office of Navigation Systems (CG-NAV). Emailed communication to Arianna Baker, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Environment Branch for Renewable Energy. March 29.

B.2.3.17. Section 3.17, Other Uses (Marine Minerals, Military Use, Aviation)

Bureau of Ocean Energy Management (BOEM). 2020. *Radar Inference Analysis for Renewable Energy Facilities on the Atlantic Outer Continental Shelf*. OCS Study BOEM 2020-039. Available: https://www.boem.gov/sites/default/files/documents/environment/Radar-Interferance-Atlantic-Offshore-Wind_0.pdf.

Bureau of Ocean Energy Management (BOEM). 2021a. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2021-0012. Available: https://www.boem.gov/vineyard-wind. Accessed: August 2021.

Cresitello, Donald E. 2020. Senior Coastal Planner, Planning and Policy Division, U.S. Army Corps of Engineers – North Atlantic Division. Emailed transmittal of unpublished NAD Sediment Needs Analysis to Jeffrey Waldner, P.G., Physical Scientist/Oceanographer, Bureau of Ocean Energy Management, Marine Minerals Division on September 1, 2020.

Hare, J. A., J. B. Blythe, K. H. Ford, S. Godfrey-McKee, B. R. Hooker, B. M. Jensen, A. Lipsky, C. Nachman, L. Pfeiffer, M. Rasser, and K. Renshaw. 2022. *NOAA Fisheries and BOEM Federal Survey Mitigation Strategy – Northeast U.S. Region.* NOAA Technical Memorandum NMFS-NE-292. Available: https://www.fisheries.noaa.gov/resource/document/federal-survey-mitigation-strategy-northeast-us-region. Accessed: December 13, 2022.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Ocean Wind LLC (Ocean Wind). 2023. Citing Westslope Consulting, LLC. 2019. Ocean Wind Project Basic Radar Line-of-Sight Study. Norman. November 6.

Patch. 2022. "County to Pay for Part of Berkeley Beach Replenishment." Reporting by Veronica Flesher. Available: https://patch.com/new-jersey/berkeley-nj/county-pay-part-berkeley-beach-replenishment. Accessed: September 19, 2022.

Press of Atlantic City. 2022. "Dune erosion causes beach access closure in Strathmere." Reporting by Bill Barlow. Available: https://pressofatlanticcity.com/news/local/dune-erosion-causes-beach-access-closure-in-strathmere/article_b8b4f8ec-0216-11ed-9734-937540d59342.html. Accessed: September 19, 2022.

Sample, Steven J. 2021. Executive Director, Military Aviation and Installation Assurance Siting Clearinghouse. Letter regarding results of Department of Defense review of the Ocean Wind COP sent to David MacDuffee, Chief, Projects and Coordination Branch, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. October 20, 2021.

B.2.3.18. Section 3.18, Recreation and Tourism

Atlantic Shores Offshore Wind (Atlantic Shores). 2021. *Construction and Operations Plan, Atlantic Shores Offshore Wind*. Volume I. September. Available: https://www.boem.gov/renewable-energy/state-activities/atlantic-shores-offshore-wind-construction-and-operations-plan.

Bureau of Ocean Energy Management (BOEM). 2012a. *Atlantic Region Wind Energy Development: Recreation and Tourism Economic Baseline Development Impacts of Offshore Wind on Tourism and Recreation Economies*. BOEM 2012-085. Available: https://espis.boem.gov/final%20reports/5228.pdf.

Bureau of Ocean Energy Management (BOEM). 2021a. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2021-0012.

Bureau of Ocean Energy Management (BOEM). 2021b. *South Fork Wind Farm and South Fork Export Cable Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2021-0012. Page 3-189.

Burlington County. No date. Parks Interactive Map. Available: https://www.co.burlington.nj.us/552/Parks-Interactive-Map.

Cape May County. No date. Department of Tourism. Tourism Impacts in Cape May County. Available: https://capemaycountynj.gov/DocumentCenter/View/79/Tourism-Impacts-in-Cape-May-County-PDF.

Carr-Harris, A. and C. Lang. 2019. Sustainability and Tourism: The Effect of the United States' First Offshore Wind Farm on the Vacation Rental Market. *Resource and Energy Economics* 57:51–67. Available: https://www.sciencedirect.com/science/article/abs/pii/S0928765518302902 #sec0060%20study.

CSA Ocean Sciences, Inc. and Exponent. 2019. *Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Headquarters, Sterling, VA. OCS Study BOEM 2019-049.

Cumberland County. 2021. Tourism and Recreation. Available: http://www.co.cumberland.nj.us/Tourism.

Haughton, J., D. Giuffre, and J. Barrett. 2003. *Blowing in the Wind: Offshore Wind and the Cape Cod Economy*. The Beacon Hill Institute. Available: https://www.beaconhill.org/BHIStudies/ BHIWindFarmStudy102803a.pdf. Accessed: October 7, 2022.

Kirkpatrick, A. J., S. Benjamin, G. S. DePiper, T. Murphy, S. Steinback, and C. Demarest. 2017. *Socio-Economic Impact of Outer Continental Shelf Wind Energy Development on Fisheries in the U.S. Atlantic*. Volume I—Report Narrative. U.S Dept. of the Interior, Bureau of Ocean Energy Management, Atlantic OCS Region, Washington, D.C. OCS Study BOEM 2017-012. 150 pp. Available: https://espis.boem.gov/final%20reports/5580.pdf. Accessed October 22, 2021.

Lutzeyer, S., D. J. Phaneuf, and L. O. Taylor. 2017. *The Amenity Costs of Offshore Windfarms: Evidence from a Choice Experiment*. (CEnREP Working Paper No. 17-017). Raleigh, NC: Center for Environmental and Resource Economic Policy. August 2017.

Mid-Atlantic Regional Council on the Ocean (MARCO). 2018. Data Portal. Recreational Boating Survey. Available: http://midatlanticocean.org/data-portal/.

National Oceanic and Atmospheric Administration (NOAA). No date. Fisheries One Stop Shop (FOSS). Available: https://www.fisheries.noaa.gov/foss/f?p=215:200:13647185114733:Mail:NO. Accessed March 23, 2022.

National Oceanic and Atmospheric Administration (NOAA). 2022a. Marine Recreational Information Program (MRIP) Survey Directories. Available: https://www.st.nmfs.noaa.gov/msd/html/ siteRegister.jsp. Accessed: April 13, 2022.

National Oceanic and Atmospheric Administration (NOAA). 2022b. *Social Indicators for Coastal Communities.* Available: https://www.fisheries.noaa.gov/national/socioeconomics/social-indicators-coastal-communities. Accessed: April 1, 2022.

National Oceanic and Atmospheric Administration (NOAA). 2022c. *Fisheries Economics of the United States 2019*. Economics and Sociocultural Status and Trends Series. NOAA Technical Memorandum NMFS-F/SPO-229A. Available: https://media.fisheries.noaa.gov/2022-07/FEUS-2019-final-v3_0.pdf. Accessed: September 19, 2022.

National Park Service (NPS). 2021. *Land and Water Conservation Fund State Assistance Program*. Federal Financial Assistance Manual Volume 71. Available: https://www.nps.gov/subjects/lwcf/upload/LWCF-FA-Manual-Vol-71-3-11-2021-final.pdf.

New Jersey Casino Reinvestment Development Authority (NJCRDA). 2012. *Atlantic City: Tourism District Master Plan*. Volume 1. Available: https://njcrda.com/wp-content/uploads/documents/2021/06/Tourism-District-Master-Plan-Vol.1.pdf.

New Jersey Department of Environmental Protection (NJDEP). 2018a. *2018–2022 New Jersey Statewide Comprehensive Outdoor Recreation Plan*. Green Acres Program. September. Available: https://www.state.nj.us/gspt/pdf/Reports/DEPComprehensiveOutdoorRecreationPlan.pdf.

New Jersey Department of Environmental Protection (NJDEP). 2018b. Blue Claws: Crabbing in New Jersey. Available: https://www.state.nj.us/dep/fgw/blueclaw.htm.

New Jersey Department of Environmental Protection (NJDEP). 2018c. Division of Fish and Wildlife. Tuckahoe WMA Impoundment Management. Available: https://www.state.nj.us/dep/fgw/news/2018/tuckahoe_improvements18-2.htm.

New Jersey Department of Environmental Protection (NJDEP). 2021a. Division of Fish and Wildlife. Wildlife Management Areas. Available: https://www.state.nj.us/dep/fgw/wmaland.htm.

New Jersey Department of Environmental Protection (NJDEP). 2021b. Parks by Location. Available: https://www.njparksandforests.org/map.html.

New Jersey Department of State. 2021a. Division of Travel and Tourism. Surfing New Jersey. Available: https://www.visitnj.org/article/surfing-new-jersey.

New Jersey Department of State. 2021b. Division of Travel and Tourism. New Jersey Sailing Center. Available: https://www.visitnj.org/nj-charter-boats/new-jersey-sailing-center.

New Jersey Department of State. 2021c. Division of Travel and Tourism. Edwin B. Forsythe National Wildlife Refuge. Available: https://visitnj.org/nj-hiking/edwin-b-forsythe-national-wildlife-refuge.

New Jersey Department of State. 2021d. Division of Travel and Tourism. Barnegat Lighthouse State Park. Available: https://www.visitnj.org/nj-lighthouses/barnegat-lighthouse-state-park.

Ocean County. 2021. Department of Parks and Recreation. Ocean County Parks. Available: http://www.oceancountyparks.org/.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Orr, Terry L., Susan M. Herz, and Darrell L. Oakley. 2013. *Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments*. Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2013-0116. Available: https://espis.boem.gov/final%20reports/5298.pdf.

Parsons, George, and Jeremy Firestone. 2018. *Atlantic Offshore Wind Energy Development: Values and Implications for Recreation and Tourism*. U.S. Department of the Interior, Bureau of Ocean Energy Management. Available: https://www.semanticscholar.org/paper/Atlantic-Offshore-Wind-Energy-Development%3A-Values-Parsons-Firestone/91b0ede146b8701cb44d72c58f09b29533df3cdf.

Parsons, G., J. Firestone, L. Yan, J. Toussaint. 2020. The Effect of Offshore Wind Power Projects on Recreational Beach Use on the East Coast of the United States: Evidence from Contingent-Behavior Data. *Energy Policy* 144:111659. Available: https://www.sciencedirect.com/science/article/abs/pii/S030142152030389X.

Smythe, T., H. Smith, A. Moore, D. Bidwell, and J. McCann. 2018. *Analysis of the Effects of Block Island Wind Farm (BIWF) on Rhode Island Recreation and Tourism Activities*. U.S. Department of the Interior, Bureau of Ocean Energy Management. Sterling, Virginia. OCS Study BOEM 2018-068. Available: https://espis.boem.gov/final%20reports/BOEM_2018-068.pdf.

Tourism Economics. 2021. Economic Impact of Tourism in New Jersey, 2021. Available: https://visitnj.org/sites/default/files/Economic_Impact_of_Tourism_in_New_Jersey_2021_Final.pdf?tag=itinerary.

U.S. Census Bureau. 2021a. ACS Business and Economy Estimates. 2015–2019 American Community Survey 5-Year Estimates. Available: https://data.census.gov/cedsci/all?q=&text=at-place%20employment&t=Business%20and%20Economy. Accessed: September 15, 2021.

U.S. Census Bureau. 2021b. ACS Employment and Payroll Estimates. 2015–2019 American Community Survey 5-Year Estimates. Available: https://data.census.gov/cedsci/all?q=&text=at-place%20employment&t=Payroll. Accessed: September 15, 2021.

B.2.3.19. Section 3.19, Sea Turtles

Alpine Ocean Seismic Survey, Inc. (Alpine). 2017. *Ocean Wind High Resolution Geophysical and Geotechnical Survey, Protected Species Observer Report*. Survey Report for Alpine Ocean Seismic Survey Inc. on behalf of Ocean Wind LLC.

Bailey, H., S. R. Benson, G. L. Shillinger, S. J. Bograd, P. H. Dutton, S. A. Eckert, S. J. Morreale, F. V. Paladino, T. Eguchi, D. G. Foley, B. A. Block, R. Piedra, C. Hitipeuw, R. F. Tapilatu, and J. R. Spotila. 2012. Identification of distinct movement patterns in Pacific leatherback turtle populations influenced by ocean conditions. *Ecological Applications* 22(3):735–747.

Barkaszi, M. J., M. Fonseca, T. Foster, A. Malhotra, and K. Olsen. 2021. *Risk Assessment to Model Encounter Rates between Large Whales and Sea Turtles and Vessel Traffic from Offshore Wind Energy on the Atlantic OCS*. OCS Study BOEM 2021-034. April 2021. Available: https://espis.boem.gov/final%20reports/BOEM_2021-034.pdf. Accessed: November 7, 2022.

Barnette, M. C. 2017. *Potential impacts of artificial reef development on sea turtle conservation in Florida*. NNMFS Southeast Regional Office, St. Petersburg, FL. January 2017. NOAA Technical Memorandum. NMFS-SER5. Available: https://tethys.pnnl.gov/sites/default/files/publications/NOAA-2017-SeaTurtle.pdf. Accessed: November 16, 2021.

Bartol, S. M., and D. R. Ketten. 2006. "Turtle and Tuna Hearing." In *Sea Turtle and Pelagic Fish Sensory Biology: Developing Techniques to Reduce Sea Turtle Bycatch in Longline Fisheries*, edited by Y. Swimmer and R. Brill, 98-105. NOAA Technical Memorandum. NMFS-PIFSC-7.

Bartol, S. M., and I. K. Bartol. 2011. Hearing Capabilities of Loggerhead Sea Turtles (*Caretta caretta*) Throughout Ontogeny: an Integrative Approach Involving Behavioral and Electrophysical Techniques. Final Report submitted to the Joint Industries Programme. 35 pp.

Bartol, S. M., J. A. Musick, and M. L. Lenhardt. 1999. Auditory evoked potentials of the loggerhead sea turtle (*Caretta caretta*). *Copeia* 1999(3):836–840.

Bejarano, A. C., J. Michel, J. Rowe, Z. Li, D. French McCay, L. McStay and D. S. Etkin. 2013. *Environmental Risks, Fate and Effects of Chemicals Associated with Wind Turbines on the Atlantic Outer Continental Shelf*. US Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2013-213.

Berreiros J. P., and V. S. Raykov. 2014. Lethal lesions and amputation caused by plastic debris and fishing gear on the loggerhead turtle Caretta (Linnaeus, 1758). Three case reports from Terceira Island, Azores (NE Atlantic). *Marine Pollution Bulletin* 86:518–522.

Bolten, A. B., L. B. Crowder, M. G. Dodd, A. M. Lauritsen, J. A. Musick, B. A. Schroeder, and B. E. Witherington. 2019. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (*Caretta caretta*) Second Revision (2008): Assessment of progress for recovery. December 2019. 21 pp. Available: https://media.fisheries.noaa.gov/dam-migration/final_nw_atl_cc_recovery_team_progress_review_report_508.pdf. Accessed November 7, 2022.

Borcuk, J. R., G. H. Mitchell, S. L. Watwood, T. E. Moll, E. M. Oliveira, and E. R. Robinson. 2017. *Dive distribution and group size parameters for marine species occurring in the U.S. Navy's Atlantic and Hawaii-Southern California training and testing study areas*. Naval Undersea Warfare Center Division. Newport, Rhode Island. NUWC-NPT Technical Report 12,243. June 2017. Available: https://apps.dtic.mil/sti/pdfs/AD1046608.pdf. Accessed: June 28, 2022.

Brazner, J. C., and J. McMillan. 2008. Loggerhead turtle (Caretta caretta) bycatch in Canadian pelagic longline fisheries: relative importance in the western North Atlantic and opportunities for mitigation. *Fisheries Research* 91(2–3):310–324.

Bugoni, L., L. Krause, and M. V. Petry. 2001. Marine debris and human impacts on sea turtles in southern Brazil. *Marine Pollution Bulletin* 42(12):1330–1334.

Bureau of Ocean Energy Management (BOEM). 2012. *Atlantic OCS Proposed Geological and Geophysical Activities: Final Programmatic Environmental Impact Statement*. Mid-Atlantic and South Atlantic Planning Areas. Office of Renewable Energy Programs. OCS EIS/EA BOEM 2014-001. March 2012. Available: https://www.boem.gov/oil-gas-energy/atlantic-geological-and-geophysical-gg-activities-programmatic-environmental-impact. Accessed: August 20, 2021.

Bureau of Ocean Energy Management (BOEM). 2018. *Biological Assessment: Data Collection and Site Survey Activities for Renewable Energy of the Atlantic Outer Continental Shelf*. U.S. Department of the Interior Bureau of Ocean Energy Management, Office of Renewable Energy Programs.

Bureau of Ocean Energy Management (BOEM). 2021a. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2021-0012. Available: https://www.boem.gov/vineyard-wind.

Bureau of Ocean Energy Management (BOEM). 2021b. *South Fork Wind Farm and South Fork Export Cable Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2020-057. Available: https://www.boem.gov/renewable-energy/state-activities/sfwf-feis.

Bureau of Ocean Energy Management (BOEM). 2022. *Ocean Wind Offshore Wind Farm Biological Assessment for National Marine Fisheries Service.* [Month].

Burke, V. J., E. A. Standora, and S. J. Morreale. 1993. Diet of juvenile Kemp's ridley and loggerhead sea turtles from Long Island, New York. *Copeia* 1993(4):1176–1180.

Burke V., S. Morreale, and E. Standora. 1994. Diet of the Kemp's ridley sea turtle, Lepidochelys kempii, in New York waters. *Fishery Bulletin* 92:26–32.

Byles, R. A. 1988. *The Behavior and Ecology of Sea Turtles in Virginia*. Unpublished Ph.D. dissertation, Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA.

Carr, A., and D. Caldwell. 1956. The ecology and migrations of Sea Turtles, I. Results of field work in Florida, 1955. *American Museum Novitates* 1793:1–23.

Ceriani, S. A., J. D. Roth, C. R. Sasso, C. M. McClellan, M. C. James, H. L. Haas, R. J. Smolowitz, D. R. Evans, D. S. Addison, D. A. Bagley, and L. M. Ehrhart. 2014. Modeling and mapping isotopic patterns in the Northwest Atlantic derived from loggerhead sea turtles. *Ecosphere* 5(9)1–24.

Conserve Wildlife Foundation of New Jersey. 2021. *New Jersey Endangered and Threatened Species Field Guide*. Available: http://www.conservewildlifenj.org/species/fieldguide/. Accessed: August 20, 2021.

Degraer, S., D. Carey, J. Coolen, Z. Hutchison, F. Kerckhof, B. Rumes, and J. Vanaverbeke. 2020. Offshore Wind Farm Artificial Reefs Affect Ecosystem Structure and Functioning: A Synthesis. *Oceanography* 33(4):48–57.

Denes, S. L., D. G. Zeddies, and M. M. Weirathmueller. 2021. *Turbine Foundation and Cable Installation at South Fork Wind Farm: Underwater Acoustic Modeling of Construction Noise*. Appendix J1 in *Construction and Operations Plan South Fork Wind Farm*. Silver Spring, Maryland: JASCO Applied Sciences.

DeRuiter, S. L., and K. L. Doukara. 2012. Loggerhead turtles dive in response to airgun sound exposure. Loggerhead turtles dive in response to airgun sound exposure. *Endangered Species Research* 16: 55–63. Available: https://www.seaturtles911.org/research/publications/DeRuiter_2012_Loggerhead_turtles_dive_in_response_to_airgun_sound_exposure.pdf. Accessed: April 1, 2022.

Dickerson, D., M. S. Wolters, C. Theriot, and C. Slay. 2004. September. Dredging impacts on sea turtles in the Southeastern USA: a historical review of protection. In *Proceedings of World Dredging Congress XVII*, Dredging in a Sensitive Environment (Vol. 27).

Eastman, C. B., J. A. Farrell, L. Whitmore, D. R. Rollinson Ramia, R. S. Thomas, J. Prine, S. F. Eastman, T. Z. Osborne, M. Q. Martindale, and D. J. Duffy. 2020. Plastic ingestion in post-hatchling sea turtles: Assessing a major threat in Florida near shore waters. *Frontiers in Marine Science* 25, August 2020.

Eckert, K. L., B. P. Wallace, J. G. Frazier, S. A. Eckert, and P. C. H. Pritchard. 2012. *Synopsis of the Biological Data on Leatherback Sea Turtles (Dermochelys coriacea)*. US. Department of the Interior, Fish and Wildlife Service, Biological Technical Publication BTP-R4015-2012, Washington D.C. Available: http://seaturtle.org/library/EckertKL_2012_USFWSTechReport.pdf. Accessed: April 1, 2022.

Edmonds, N. J., C. J. Firmin, D. Goldsmith, R. C. Faulkner, and D. T. Wood. 2016. A review of crustacean sensitivity to high amplitude underwater noise: Data needs for effective risk assessment in relation to UK commercial species. *Marine Pollution Bulletin* 108(1):5–11.

Epperly, S., L. Avens, L. Garrison, T. Henwood, W. Hoggard, J. Mitchell, J. Nance, J. Poffenberger, C. Sasso, E. Scott-Denton, and C. Yeung. 2002. *Analysis of Sea Turtle Bycatch in the Commercial Shrimp Fisheries of Southeast U.S. Waters and the Gulf of Mexico*. NOAA Technical Memorandum NMFS-SEFSC-490:1–88.

Excelon Generation. 2012. *Annual sea turtle incidental take report – 2012*. Oyster Creek Nuclear Generating Station report submitted to NMFS. Prepared by M. Browne, K. Voishnis, and J. Kerr. December 2012. Available: https://www.nrc.gov/docs/ML1236/ML12361A025.pdf. Accessed: November 16, 2021.

Finkbeiner, E. M., B. P. Wallace, J. E. Moore, R. L. Lewison, L. B. Crowder, and A. J. Read. 2011. Cumulative estimates of sea turtle bycatch and mortality in USA fisheries between 1990 and 2007. *Biological Conservation* 144(11):2719–2727.

Finneran, J., E. Henderson, D. Houser, K. Jenkins, S. Kotecki, and J. Mulsow. 2017. *Criteria and Thresholds for US Navy Acoustic and Explosive Effects Analysis (Phase III)*. Technical report by Space and Naval Warfare Systems Center Pacific (SSC Pacific). 183 pp.

Foley, A. M., B. A. Stacy, R. F. Hardy, C. P. Shea, K. E. Minch, and B. A. Schroeder. 2019. Characterizing Watercraft-Related Mortality of Sea Turtles in Florida. *The Journal of Wildlife Management* 83(5):1057–1072. Available: https://wildlife.onlinelibrary.wiley.com/doi/pdf/10.1002/jwmg.21665. Accessed: April 1, 2022.

Foley, A. M., K. Singel, R. Hardy, R. Bailey, K. Sonderman, and S. Schaf. 2008. *Distributions, relative abundances, and mortality factors for sea turtles in Florida from 1980 through 2007 as determined from strandings*. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Jacksonville Field Laboratory. Available: https://georgehbalazs.com/wp-content/uploads/2020/03/Stranding-Report-2007.pdf. Accessed: November 16, 2021.

Gitschlag, G. R., and B. A. Herczeg. 1994. Sea Turtle Observations at Explosive Removals of Energy Structures. *Marine Fisheries Review* 56(2):1–8.

Greater Atlantic Regional Fisheries Office (GARFO). 2021. Master ESA Species Table - Sea Turtles. Available: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-species-presence-table-sea-turtles-greater.

Gregory, M. R. 2009. Environmental implications of plastic debris in marine settings – Entanglement, ingestion, smothering, hangers-on, hitch-hiking, and alien invasion. *Philosophical Transactions of the Royal Society* B 364:2013–2025.

Hastings, R. W., L. H. Ogren, and M. T. Marbry. 1976. Observations of Fish Fauna Associated with Offshore Platforms in the Northeastern Gulf of Mexico. *Fisheries Bulletin* 74(2):387–402.

Hazel, J., I. Lawler, H. Marsh, and S. Robson. 2007. Vessel speed increases collision risk for the green turtle Chelonia mydas. *Endangered Species Research* 3:105–113.

Heithaus, M. R., J. J. McLash, A. Frid, L. W. Dill, and G. J. Marshall. 2002. Novel insights into green sea turtle behavior using animal-borne video cameras. Journal *of the Marine Biological Association of the UK* 82(06):1049–1050.

Henwood, T. A., and W. E. Stuntz. 1987. Analysis of sea turtle captures and mortalities during commercial shrimp trawling. *Fisheries Bulletin* 85(4):814–817.

Hoarau, L., L. Ainley, C. Jean, and S. Ciccione. 2014. Ingestion and defecation of marine debris by loggerhead sea turtles, from by-catches in the south-west Indian Ocean. *Marine Pollution Bulletin* 84:90–96.

Hochscheid, S. 2014. Why we mind sea turtles' underwater business: A review on the study of diving behavior. *Journal of Experimental Marine Biology and Ecology*, 450:118–136.

Hutchison, Z. L., M. L. Bartley, S. Degraer, P. English, A. Khan, J. Livermore, B. Rumes, and J. W. King. 2020. Offshore wind energy and benthic habitat changes: Lessons from Block Island Wind Farm. *Oceanography* 33(4):58–69.

James, M. C., S. A. Sherrill-Mix, K. Martin, and R. A. Myers. 2006. Canadian waters provide critical foraging habitat for leatherback sea turtles. *Biological Conservation* 133:347–357.

Janßen, H., C. B. Augustin, H. H. Hinrichsen, and S. Kube. 2013. Impact of secondary hard substrate on the distribution and abundance of *Aurelia aurita* in the western Baltic Sea. *Marine Pollution Bulletin* 75: 224–234.

Johnson, A. 2018. *The effects of turbidity and suspended sediments on ESA-listed species from projects occurring in the Greater Atlantic Region*. Greater Atlantic Region Policy Series 18-02. NOAA Fisheries Greater Atlantic Regional Fisheries Office. 106 pp. Available: https://www.greateratlantic.fisheries.noaa.gov/policyseries/index.php/GARPS/article/view/8/8. Accessed: April 1, 2022.

Ketten, D. R., and S. M. Bartol. 2006. *Functional measures of sea turtle hearing*. Woods Hole Oceanographic Institution, Woods Hole, Massachusetts. Available: www.ntis.gov.

Kraus, S. D., S. Leiter, K. Stone, B. Wikgren, C. Mayo, P. Hughes, R. D. Kenney, C. W. Clark, A. N. Rice, B. Estabrook and J. Tielens. 2016. *Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles.* OCS Study BOEM 2016-054. Sterling, Virginia: U.S. Department of the Interior, Bureau of Ocean Energy Management.

Lavender, A. L., S. M. Bartol, and I. K. Bartol. 2014. Ontogenetic investigation of underwater hearing capabilities in loggerhead sea turtles (*Caretta caretta*) using a dual testing approach. *Journal of Experimental Biology* 217:2580–2589.

Lazell, J. D., Jr. 1980. New England waters: Critical habitat for marine turtles. *Copeia* 1980(2):290–295.

Lohmann, K. J., N. F. Putman, and C. M. F. Lohmann. 2008. Geomagnetic Imprinting: a Unifying Hypothesis of Long-Distance Natal Homing in Salmon and Sea Turtles. *Proceedings of the National Academy of Sciences* 105(49):19096–190101.

Luschi, P., S. Benhamou, C. Girard, S. Ciccione, D. Roos, J. Sudre, and S. Benvenuti. 2007. Marine Turtles use Geomagnetic Cues during Open Sea Homing. *Current Biology* 17:126–133. Available: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.572.8884&rep=rep1&type=pdf. Accessed: April 1, 2022.

Lutcavage, M. E., and P. L. Lutz. 1997. Diving physiology. In: Lutz P. L, Musick J. A, editors. *The biology of sea turtles*. CRC Press; Boca Raton, FL: pp. 277–296.

Martin, K. J., S. C. Alessi, J. C. Gaspard, A. D. Tucker, G. B. Bauer, and D. A. Mann. 2012. Underwater hearing on the loggerhead turtle (*Caretta caretta*): A comparison of behavioral and auditory evoked potential audiograms. *Journal of Experimental Biology* 215(17):3001–3009.

Mavraki, N., S. Degraer, J. Vanaverbeke, and U. Braeckman. 2020. Organic matter assimilation by hard substrate fauna in an offshore wind farm area: a pulse-chase study. *ICES Journal of Marine Science* 77:2681–2693.

Mazor, T., N. Levin, H. P. Possingham, Y. Levy, D. Rocchini, A. J. Richardson, et al. 2013. Can satellite-based night lights be used for conservation? The case of nesting sea turtles in the Mediterranean. *Biological Conservation* 159:63–72. Available: https://karkgroup.org/wp-content/uploads/Mazor-et-al-2013-sea-turtles.pdf. Accessed: April 8, 2022.

McCauley, R. D., J. Fewtrell, A. J. Duncan, C. Jenner, M.-N. Jenner, J. D. Penrose, R. I. T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000. Marine seismic surveys: a study of environmental implications. *The APPEA Journal* 40:692–708.

McKenna, M. F., D. Ross, S. M. Wiggins, and J. A. Hildebrand. 2012. Underwater radiated noise from modern commercial ships. *Journal of the Acoustical Society of America* 131(1):92–103. Available: https://www.cetus.ucsd.edu/docs/publications/McKennaJASA2012.pdf. Accessed: April 6, 2022.

Methratta, E. T., and W. R. Dardick. 2019. Meta-Analysis of Finfish Abundance at Offshore Wind Farms. *Reviews in Fisheries Science & Aquaculture* 27(2):242–260.

Meylan, A. 1995. Sea turtle migration: Evidence from tag returns. In *Biology and Conservation of Sea Turtles* (revised), edited by K. A. Bjorndal, pp. 91–100. Washington, D.C.: Smithsonian Institution Press.

Michel, J. A., C. Bejarano, C. H. Peterson, and C. Voss. 2013. *Review of biological and biophysical impacts from dredging and handling of offshore sand*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Herndon, VA. OCS Study BOEM 2013-0119. 258 pp. Available: https://espis.boem.gov/final%20reports/5268.pdf. Accessed: November 16, 2021.

Miller, J. H., and G. R. Potty. 2017. Overview of underwater acoustic and seismic measurements of the construction and operation of the Block Island Wind Farm. *Journal of the Acoustical Society of America* 141(5):3993. DOI:10.1121/1.4989144. Available: https://asa.scitation.org/doi/10.1121/1.4989144. Accessed: April 1, 2022.

Minerals Management Service (MMS). 2007. *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf*. Available: https://www.boem.gov/Guide-To-EIS/. Accessed: January 1, 2019.

Moein, S. E., J. A. Musick, J. A. Keinath, D. E. Barnard, M. Lenhardt, and R. George. 1994. *Evaluation of seismic sources for repelling sea turtles from hopper dredges*. Final report submitted to the U.S. Army Corps of Engineers Waterways Experimental Station by the Virginia Institute of Marine Science, College of William and Mary. Gloucester Point, VA.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 1991. Recovery Plan for U.S. Population of the Atlantic Green Turtle (*Chelonia mydas*). Washington, D.C.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 1992. Recovery Plan for Leatherback Turtles (*Dermochelys coriacea*) in the U.S. Caribbean, Atlantic and Gulf of Mexico. Silver Spring, Maryland: National Marine Fisheries Service.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2007a. Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) 5-Year Review: Summary and Evaluation. Silver Spring, Maryland: National Marine Fisheries Service, Office of Protected Resources; Albuquerque, New Mexico: U.S. Fish and Wildlife Service, Southwest Region.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2007b. Green Sea Turtle (*Chelonia mydas*) 5-Year Review: Summary and Evaluation. August.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2007c. Loggerhead Sea Turtle (Caretta caretta) 5-Year Review: Summary and Evaluation. National Fisheries Service, Washington, D.C.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2013. Leatherback Sea Turtle (*Dermochelys coriacea*) 5-Year Review: Summary and Evaluation. Silver Spring, Maryland, and Jacksonville, Florida. November.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2015a. Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) 5-Year Review: Summary and Evaluation. Silver Spring, Maryland, and Albuquerque, New Mexico. July.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2015b. Green Turtle (*Chelonia mydas*) Status Review under the U.S. Endangered Species Act. Report of the Green Turtle Status Review Team.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2020. Endangered Species Act Status Review of the Leatherback Turtle (*Dermochelys coriacea*). Report to the National Marine Fisheries Service Office of Protected Resources and U.S. Fish and Wildlife Service.

National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and Secretariat of Environment and Natural Resources. 2011. Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*). Second revision. Silver Spring, Maryland: National Marine Fisheries Service, U.S. Fish and Wildlife Service, and Secretariat of Environment and Natural Resources.

National Marine Fisheries Service (NMFS). 2016. Endangered Species Act Section 7 Consultation on the Continued Prosecution of Fisheries and Ecosystem Research Conducted and Funded by the Northeast Fisheries Science Center and the Issuance of a Letter of Authorization under the Marine Mammal Protection Act for the Incidental Take of Marine Mammals Pursuant to those Research Activities PCTS ID: NER-2015-12532. Available: https://media.fisheries.noaa.gov/dam-migration/nefsc_rule2016_biop.pdf. Accessed: April 1, 2022.

National Marine Fisheries Service (NMFS). 2019. Kemp's Ridley Turtle *Lepidochelys kempii*. Species Directory. Available: https://www.fisheries.noaa.gov/species/kemps-ridley-turtle. Accessed: December 7, 2020.

National Marine Fisheries Service (NMFS). 2020. *Section 7 Effect Analysis: Turbidity in the Greater Atlantic Region: Guidance for action agencies to address turbidity in their Effects Analysis*. NOAA Greater Atlantic Regional Fisheries Office. Available: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effect-analysis-turbidity-greater-atlantic-region. Accessed: November 16, 2021.

National Marine Fisheries Service (NMFS). 2021a. Sea Turtle Stranding and Salvage Network Public. Annual data reports for Zone 39, in New Jersey. Available: https://grunt.sefsc.noaa.gov/stssnrep/SeaTurtleReportI.do?action=reportquery. Accessed: September 21, 2021.

National Marine Fisheries Service (NMFS). 2021b. Section 7 Consultation with GARFO - Effects of certain site assessment and site characterization activities to be carried out to support the siting of offshore wind energy development projects off the U.S. Atlantic coast.

National Oceanic and Atmospheric Administration (NOAA). 2013. *Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals: Acoustic threshold levels for onset of permanent and temporary threshold shifts*. December 2013, 76 pp. Silver Spring, Maryland: NMFS Office of Protected Resources. Available: http://www.nmfs.noaa.gov/pr/acoustics/draft_acoustic_guidance_2013.pdf.

National Park Service (NPS). 2021. Review of the Sea Turtle Science and Recovery Program at Padre Island National Seashore. Approved June 8, 2020; Amended May 7, 2021. Available: https://www.nps.gov/pais/learn/management/upload/PAIS-STSR-Review-Report_20210507_FINALamended_508.pdf.

National Research Council. 1990. *Decline of the Sea Turtles: Causes and Prevention*. Washington, D.C.: National Academy Press. 280 pp. Available: https://nap.nationalacademies.org/catalog/1536/decline-of-the-sea-turtles-causes-and-prevention. Accessed: March 28, 2002.

National Science Foundation (NSF) and U.S. Geological Survey (USGS). 2011. *Final Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research*. Available: https://www.nsf.gov/geo/oce/envcomp/usgs-nsf-marine-seismic-research/nsf-usgs-final-eis-oeis_3june2011.pdf. Accessed: August 20, 2021.

Nelms, S. E., E. M. Duncan, A. C. Broderick, T. S. Galloway, M. H. Godfrey, M. Hamann, P. K. Lindeque, and B. J. Godley. 2016. Plastic and marine turtles: A review and call for research. *ICES Journal of Marine Science* 73(2):165–181.

New Jersey Department of Environmental Protection (NJDEP). 2006. New Jersey Marine Mammal and Sea Turtle Conservation Workshop Proceedings. Endangered and Nongame Species Program Division of Fish and Wildlife. April 17-19, 2006. Available: https://www.state.nj.us/dep/fgw/ensp/pdf/marinemammal_seaturtle_workshop06.pdf. Accessed: September 21, 2021.

New Jersey Department of Environmental Protection (NJDEP). 2010. *Ocean/Wind Power Ecological Baseline Studies January 2008–December 2009*. Final Report. Prepared for New Jersey Department of Environmental Protection Office of Science by Geo-Marine, Inc., Plano, Texas. Available: https://dspace.njstatelib.org/xmlui/handle/10929/68435. Accessed: July 2010.

New Jersey Department of Environmental Protection (NJDEP). 2010. Citing Mrosovsky, N. 1980. Thermal biology of sea turtles. *American Zoologist* 20(3):531–547.

Normandeau Associates, Inc. (Normandeau), Exponent, Inc., T. Tricas, and A. Gill. 2011. *Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species*. Final Report. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09. Available: https://espis.boem.gov/final%20reports/5115.pdf.

Normandeau Associates, Inc. and APEM Inc. 2018a. *Digital aerial baseline survey of marine wildlife in support of offshore wind energy: Summer 2018 taxonomic analysis summary report*. Prepared for New York State Energy Research and Development Authority. Available: https://remote.normandeau.com/docs/NYSERDA_Summer_2018_Taxonomic_Analysis_Summary_Report.pdf.

Normandeau Associates, Inc. and APEM Inc. 2018b. *Digital aerial baseline survey of marine wildlife in support of Offshore Wind Energy: Spring 2018 taxonomic analysis summary report*. Prepared for New York State Energy Research and Development Authority. Available: https://remote.normandeau.com/docs/NYSERDA_Spring_2018_Taxonomic_Analysis_Summary_Report.pdf.

Normandeau Associates, Inc. and APEM Inc. 2019a. *Digital aerial baseline survey of marine wildlife in support of offshore wind energy: Spring 2019 taxonomic analysis summary report*. Prepared for New York State Energy Research and Development Authority. Available: https://remote.normandeau.com/docs/NYSERDA_Spring_2019_Taxonomic_Analysis_Summary_Report.pdf.

Normandeau Associates, Inc. and APEM Inc. 2019b. *Digital aerial baseline survey of marine wildlife in support of offshore wind energy: Fall 2018 taxonomic analysis summary report*. Prepared for New York State Energy Research and Development Authority. Available: https://remote.normandeau.com/docs/NYSERDA_Fall_2018_Taxonomic_Analysis_Summary_Report.pdf.

Normandeau Associates, Inc. and APEM Inc. 2020. *Digital aerial baseline survey of marine wildlife in support of offshore wind energy: Winter 2018-2019 taxonomic analysis summary report*. Prepared for New York State Energy Research and Development Authority. Available: https://remote.normandeau.com/docs/NYSERDA_Winter_2018_19_Taxonomic_Analysis_Summary_Report.pdf.

Northeast Fisheries Science Center and Southeast Fisheries Science Center (NEFSC and SEFSC). 2011. *Preliminary Summer 2010 Regional Abundance Estimate of Loggerhead Turtles (Caretta caretta) in Northwestern Atlantic Ocean Continental Shelf Waters*. Northeast Fisheries Science Center Reference Document 11-03. On file, National Marine Fisheries Service, Woods Hole, Massachusetts. April.

Northeast Regional Ocean Council (NROC). 2023. Northeast Ocean Data Portal. Log density of tagged loggerhead sea turtles – annual percent predicted density in each grid cell. Available: https://www.northeastoceandata.org/data-explorer/. Accessed: January 23, 2023.

O'Hara, J., and J. R. Wilcox. 1990. Responses of loggerhead sea turtles, *Caretta caretta*, to low frequency sound. *Copeia* 199:564–567.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Orr, T. L., S. M. Herz, and D. L. Oakley. 2013. *Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments.* Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2013-0116. 429 pp. Available: https://espis.boem.gov/final%20reports/5298.pdf. Accessed November 18, 2021.

Palka, D. L., S. Chavez-Rosales, E. Josephson, D. Cholewiak, H. L. Haas, L. Garrison, M. Jones, D. Sigourney, G. Waring (retired), M. Jech, E. Broughton, M. Soldevilla, G. Davis, A. DeAngelis, C. R. Sasso, M. V. Winton, R. J. Smolowitz, G. Fay, E. LaBrecque, J. B. Leiness, K. Dettloff, M. Warden, K. Murray, and C. Orphanides. 2017. *Atlantic Marine Assessment Program for Protected Species: 2010–2014*. OCS Study BOEM 2017-071. Washington, D.C.: U.S. Department of the Interior, Bureau of Ocean Energy Management, Atlantic OCS Region. Available: https://espis.boem.gov/final%20reports/5638.pdf.

Palka, D., L. Aichinger Dias, E. Broughton, E. Chavez-Rosales, D. Cholewiak, G. Davis, A. DeAngelis, L. Garrison, H. Haas, J. Hatch, K. Hyde, M. Jech, E. Josephson, L. Mueller-Brennan, C. Orphanides, N. Pegg, C. Sasso, D. Sigourney, M. Soldevilla, and H. Walsh. 2021. *Atlantic Marine Assessment Program for Protected Species: FY15 – FY19*. OCS Study BOEM 2021-051. Washington DC: US Department of the Interior, Bureau of Ocean Energy Management. Available: https://espis.boem.gov/Final%20reports/BOEM_2021-051.pdf.

Patel, S. H., M. V. Winton, J. M. Hatch, H. L. Haas, V. S. Saba, G. Fay, and R. J. Smolowitz. 2021. Projected shifts in loggerhead sea turtle thermal habitat in the Northwest Atlantic Ocean due to climate change. *Scientific Reports* 11:8850.

Pezy, J. P., A. Raoux, and J. C. Dauvin. 2018. An ecosystem approach for studying the impact of offshore wind farms: A French case study. *ICES Journal of Marine Science* 77(3):1238–1246.

Piniak, W. E. D., D. A. Mann, C. A. Harms, T. T. Jones, and S. A. Eckert. 2016. *Hearing in the juvenile green sea turtle (*Chelonia mydas*): A comparison of underwater and aerial hearing using auditory evoked potentials*. *PLOS ONE* 11(10):e0159711.

Piniak, W. E. D., D. A. Mann, S. A. Eckert, and C. A. Harms. 2012a. Amphibious hearing in sea turtles. p. 83–88. In: A.N. Popper and A. Hawkins (eds.) *The Effects of Noise on Aquatic Life*. Springer, New York. 695 p.

Piniak, W. E. D., S. A. Eckert, C. A. Harms, and E. M. Stringer. 2012b. *Underwater Hearing Sensitivity of the Leatherback Sea Turtle (*Dermochelys coriacea*): Assessing the Potential Effect of Anthropogenic Noise*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Headquarters, Herndon, VA. OCS Study BOEM 2012-01156. 35 p.

Plotkin, P. T., M. K. Wicksten, and A. F. Amos. 1993. Feeding ecology of the loggerhead sea turtle, Caretta, in the northwestern Gulf of Mexico. *Marine Biology* 115(1):1–15.

Poloczanska, E. S., C. J. Limpus, and G. C. Hays. 2009. "Vulnerability of Marine Turtles to Climate Change." Chapter 2 in D. W. Sims (editor) *Advances in Marine Biology* 56:151–211. Available: http://seaturtle.org/PDF/PoloczanskaES_2009_InAdvancesinMarineBiology_p151-211.pdf.

Popper, A. N., A. D. Hawkins, R. R. Fay, D. A. Mann, S. Bartol, T. J. Carlson, S. Coombs, W. T. Ellison, R. L. Gentry, M. B. Halvorsen, S. Løkkeborg, P. H. Rogers, B. L. Southall, D. G. Zeddies, and W. N. Tavolga. 2014. *Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report* prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. ASA S3/SC1.4 TR-2014. Technical report.

Ramirez, A, C. Y. Kot, and D. Piatkowski. 2017. *Review of sea turtle entrainment risk by trailing suction hopper dredges in the US Atlantic and Gulf of Mexico and the development of the ASTER decision support tool*. Sterling (VA): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-084. 275 pp.

Raoux, A., S. Tecchio, J. P. Pezy, G. Lassalle, S. Degraer, S. Wilhelmsson, M. Cachera, B. Ernande, C. Le Guen, M. Haraldsson, K. Grangere, F. Le Loc'h, J. C. Dauvin, and N. Niquil. 2017. Benthic and fish aggregation inside an offshore wind farm: Which effects on the trophic web functioning? *Ecological Indicators* 72:33–46.

Reine, K. J., and D. G. Clarke. 1998. E*ntrainment by hydraulic dredges – A review of potential impacts, Technical Note DOER-E1* (pp. 1–14). U.S. Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS.

Ridgway S. H., E. G. Wever, J. G. McCormick, J. Palin, and J. H. Anderson. 1969. Hearing in the giant sea turtle, *Chelonia mydas*. *Proceedings of the National Academy of Science US* 64(2):884–890.

Ruckdeschel, C. A., and C. R. Shoop. 1988. Gut contents of loggerheads: Findings, problems and new questions. In *Proceedings of the Eighth Annual Workshop on Sea Turtle Biology and Conservation*, 97-98, 146 pp. Edited by B. A. Schroeder. NOAA Technical Memorandum NMFS-SEFC-214.

Salmon, M., and J. Wyneken. 1990. Do swimming loggerhead sea turtles (*Caretta caretta* L.) use light cues for offshore orientation? *Marine Behaviour and Physiology* 17(4):233–246.

Samuel, Y., S. J. Morreale, C. W. Clark, C. H. Greene, and M. E. Richmond. 2005. Underwater, Low-frequency Noise in a Coastal Sea Turtle Habitat. *Journal of the Acoustical Society of America* 117(3):1465–1472.

Sasso, C. R. and S. P. Epperly. 2006. Seasonal sea turtle mortality risk from forced submergence in bottom trawls. *Fisheries Research* 81:86–88.

Schmid, J. R. 1998. Marine turtle populations on the west-central coast of Florida: Results of tagging studies at the Cedar Keys, Florida, 1986–1995. *Fishery Bulletin* 96:589–602.

Schultze, L., L. Merckelbach, J. Horstmann, S. Raasch, and J. Carpenter: 2020. Increased mixing and turbulence in the wake of offshore wind farms. *Journal of Geophysical Research: Oceans* 125. *Journal of Geophysical Research*: Oceans, 125, e2019JC015858. https://doi.org/10.1029/2019JC015858. Accessed April 1, 2022.

Schuyler, Q. A., C. Wilcox, K. Townsend, B. D. Hardesty, and N. J. Marshall. 2014. Mistaken identity? Visual similarities of marine debris to natural prey items of sea turtles. *BMC Ecology* 14(14). DOI:10.1186/1472-6785-14-14.

Seminoff, J. A., C. D. Allen, G. H. Balazs, P. H. Dutton, T. Eguchi, H. L. Haas, S. A. Hargrove, M. P. Jensen, D. L. Klemm, A. M. Lauritsen, S. L. MacPherson, P. Opay, E. E. Possardt, S. L. Pultz, E. E. Seney, K. S. Van Houtan, and R. S. Waples. 2015. Status Review of the Green Turtle (*Chelonia mydas*) Under the U.S. Endangered Species Act. NOAA Technical Memorandum, NOAANMFS-SWFSC-539.

Seney, E. E., and J. A. Musick. 2007. Historical diet analysis of loggerhead sea turtles (Caretta caretta) in Virginia. *Copeia* 2007(2):478–489.

Shaver D. J., B. A. Schroeder, R. A. Byles, P. M. Burchfield, J. Peña, and R. Márquez. 2005. Movements and home ranges of adult male Kemp's ridley sea turtles (*Lepidochelys kempii*) in the Gulf of Mexico investigated by satellite telemetry. *Chelonian Conservation and Biology* 4(4):817–827.

Shaver, D., and C. Rubio. 2008. Post-nesting movement of wild and head-started Kemp's ridley sea turtles *Lepidochelys kempii* in the Gulf of Mexico. *Endangered Species Research* 4:43–55.

Shigenaka, G., S. Milton, P. Lutz, R. Hoff, R. Yender, and A. Mearns. 2010. *Oil and Sea Turtles: Biology, Planning, and Response*. NOAA Office of Restoration and Response Publication. 116 pp. Available: https://www.widecast.org/Resources/Docs/Shigenaka_et_al_2021.pdf. Accessed: April 8, 2022.

Shoop, C. R., and R. D. Kenney. 1992. Seasonal distribution and abundances of loggerhead and leatherback sea turtles in waters of the northeastern United States. *Herpetological Monograph* 6:43–67.

Smultea Environmental Sciences. 2018. Protected Species Observer Technical Report OCW01 Geotechnical 1A Survey New Jersey (2017). Prepared for Fugro Marine GeoServices, Inc., Norfolk, Virginia, and DONG Energy Wind Power (US) LLC, Boston, Massachusetts, by Smultea Environmental Sciences, Preston, Washington.

Snoek, R., R. de Swart, K. Didderen, W. Lengkeek, and M. Teunis. 2016. *Potential effects of electromagnetic fields in the Dutch North Sea*. Final report submitted to Rijkswaterstaat Water, Verkeer en Leefmgeving. 95 pp. Available: https://www.buwa.nl/fileadmin/buwa_upload/Bureau_Waardenburg_rapporten/16-101_BuWareport_potential_effects_of_electromagnetic_fields_in_the_dutch_north_sea.pdf. Accessed: April 1, 2022.

Snyder, R. 2017. Monitoring nesting sea turtles using a thermal camera. *ECO Magazine* January/February 2017:36–41. Available: https://www.seiche.com/wp-content/uploads/2020/01/Eco-Magazine-JanFeb-2017new.pdf. Accessed: November 7, 2022.

Southall, B. L., A. E. Bowles, W. T. Ellison, J. J. Finneran, R. L. Gentry, C. R. Greene, Jr., D. Kastak, D. R. Ketten, J. H. Miller, P. E. Nachtigall, W. J. Richardson, J. A. Thomas, and P. L. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals* 33(4):411–521.

Stöber, U., and F. Thomsen. 2021. How could operational underwater sound from future offshore wind turbines impact marine life? *Journal of the Acoustical Society of America* 149(3):1791–1795.

Thomás, J., R. Guitart, R. Mateo, and J. A. Raga. 2002. Marine debris ingestion in loggerhead turtles, *Caretta caretta*, from the Western Mediterranean. *Marine Pollution Bulletin* 44:211–216.

Tougaard, J., L. Hermannsen, and P. T. Madsen. 2020. How loud is the underwater noise from operating offshore wind turbines? *Journal of the Acoustical Society of America* 148(5):2885–2893.

Tougaard, J., O. D. Henriksen, and Lee A. Miller. 2009. Underwater noise from three types of offshore wind turbines: Estimation of impact zones for harbor porpoises and harbor seals. *Journal of the Acoustical Society of America* 125(6):3766–3773. DOI:10.1121/1.3117444.

Turtle Expert Working Group (TEWG). 2007. *An Assessment of the Leatherback Turtles Population in the Atlantic Ocean*. NOAA Technical Memorandum NMFS-SEFSC-555. A Report of the Turtle Expert Working Group. U.S. Department of Commerce. April 2007.

Turtle Expert Working Group (TEWG). 2009. *An Assessment of the Loggerhead Turtle Population in the Western North Atlantic Ocean*. NOAA Technical Memorandum NMFS-SEFSC-575. U.S. Department of Commerce.

U.S. Army Corps of Engineers (USACE). 2020. *South Atlantic Regional Biological Opinion for Dredging and Material Placement Activities in the Southeast United States*. 646 pp. Available: https://media.fisheries.noaa.gov/dam-migration/sarbo_acoustic_revision_6-2020-opinion_final.pdf. Accessed: November 16, 2021.

U.S. Department of the Navy (Navy). 2007. Navy OPAREA Density Estimate (NODE) for the Northeast OPAREAs for the Northeast OPAREAS: Boston, Narragansett Bay, and Atlantic City. Prepared for the Department of the Navy, U.S. Fleet Forces Command, Norfolk, Virginia. Contract #N62470-02-D-9997, Task Order 045. Prepared by Geo-Marine, Inc., Hampton, Virginia. Available: https://seamap.env.duke.edu/downloads/resources/serdp/Northeast%20NODE%20Final%20Report.pdf.

U.S. Department of the Navy (Navy). 2017. *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)*. Technical report. June 2017. Available: https://nwtteis.com/portals/nwtteis/files/technical_reports/Criteria_and_Thresholds_for_U.S._Navy_Acoustic_and_Explosive_Effects_Analysis_June2017.pdf. Accessed: March 31, 2022.

U.S. Department of the Navy (Navy). 2018. *Hawaii-Southern California Training and Testing EIS/OEIS*. Available: https://www.hstteis.com/portals/hstteis/files/hstteis_p3/feis/section/HSTT_FEIS_3.08_Reptiles_October_2018.pdf. Accessed: September 3, 2020.

Wang, J., X. Zou, W. Yu, D. Zhang, and T. Wang. 2019. Effects of established offshore wind farms on energy flow of coastal ecosystems: A case study of the Rudong offshore wind farms in China. *Ocean & Coastal Management* 171:111–118.

Watwood, S. L., and D. M. Buonantony. 2012. *Dive distribution and group size parameters for marine species occurring in Navy training and testing areas in the North Atlantic and North Pacific oceans*. Newport, Rhode Island. NUWC-NPT Technical Document 12,085. March 2012. Available: https://apps.dtic.mil/sti/pdfs/ADA560975.pdf. Accessed: June 28, 2022.

Weishampel, Z. A., W-H. Cheng, and J. F. Weishampel. 2016. Sea turtle nesting patterns in Florida vis-a-vis satellite-derived measures of artificial lighting. *Remote Sensing in Ecology and Conservation* 2(1):59–72.

Wibbels, T., and E. Bevan. 2019. Kemp's Ridley, Lepidochelys kempii. The IUCN Red List of Threatened Species in 2019: e.T11533A142050590. Available: https://www.iucnredlist.org/species/11533/142050590.

Winton, M. V, G. Fay, H. L. Haas, M. Arendt, S. Barco, M. C. James, C. Sasso, and R. Smolowitz. 2018. Estimating the distribution and relative density of satellite-tagged loggerhead sea turtles using geostatistical mixed effects models. *Marine Ecology Progress Series* 586:217–232.

Witzell, W. N., and J. R. Schmid. 2005. Diet of immature Kemp's ridley turtles (*Lepidochelys kempi*) from Gullivan Bay, Ten Thousand Islands, southwest Florida. *Bulletin of Marine Science* 77(2):191–199.

B.2.3.20. Section 3.20, Scenic and Visual Resources

Atlantic Shores Offshore Wind (Atlantic Shores). 2021. *Construction and Operations Plan, Atlantic Shores Offshore Wind*. Volume I. September. Available: https://www.boem.gov/renewable-energy/state-activities/atlantic-shores-offshore-wind-construction-and-operations-plan.

Bureau of Ocean Energy Management (BOEM). 2021c. *Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Energy Developments on the Outer Continental Shelf of the United States*. OCS Study BOEM 2021-032. April.

Bureau of Ocean Energy Management (BOEM). 2022. *Ocean Wind Cumulative Historic Resources Visual Effects Analysis.* June.

Capitol Airspace Group. Ocean Wind Project Aircraft Detection Lighting System (ADLS) Efficacy Analysis. April 16.

Landscape Institute and Institute of Environmental Management and Assessment. 2016. *Guidelines for Landscape and Visual Assessment 3rd Edition*. Spon Press.

New Jersey Department of Environmental Protection (NJDEP). 2006. Public Access in New Jersey: The Public Trust Doctrine and Practical Steps to Enhance Public Access. Handbook prepared by the Coastal Management Office of New Jersey.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

B.2.3.21. Section 3.21, Water Quality

Bejarano, A. C., J. Michel, J. Rowe, Z. Li, D. French McCay, L. McStay, and D. S. Etkin. 2013. *Environmental Risks, Fate and Effects of Chemicals Associated with Wind Turbines on the Atlantic Outer Continental Shelf*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2013-213.

Bureau of Ocean Energy Management (BOEM). 2016. *Use of Finite-Volume Modeling and the Northeast Coastal Ocean Forecast System in Offshore Wind Energy Resource Planning*. BOEM 2016-050. July. Available: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/NE-Ocean-Forecast-Model-Final-Report.pdf. Accessed: September 21, 2022.

Bureau of Ocean Energy Management (BOEM). 2019. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Continental Shelf*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, VA. OCS Study BOEM 2019- 036. May 2019.

Bureau of Ocean and Energy Management (BOEM). 2021c. Hydrodynamic Modeling, Particle Tracking and Agent-Based Modeling of Larvae in the U.S. Mid-Atlantic Bight. OCE Study, BOEM 2021-049. Available: https://espis.boem.gov/final%20reports/BOEM_2021-049.pdf. Accessed: October 29, 2021.

Carpenter, J. R., L. Merckelbach, U. Callies, S. Clark, L. Gaslikova, and B. Baschek. 2016. "Potential Impacts of Offshore Wind Farms on North Sea Stratification." *PLOS ONE* 11(8): e0160830. Available: https://doi.org/10.1371/journal.pone.0160830.

Cazenave, Pierre William, Ricardo Torres, and J. Icarus Alen. 2016. "Unstructured Grid Modelling of Offshore Wind Farm Impacts on Seasonally Stratified Shelf Seas." *Progress in Oceanography* 145(2016) 25–41.

Center for Coastal Studies (CCS). 2017. *Water Quality Parameters*. Available: http://coastalstudies.org/cape-cod-bay-monitoring-program/monitoring-stations/. Accessed: June 18, 2018.

Connell, B. 2010. Nutrient Monitoring in NJ's Coastal Waters. Retrieved from NJDEP - Water Monitoring & Standards Marine Water Monitoring. Available: http://www.nj.gov/dep/wms/NJDEP%20MW%20Nutrients.pdf. Accessed: April 1, 2022

Department of Energy (DOE). 2014. *Assessment of Ports for Offshore Wind Development in the United States*. March 2014. 700694-USPO-R-03.

Harris, J., R. Whitehouse, and J. Sutherland. 2011. "Marine Scour and Offshore Wind: Lessons Learnt and Future Challenges. Proceedings of the International Conference on Offshore Mechanics and Arctic Engineering" OMAE. 5. 10.1115/OMAE2011-50117.

Kaplan, B., ed. 2011. *Literature Synthesis for the North and Central Atlantic Ocean*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2011-012. Available: https://www.boem.gov/ESPIS/5/5139.pdf. Accessed: October 30, 2018.

Kirchgeorg, T., I. Weingberg, M. Hornig, R. Baier, M. J. Schmid, and B. Brockmeyer. 2018. Emissions from Corrosion Protection Systems of Offshore Wind Farms: Evaluation of the Potential Impact on the Marine Environment. *Marine Pollution Bulletin* 136:257–268.

Latham, Pam, Whitney Fiore, Michael Bauman, and Jennifer Weaver. 2017. *Effects Matrix for Evaluating Potential Impacts of Offshore Wind Energy Development on U.S. Atlantic Coastal Habitats*. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2017-014. Available: https://www.boem.gov/Effects-Matrix-Evaluating-Potential-Impacts-of-Offshore-Wind-Energy-Development-on-US-Atlantic-Coastal-Habitats/. Accessed: October 30, 2018.

National Oceanic and Atmospheric Administration (NOAA). 2018. NOAA Deep Sea Coral Data Portal. Available: http://deepseacoraldata.noaa.gov. Accessed: August 2, 2018.

New Jersey Department of Environmental Protection (NJDEP). 2018. Digital Geodata Series – DGS02-1 Well Head Protection Areas for Public Community Water Supply Wells in New Jersey. April 4. Available: https://www.state.nj.us/dep/njgs/geodata/dgs02-2.htm#image. Accessed: September 8, 2021.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Ocean Wind LLC (Ocean Wind). 2023. Citing Normandeau Associates Inc. 2015. *Modeling sediment dispersion from cable burial for the Seacoast Reliability Project, Little Bay, New Hampshire*.

South Carolina Department of Health and Environmental Control. 2018. SC Watershed Atlas: Impaired Waters – 303(d) 2018. Available: https://gis.dhec.sc.gov/watersheds/. Accessed: November 22, 2021.

U.S. Environmental Protection Agency (USEPA). 2000. *Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras*. Office of Water. EPA-822-R-00-012. Available: https://nepis.epa.gov/Exe/ZyPDF.cgi/20003HYA.PDF?Dockey=20003HYA.PDF. Accessed: November 8, 2018.

U.S. Environmental Protection Agency (USEPA). 2012. *National Coastal Condition Report IV*. September. Available: https://www.epa.gov/sites/default/files/201410/documents/0_nccr_4_report_508_bookmarks.pdf. Accessed: September 8, 2021.

U.S. Environmental Protection Agency (USEPA). 2015. *National Coastal Condition Assessment 2010*. Office of Water and Office of Research and Development. EPA 841-R-15-006. Available: https://www.epa.gov/sites/production/files/2016-01/documents/ncca_2010_report.pdf. Accessed: October 30, 2018.

U.S. Environmental Protection Agency (USEPA). 2020. NEPAAssist Mapping Layer Descriptions – Impaired Water Points, Impaired Streams, Impaired Water Bodies. EPA Office of Water ATTAINS Geospatial Data.

B.2.3.22. Section 3.22, Wetlands

Atlantic Shores Offshore Wind (Atlantic Shores). 2021. *Construction and Operations Plan, Atlantic Shores Offshore Wind*. Volume I. September. Available: https://www.boem.gov/renewable-energy/state-activities/atlantic-shores-offshore-wind-construction-and-operations-plan.

New Jersey Department of Environmental Protection (NJDEP). 2015. Wetlands of New Jersey GIS. Available: https://gisdata-njdep.opendata.arcgis.com/datasets/wetlands-of-new-jersey-from-land-use-land-cover-2012-update/explore?location=40.143284%2C-74.755600%2C8.71. Accessed: October 7, 2021.

New Jersey Department of Environmental Protection (NJDEP). 2020. *Final Report: The Status and Future of Tidal Marshes in New Jersey Faced with Sea Level Rise*. NJDEP Science Advisory Board. Prepared by SAB Work Group. August. Available: https://www.nj.gov/dep/sab/sab-salt-marsh.pdf. Accessed: April 1, 2022.

New Jersey Department of Environmental Protection (NJDEP). 2021. Barnegat Bay. Phase Two: Moving Science into Action. Available: https://www.nj.gov/dep/barnegatbay/wetlands.html. Accessed: October 27, 2021.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

B.3. Glossary

Term	Definition
affected environment	Environment as it exists today that could be potentially affected by the proposed Project
algal blooms	Rapid growth of the population of algae, also known as algae bloom
allision	A moving ship running into a stationary ship
anthropogenic	Generated by human activity
archaeological resource	Historical place, site, building, shipwreck, or other archaeological site on the landscape
below grade	Below ground level
benthic	Related to the bottom of a body of water
benthic resources	The seafloor surface, the substrate itself, and the communities of bottom-dwelling organisms that live within these habitats
Cetacea	Order of aquatic mammals made up of whales, dolphins, porpoises, and related lifeforms
coastal habitat	Coastal areas where flora and fauna live, including salt marshes and aquatic habitats
coastal waters	Waters in nearshore areas where bottom depth is less than 98.4 feet (30 meters)
coastal zone	The lands and waters starting at 3 nm from the land and ending at the first major land transportation route
commercial fisheries	Areas or entities raising and catching fish for commercial profit
commercial-scale wind energy facility	Wind energy facility usually greater than 1 MW that sells the produced electricity
criteria pollutant	One of six common air pollutants for which USEPA sets NAAQS: CO, lead, NO_2, ozone, particulate matter, or SO_2
critical habitat	Geographic area containing features essential to the conservation of threatened or endangered species
cultural resource	Historical districts, objects, places, sites, buildings, shipwrecks, and archaeological sites on the American landscape, as well as sites of traditional, religious, or cultural significance to cultural groups, including Native American tribes
culvert	structure, usually a tunnel, allowing water to flow under an obstruction (e.g., road, trail)
cumulative impacts	Impacts that could result from the incremental impact of a specific action, such as the proposed Project, when combined with other past, present, or reasonably foreseeable future actions or other projects; can occur from individually minor, but collectively significant actions that take place over time
demersal	Living close to the ocean floor
design envelope	The range of proposed Project characteristics defined by the applicant and used by BOEM for purposes of environmental review and permitting
dredging	Removal of sediments and debris from the bottom of lakes, rivers, harbors, and other waterbodies
duct bank	Underground structure that houses the onshore export cables, which consists of polyvinyl chloride pipes encased in concrete

Term	Definition
ecosystem	Community of interacting living organisms and nonliving components (such as air, water, soil)
electromagnetic field	A field of force produced by electrically charged objects and containing both electric and magnetic components
embayment	Recessed part of a shoreline
endangered species	A species that is in danger of extinction in all or a significant portion of its range
Endangered Species Act-listed species	Species listed under the ESA of 1973 (as amended)
environmental protection measure	Measure proposed to avoid or minimize potential impacts
ensonification	The process of filling with sound
environmental consequences	The potential direct, indirect, and cumulative impacts that the construction, O&M, and decommissioning of the proposed Project would have on the environment
environmental justice communities	Minority and low-income populations affected by the proposed Project
epifauna	Fauna that lives on the surface of a seabed (or riverbed), or is attached to underwater objects or aquatic plants or animals
essential fish habitat	"Those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (50 CFR 600)
export cables	Cables connecting the wind facility to the onshore electrical grid power
export cable corridor	Area identified for routing the entire length of the onshore and offshore export cables
federal aids to navigation	Visual references operated and maintained by USCG, including radar transponders, lights, sound signals, buoys, and lighthouses, that support safe maritime navigation
finfish	Vertebrate and cartilaginous fishery species, not including crustaceans, cephalopods, or other mollusks
for-hire commercial fishing	Commercial fishing on a for-hire vessel (i.e., a vessel on which the passengers make a contribution to a person having an interest in the vessel in exchange for carriage)
for-hire recreational fishing	Fishing from a vessel carrying a passenger for hire who is engaged in recreational fishing
foundation	The bases to which the WTGs and OSS are installed on the seabed. Three types of foundations have been considered and reviewed for the Project: jacket, monopile, or gravity-based structure.
geomagnetic	Relating to the magnetism of the Earth
hard-bottom habitat	Benthic habitats composed of hard-bottom (e.g., cobble, rock, and ledge) substrates
historic property	Prehistoric or historic district, site, building, structure, or object that is eligible for or already listed in the NRHP; also includes any artifacts, records, and remains (surface or subsurface) related to and located within such a resource
historical resource	Prehistoric or historic district, site, building, structure, or object that is eligible for or already listed in the NRHP; also includes any artifacts, records, and remains (surface or subsurface) related to and located within such a resource

Term	Definition
horizontal directional drilling	Trenchless technique for installing underground cables, pipes, and conduits using a surface-launched drilling rig
hull	Watertight frame or body of a ship
infauna	Fauna living in the sediments of the ocean floor (or river or lake beds)
inter-array cables	Cables connecting the wind turbine generators to the electrical service platforms
interconnection facility	Substation connecting the proposed Project to the existing bulk power grid system
inter-link cables	Cables connecting the electrical service platforms to one another
invertebrate	Animal with no backbone
jacket foundation	Latticed steel frame with three or four supporting piles driven into the seabed
jack-up vessel	Mobile and self-elevating platform with buoyant hull
jet excavation	Process of moving or removing soil with a jet
jet plowing	Plowing in which the jet plow, with an adjustable blade, or plow rests on the seafloor and is towed by a surface vessel; the jet plow creates a narrow trench at the designated depth, while water jets fluidize the sediment within the trench; in the case of the proposed Project, the cables would then be feed through the plow and laid into the trench as it moves forward; the fluidized sediments then settle back down into the trench and bury the cable
knot	Unit of speed equaling 1 nm per hour
landfall site	The shoreline landing site at which the offshore cable transitions to onshore
marine mammal	Aquatic vertebrate distinguished by the presence of mammary glands, hair, three middle ear bones, and a neocortex (a region of the brain)
marine waters	Waters in offshore areas where bottom depth is more than 98.4 feet (30 meters)
mechanical cutter	Method of submarine cable installation equipment that involves a cutting wheel or excavation chain to cut a narrow trench into the seabed allowing the cable to sink under its own weight or be pushed to the bottom of the trench via a cable depressor
mechanical plow	Method of submarine cable installation equipment that involves pulling a plow along the cable route to lay and bury the cable. The plow’s share cuts into the soil, opening a temporary trench, which is held open by the side walls of the share, while the cable is lowered to the base of the trench via a depressor. Some plows may use additional jets to fluidize the soil in front of the share.
monopile or monopile foundation	A long steel tube driven into the seabed that supports a tower
nautical mile	A unit used to measure sea distances and equivalent to approximately 1.15 miles (1.85 kilometers)
offshore substation	The interconnection point between the WTGs and the export cable; the necessary electrical equipment needed to connect the inter-array cables to the offshore export cables
onshore substation	Substation connecting the proposed Project to the existing bulk power grid system

Term	Definition
operations and maintenance facilities	Would include offices, control rooms, warehouses, shop space, and pier space
Outer Continental Shelf	All submerged land, subsoil, and seabed belonging to the United States but outside of states' jurisdiction
pile	A type a foundation akin to a pole
pile driving	Installing foundation piles by driving them into the seafloor
pinnipeds	Carnivorous, semiaquatic marine mammals with fins, also known as seals
pin pile	Small-diameter pipe driven into the ground as foundation support
plume	Column of fluid moving through another fluid
private aids to navigation	Visual references on structures positioned in or near navigable WOTUS, including radar transponders, lights, sound signals, buoys, and lighthouses, that support safe maritime navigation; permits for the aids are administered by USCG
Project area	The combined onshore and offshore area where proposed Project components would be located
protected species	Endangered or threatened species that receive federal protection under the ESA of 1973 (as amended)
scour protection	Protection consisting of rock and stone that would be placed around all foundations to stabilize the seabed near the foundations as well as the foundations themselves
scrublands	Plant community dominated by shrubs and often also including grasses and herbs
sessile	Attached directly by the base
silt substrate	Substrate made of a granular material originating from quartz and feldspar, and whose size is between sand and clay
soft-bottom habitat	Benthic habitats include soft-bottom (i.e., unconsolidated sediments) and hard-bottom (e.g., cobble, rock, ledge) substrates, as well as biogenic habitat (e.g., eelgrass, mussel beds, worm tubes) created by structure-forming species
substrate	Earthy material at the bottom of a marine habitat; the natural environment that an organism lives in
suspended sediments	Very fine soil particles that remain in suspension in water for a considerable period of time without contact with the bottom; such material remains in suspension due to the upward components of turbulence and currents, or by suspension
threatened species	A species that is likely to become endangered within the foreseeable future
tidal energy project	Project related to the conversion of the energy of tides into usable energy, usually electricity
tidal flushing	Replacement of water in an estuary or bay because of tidal flow
trawl	A large fishing net dragged by a vessel at the bottom or in the middle of sea or lake water
turbidity	A measure of water clarity
utility right-of-way	Registered easement on private land that allows utility companies to access the utilities or services located there
vibracore	Technology/technique for collecting core samples of underwater sediments and wetland soils

Term	Definition
viewshed	Area visible from a specific location
visual resource	The visible physical features on a landscape, including natural elements such as topography, landforms, water, vegetation, and manmade structures
wetland	Land saturated with water; marshes; swamps
wind energy	Electricity from naturally occurring wind
wind energy area	Areas with significant wind energy potential and defined by BOEM
wind turbine generator	Component that puts out electricity in a structure that converts kinetic energy from wind into electricity

NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen dioxide

This page intentionally left blank.

Appendix C. Additional Analysis for Alternatives Dismissed

BOEM considered alternatives to the Proposed Action that were identified through coordination with cooperating and participating agencies and through public comments received during the public scoping period for the EIS. BOEM evaluated the alternatives and excluded from further consideration alternatives that did not meet the purpose and need, did not meet the screening criteria, or both. The screening criteria are presented below in Section C.1, *Alternatives Screening Criteria*. Alternatives that were considered and carried forward for detailed analysis are presented in Section 2.1, *Alternatives Analyzed in Detail*, of this Final EIS, and alternatives excluded from further consideration are presented in Section 2.1.7, *Alternatives Considered but not Analyzed in Detail*.

For several alternatives considered but not analyzed in detail, additional analysis was necessary to identify economic and technical feasibility concerns and resource impacts and determine whether those concerns and impacts were unacceptable. Section C.2, *Supplemental Information*, provides the analysis conducted to support the rationale for dismissal for the associated alternative.

C.1. Alternatives Screening Criteria

An alternative was considered but not analyzed in detail if it met any of the following criteria:

- It is outside the jurisdiction of the Lead Agency,[1] including resulting in activities that are not allowed under the lease (e.g., requiring locating part or all of the wind energy facility outside of the Lease Area, or constructing and operating a facility for another form of energy).
- It would not respond to the purpose and need of BOEM’s action, including not furthering the United States’ policy to make OCS energy resources available for expeditious and orderly development, subject to environmental safeguards.[2]
- It would require a major change to an existing law, regulation, or policy.
- It would not be responsive to the Applicant’s goals, lease constraints, and obligations, such as alternatives that would:
    - Partially or completely relocate the Project outside of the defined geographic area where it was proposed; or
    - Result in the development of a Project that would not allow the developer to satisfy contractual obligations (e.g., resulting in a Project with a nameplate capacity that is less than what is required under a Power Purchase Agreement; result in significant implementation delays that would prevent the Project from initiating commercial operations by the contractually required date in the Power Purchase Agreement).
- It is technically infeasible, meaning implementation of the alternative is unlikely given past and current practice, technology (e.g., experimental turbine design or foundation type), or site conditions (e.g., presence of boulders) as determined by BOEM’s technical experts.
- It is economically infeasible, meaning implementation of the alternative is unlikely due to unreasonable costs as determined by BOEM’s technical experts; while this does not require cost-benefit analysis or speculation about an applicant’s costs and profits, there must be a reasonable basis.

[1] “Include reasonable alternatives not within the jurisdiction of the lead agency” was removed with CEQ’s updated NEPA-implementing regulations. See 43304 *Federal Register* 85, July 16, 2020.
[2] 43 USC 1332(3)

- It cannot be analyzed because its implementation is remote or speculative, or it is too conceptual in that it lacks sufficient detail to meaningfully analyze impacts.
- It is substantially similar in design to an alternative that is or will be analyzed in detail.
- It is environmentally infeasible, meaning implementation of the alternative would not be allowed by another agency from which a permit or approval is required, or implementation results in an obvious and substantial increase in impacts on the human environment.[3]
- It does not address a specific environmental or socioeconomic concern or issue.

C.2. Supplemental Information

C.2.1 Wind Turbine Array Layout Spacing

Commenters suggested that BOEM should analyze an alternative wind turbine layout using a 2-nm by 2-nm wind turbine layout to provide safe access for fishing vessels. BOEM evaluated the number of turbine positions that could be within the Lease Area using this spacing and found that a 2-nm by 2-nm wind turbine layout would only provide for 30 wind turbine positions in the Lease Area. Figure C-1 illustrates the wind turbine layout on a 2-nm grid. A 2-nm by 2-nm layout would significantly reduce annual energy production, resulting in failure to meet the required 1,100 MW of wind energy. Use of a 12-MW or 14-MW WTG for the 30 WTGs would result in a Project nameplate capacity of 360 and 420 MW, respectively. The reduced nameplate capacity and annual energy production would fail to fulfill BPU's solicitation award for 1,100 MW of offshore wind and would not meet the purpose of and need for action. Therefore, this alternative was dismissed from further consideration.

[3] "Human environment means comprehensively the natural and physical environment and the relationship of present and future generations of Americans with that environment" (40 CFR 1508.1(m)).

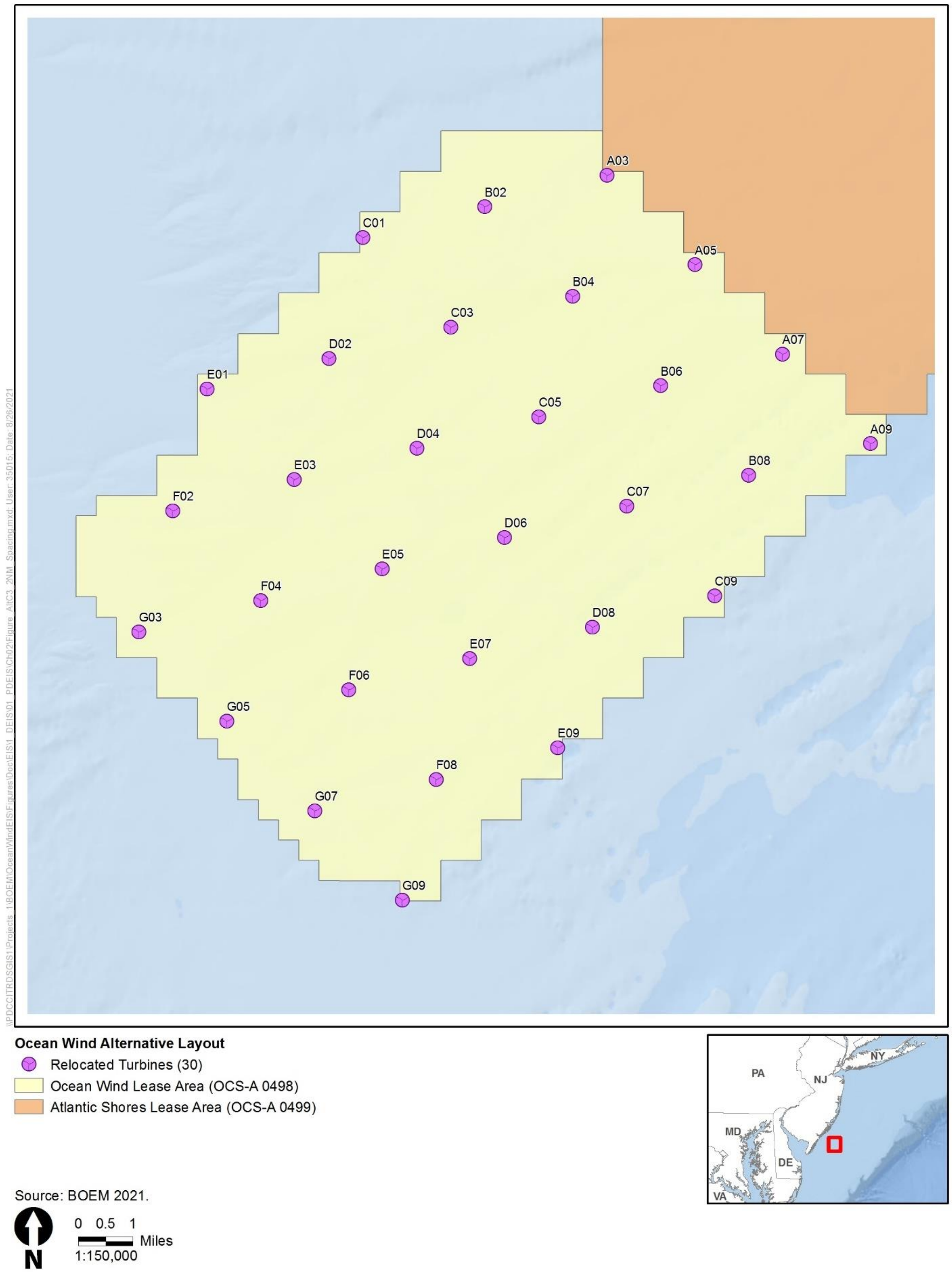


Figure C-1 Wind Turbine Layout on 2-Nautical Mile Grid

C.2.2 SAV Avoidance Alternative E-2

Under Alternative E-2, the construction, O&M, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the Ocean Wind 1 COP, subject to applicable mitigation measures. However, modifications would be made to the Oyster Creek export cable route to minimize impacts on SAV in Barnegat Bay. Figure C-2 illustrates Alternative E-2 as well as Alternative E-1, which was also dismissed from further consideration as described in Section 2.1.7, *Alternatives Considered but not Analyzed in Detail*. The export cable route would make landfall on Island State Beach Park within an auxiliary parking lot of Swimming Area #2 and then follow Central Avenue/Shore Road north approximately 2.7 miles before entering Barnegat Bay at an existing tidal pond. Alternative E-2 would increase the export cable route by approximately 4.3 miles, which would likely require installation of a reactive compensation station approximately 3 to 5 miles offshore of Island Beach State Park due to energy dissipation and consequent limits in the distance that active power can be carried.

Table C-1 presents impacts of Alternative E-2 on SAV in comparison to the Proposed Action and Alternative E. The Proposed Action and Alternative E are carried forward for detailed analysis in the Final EIS.

Table C-1 SAV Impacts of Alternative E-2 Compared to the Proposed Action and Alternative E

Data	Proposed Action (Acres)	Alternative E (Acres)	Alternative E-2 (Acres)
1979 Data	16.78	0.07	0.71
1985–1987 Data	14.66	1.18	--
2009 Data	13.01	0.03	--
Ocean Wind Survey Data	15.38	0.69	N/A

A reactive compensation station would be similar in appearance to the OSS that would be installed within the Lease Area, and it would include structural components similar to that of an OSS. Installation methodology would also be similar to that for the OSS. First, foundation (monopile or jacket) would be piled into the seabed, and then the topside would be installed with the help of a heavy-lift vessel. An example of a reactive compensation station installed at a previous Ørsted project is shown on Figure C-3.

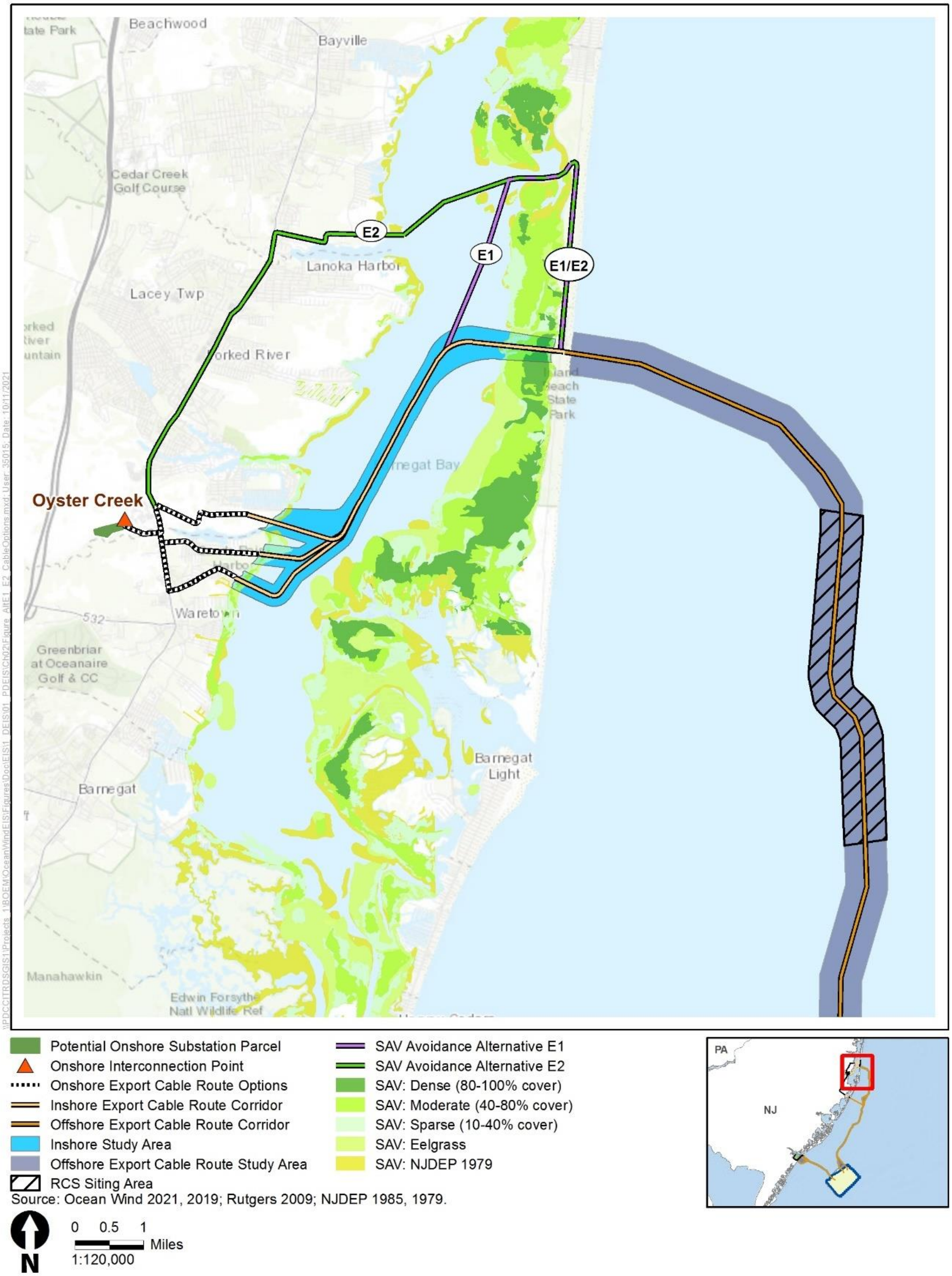


Figure C-2 Alternatives E-1 and E-2: Submerged Aquatic Vegetation Avoidance Alternative (Northern Route)

Figure C-3 Example of a Reactive Compensation Station (Hornsea I)

C.2.2.1. Feasibility Analysis and Environmental Consequences

Alternative E-2 would result in 0.71 acre of SAV impacts, substantially less than the Proposed Action. However, the increased export cable length and associated installation of a reactive compensation station would result in substantial adverse impacts on other resources, most notably through the presence of an above-water physical structure much closer to shore within the navigation approaches to New York Harbor, in an area of higher vessel transit than the Lease Area (navigation and vessel traffic, scenic and visual resources); additional foundation installations (benthic resources, marine mammals, sea turtles); and approximately 4.5 kilometers of new offshore and 4.4 kilometers of new onshore export cable route on Island Beach State Park and 10.6 kilometers of new onshore export cable route in Berkeley Township (land use and coastal infrastructure).

A portion of new offshore cable route would be in an unmapped area, so the potential presence of MEC and UXO, marine archaeological resources, and other unmapped obstacles in this portion of the route is unknown. Obtaining the required G&G, benthic, socioeconomic, and biological survey data to determine the technical feasibility of Alternative E-2 could take up to 2 years, which would result in delays to the anticipated commencement of commercial operations.

Benthic Resources: Under Alternative E-2, the export cable route would be aligned to avoid impacts on mapped SAV. Because export cables need to be spaced at 50 meters apart, the HDD would exit within the mapped SAV, which could result in up to 2 acres of SAV impacts. The reactive compensation station foundation would result in additional permanent conversion of up to 1 acre of sand and muddy sand-mobile or coarse sediment-mobile benthic habitat.

Marine Mammals, Sea Turtles: The decreased impact on SAV would potentially affect marine mammal prey species. The reduced acreage of SAV affected by cable emplacement within Barnegat Bay would reduce potential impacts on adult green sea turtles, as they are the only sea turtles that forage exclusively on aquatic vegetation such as eelgrass. While the number of green sea turtles that would potentially benefit is not quantifiable, the species regularly occurs in Barnegat Bay (Excelon Generation 2012); therefore, minimizing impacts on SAV in Barnegat Bay would avoid the destruction of important foraging habitat. The reactive compensation station would in essence be another OSS, causing additional temporary and permanent impacts on marine mammals and sea turtles.

Commercial Fishing: Alternative E-2 may result in slightly greater impacts on commercial fisheries and for-hire recreational fishing during construction due to avoidance of the area for nearshore fisheries due to the extended length of the export cable in Barnegat Bay. The acreage of SAV affected by cable emplacement and maintenance would be reduced and would slightly benefit the fisheries because SAV provides nursery habitat for targeted fishery species, thus possibly enhancing potential recruitment to the fishery, although any enhancement would be minimal. Alternative E-2 would likely require a reactive compensation station, which would require additional pre-construction surveys and installation of additional foundations; however, the incremental contribution of these activities would be minor in relation to the overall impacts of Alternative E-2.

Cultural Resources: Alternative E-2 would expand the APE to locations that have not been surveyed for the presence of onshore archaeological sites or ancient submerged landforms; therefore, there would be an increased potential for adverse impacts on cultural resources. Ground-disturbing construction activities could disturb or destroy undiscovered archaeological sites and TCPs, if present. However, state and federal requirements to identify cultural resources, assess Project impacts, and develop treatment plans to avoid, minimize, or mitigate adverse impacts would limit the extent, scale, and magnitude of impacts on individual cultural resources. The reactive compensation station approximately 3 to 5 miles offshore of Island Beach State Park would expand the visual study area. The reactive compensation station would likely be visible from historic properties and result in impacts on the historic properties.

Land Use and Coastal Infrastructure: Under Alternative E-2, the presence of a reactive compensation station would affect recreation and tourism as well as property values if visitors decide to visit different coastal locations and potential residents choose to select different residences. Construction of the Oyster Creek cable corridor under Alternative E-2 would result in up to 50 acres of temporary disturbance, an increase of 38 acres compared to the Proposed Action. Alternative E-2 would have a longer cable and would cause land disturbance in both Island Beach State Park and Lacey Township. Alternative E-2 would increase the onshore portion of the Oyster Creek export cable route by approximately 2.7 miles on Island Beach State Park. An additional approximately 3 acres of workspace and associated clearing would be needed to accommodate the turning radius for the cable from the road to the HDD workspace. The workspace would affect the undeveloped shrub/scrub and dune habitat adjacent to Tidal Pond Bird Blind Observation Trail. An additional approximately 6 acres of clearing would be needed adjacent to Central Avenue/Shore Road to accommodate the vaults for the cables once installed in the road (allowing for a 15-foot spacing between the two).

Trenching and installation activities to bury the cable would temporarily disturb beaches, wetlands, and vegetation on the barrier island and potentially interfere with recreational activities in the state park. The additional alignment, running the export cable north along Central Avenue/Shore Road before exiting west into Barnegat Bay, would likely require full road closure, partial road closure with specific construction sequencing, and traffic attenuation. Should full closure of the road be necessary, the park would likely require closing all public recreational access south of the ongoing construction. After construction, the right-of-way would be restored to pre-disturbance conditions. Future maintenance or emergency repairs may occur during times of heavy park visitation, and may result in intermittent impacts on Island Beach State Park and park users.

Navigation and Vessel Traffic: The reactive compensation station installed under Alternative E-2 would create a potential navigational hazard in an area of high fishing and recreational vessel activity, as there is substantial vessel movement along the coast and at the mouth of Barnegat Inlet (Figure C-4). Deep-draft vessel traffic would be 4 to 6 miles to the east of the potential substation location, resulting in no impacts on deep-draft vessel traffic. Tug traffic is likely to follow the informal fairway route that currently delineates the typical tug routes. Alternative E-2 would slightly increase risk of an allision by a fishing or pleasure vessel due to the presence of an additional fixed structure within near-shore waters.

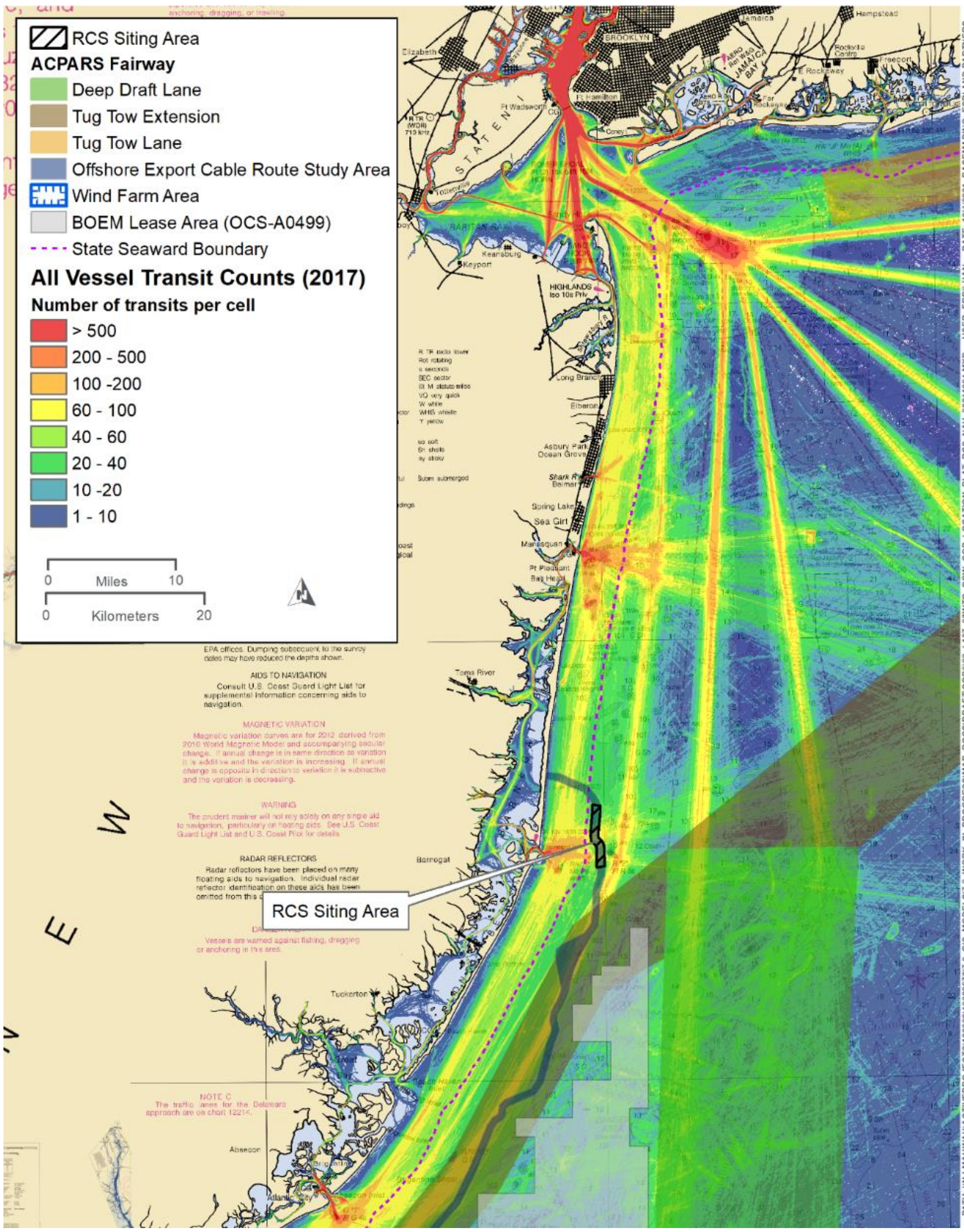


Figure C-4 Navigation and Vessel Traffic in the Vicinity of a Reactive Compensation Station

Scenic and Visual Resources: Alternative E-2 would increase the export cable route and would likely require installation of a reactive compensation station offshore of Island Beach State Park. As shown on Figure C-3, a reactive compensation station would be similar in appearance to the OSS that would be installed within the Lease Area. The reactive compensation station would be visually prominent from viewpoints on Long Beach given its proximity (see Figure C-5 for a visual simulation of the reactive compensation station as viewed from Long Beach). As shown on Figure C-6, the reactive compensation station would also expand the geographic extent of noticeable elements associated with the Proposed Action, with visual impacts extending farther north compared to the Proposed Action.

Due to distance, extensive FOVs, strong contrasts, large scale of change, level 6 prominence, and heretofore undeveloped ocean views, Alternative E-2 would have major effects on the open ocean character unit and viewer boating and cruise ship experiences. Effects of Alternative E-2 on high- and moderate-sensitivity seascape character units and landscape character units would also be major due to view distances, moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation. The daytime presence of offshore WTGs, OSS, and the reactive compensation station as well as their nighttime lighting would change viewers' perception of ocean scenes from natural and undeveloped to a developed energy environment characterized by WTGs and OSS. In clear weather, the WTGs, OSS, and reactive compensation station would be unavoidable presences in views from the coastline, with moderate effects on landscape character.

Figure C-5 Visual Prominence of the Reactive Compensation Station, Given Its Size and Location Offshore

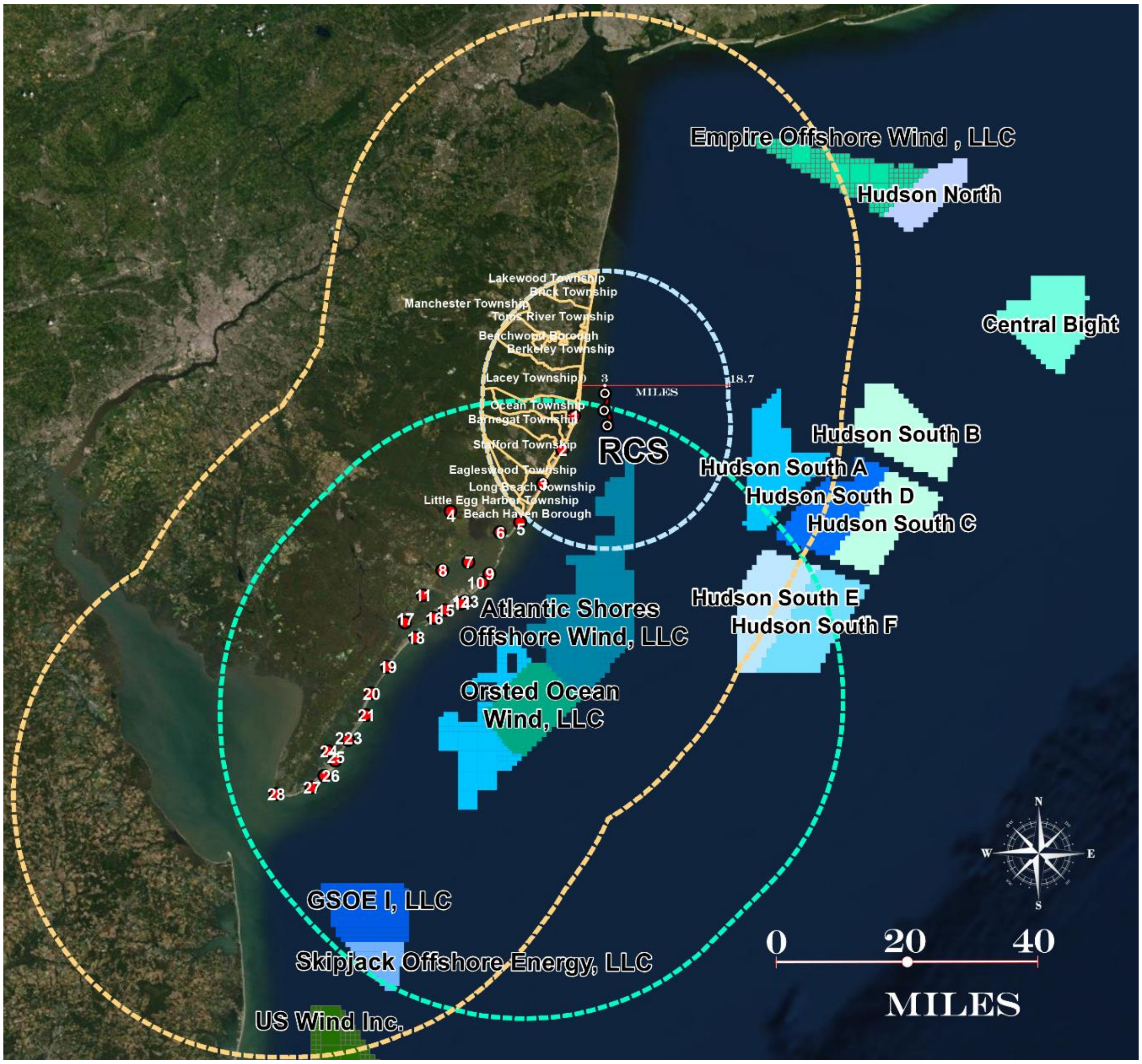


Figure C-6 Reactive Compensation Station Siting Location and Associated Visual Resource Impacts: Extension of the Visual Study Area

Wetlands: Alternative E-2 would result in increased temporary impacts compared to the Proposed Action. The onshore cable route to Oyster Creek would be longer than under the Proposed Action and would traverse more wetland areas. Table C-2 provides a comparison of the wetland impacts of Alternative E-2 in comparison to the Proposed Action and Alternative E. The Proposed Action and Alternative E are carried forward for detailed analysis in the Final EIS.

Table C-2 Temporary Wetland Impacts Along Oyster Creek Onshore Export Cable Route

Wetland Community	Proposed Action (Acres)	Alternative E (Acres)	Alternative E-2 (Acres)
Atlantic White Cedar Wetlands	--	--	0.50
Coniferous Scrub/Shrub Wetlands	--	--	0.23
Deciduous Scrub/Shrub Wetlands	1.06	1.06	0.07
Deciduous Wooded Wetlands	0.96	0.96	--

Wetland Community	Proposed Action (Acres)	Alternative E (Acres)	Alternative E-2 (Acres)
Herbaceous Wetlands	0.06	0.06	--
Mixed Scrub/Shrub Wetlands (Coniferous Dominant)	0.81	0.81	0.08
Mixed Scrub/Shrub Wetlands (Deciduous Dominant)	0.99	1.32	2.63
Mixed Wooded Wetlands (Coniferous Dominant)	--	--	0.68
Mixed Wooded Wetlands (Deciduous Dominant)	--	--	0.01
Phragmites Dominate Coastal Wetlands	0.08	0.08	0.16
Saline Marsh (High Marsh)	1.14	1.14	0.20
Saline Marsh (Low Marsh)	--	--	--
Total: Oyster Creek	**5.10**	**5.43**	**4.55**

BOEM calculated temporary wetland impacts in geographic information systems for the Proposed Action and alternatives based on the longest Oyster Creek cable route option using a 50-foot corridor width.

C.2.3 SAV Avoidance Alternative E-3

Under Alternative E-3, the construction, O&M, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the Ocean Wind 1 COP, subject to applicable mitigation measures. However, modifications would be made to the Oyster Creek export cable route to minimize impacts on SAV in Barnegat Bay and utilize existing corridors, as preferred by NJDEP (Figure C-7). The export cable route would make landfall in an existing parking lot in Ship Bottom, New Jersey, and then follow Route 72 and U.S. Highway 9 to the onshore substation (Figure 2-11). After making landfall the export cable would be constructed as a buried onshore cable route.

Initially, Alternative E-3 proposed attaching the export cables to the Route 72 Bridge; however, through coordination with the New Jersey Department of Transportation, BOEM found that the proposed export cables cannot be attached to the Route 72 Bridge due to issues with weight and integrity. Consequently, the export cables would need to be routed through Manahawkin Bay, along a corridor that was previously disturbed during the recent rehabilitation of the Route 72 Bridge.

Table C-3 presents impacts of Alternative E-3 on SAV in comparison to the Proposed Action and Alternative E. The Proposed Action and Alternative E are carried forward for detailed analysis in the DEIS.

Table C-3 SAV Impacts of Alternative E-3 Compared to the Proposed Action and Alternative E

Data	Proposed Action (Acres)	Alternative E (Acres)	Alternative E-3 (Acres)
1979 Data	16.78	0.07	10.38
1985–1987 Data	14.66	1.18	16.05
2009 Data	13.01	0.03	1.78
Ocean Wind Survey Data	15.38	0.69	N/A

N/A = not applicable

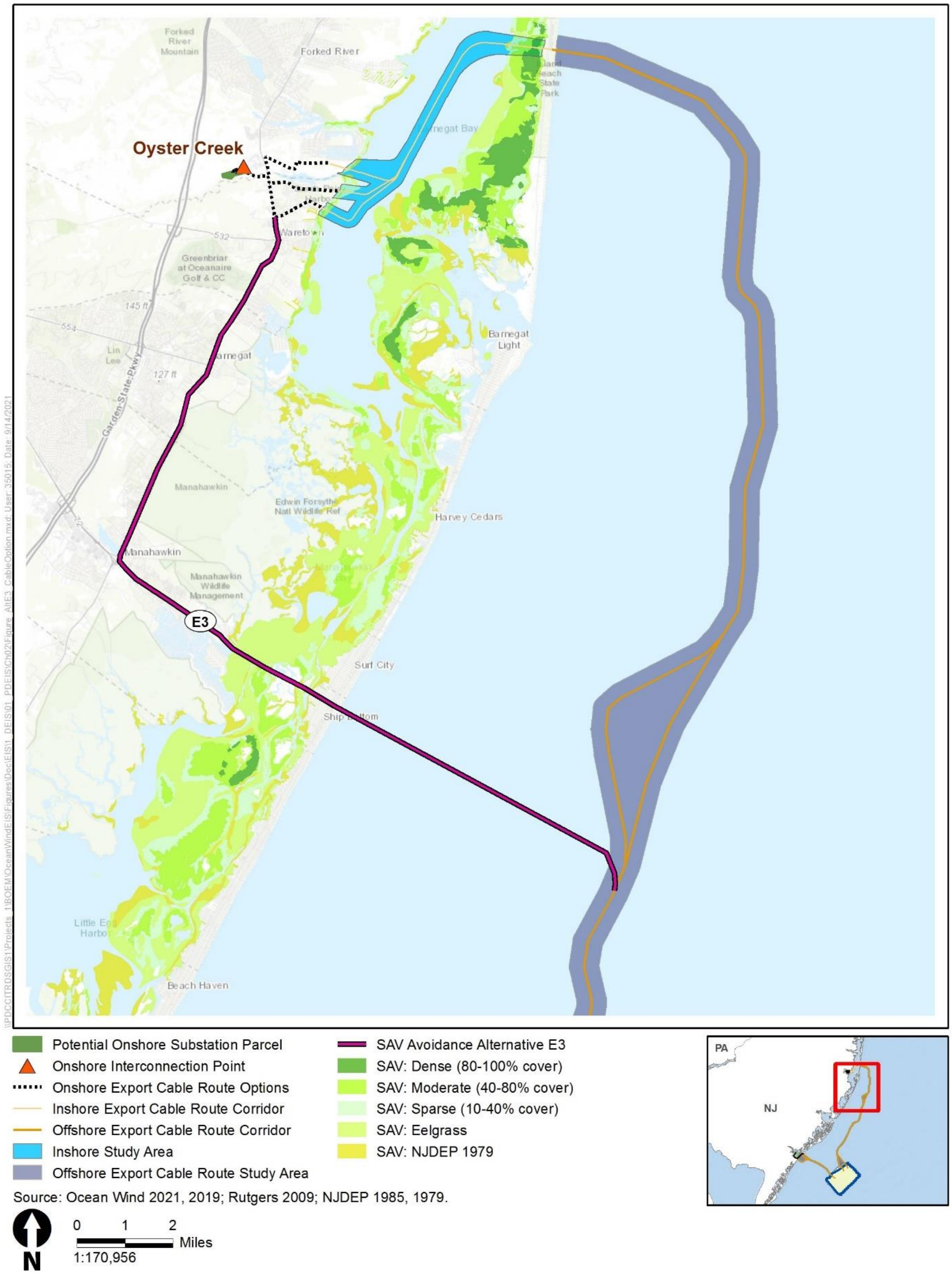


Figure C-7 Alternative E-3: Submerged Aquatic Vegetation Avoidance Alternative (Southern Route)

C.2.3.1. Feasibility Analysis and Environmental Consequences

Alternative E-3 was developed to minimize impacts on SAV. Alternative E-3 would result in substantially less SAV impacts than the Proposed Action according to the 2009 survey data. However, Alternative E-3 would result in substantial adverse impacts on other resources, as described below.

Alternative E-3 would include approximately 11.7 kilometers of new offshore and 22 kilometers of new onshore export cable route. Given the extent of new offshore cable route in an unmapped area, the potential presence of MEC and UXO, marine archaeological resources, and other unmapped obstacles in a substantial portion of the route is unknown. Obtaining the required G&G, benthic, socioeconomic, and biological survey data to determine the technical feasibility of Alternative E-3 could take up to 2 years, which would result in delays to the anticipated commencement of commercial operations and may result in a determination that Alternative E-2 is not feasible or results in unacceptable unavoidable impacts.

Benthic Resources: Alternative E-3 would minimize impacts on SAV associated with emplacement of the export cables. Although historic SAV mapping shows SAV throughout Manahawkin Bay, the recent Route 72 Bridge Rehabilitation Project affected SAV along the bridge, which is the same location proposed for the export cable route.

Marine Mammals, Sea Turtles: The decreased impact on SAV would potentially beneficial affect marine mammal prey species. The avoidance of impacts on SAV in Barnegat Bay and reduced acreage of SAV affected by cable emplacement within Manahawkin Bay would reduce potential impacts on adult green sea turtles, as they are the only sea turtles that forage exclusively on aquatic vegetation such as eelgrass. While the number of green sea turtles that would potentially benefit is not quantifiable, the species regularly occurs in Barnegat Bay (Excelon Generation 2012); therefore, minimizing impacts on SAV in Barnegat Bay would avoid the destruction of important foraging habitat.

Commercial Fishing: Alternative E-3 would lead to the same types of impacts on commercial fisheries and for-hire recreational fishing from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action. The acreage of SAV affected by cable emplacement and maintenance would be reduced and would slightly benefit the fisheries because SAV provides nursery habitat for targeted fishery species, thus possibly enhancing potential recruitment to the fishery, although any enhancement would be minimal.

Cultural Resources: Alternative E-3 would expand the APE to locations that have not been surveyed for the presence of onshore archaeological sites or ancient submerged landforms; therefore, there is an increased potential for adverse impacts on cultural resources. Ground-disturbing construction activities could disturb or destroy undiscovered archaeological sites and TCPs, if present. However, state and federal requirements to identify cultural resources, assess Project impacts, and develop treatment plans to avoid, minimize, or mitigate adverse impacts would limit the extent, scale, and magnitude of impacts on individual cultural resources.

Land Use and Coastal Infrastructure: Alternative E-3 would increase the onshore export cable route by approximately 9 miles, and would result in up to 57 acres of temporary disturbance, an increase of 45 acres compared to the Proposed Action. Increased onshore cable routing would extend onshore construction duration and increase adverse impacts on local communities from increased noise and traffic. Under Alternative E-3, the export cable route would make landfall in an existing parking lot in Ship Bottom, New Jersey, and then follow Route 72 and U.S. Highway 9 to the onshore substation, constructed as a buried onshore cable route. Landfall siting in Surf City/Ship Bottom would be challenging given the roadway configurations, dense development in these locations, and need for 50 meters of separation between the two cables at landfall. There are only two north-south roads in Ship Bottom and three north-south roads in Surf City. The main roadway, Long Beach Boulevard, is approximately 120 to 130 meters from the beach, depending on which east-west street is selected. To meet depth requirements below dunes, it is anticipated that the HDD would need to be set back from the beach, which would locate portions of the drill site back to the second block on the barrier island affecting two of the north-south routes. Up to 2 acres is needed to support the drilling activities. However, due to the heavy development, even if this area is available, the orientation of the Project site (several connected two-lane roadways) is not optimal, as the narrowness of the roads would require heavy machinery to operate in very tight conditions. Road closures and temporary detours would affect the communities of Ship Bottom and Surf City.

Scenic and Visual Resources: Alternative E-3 would not add new aboveground infrastructure and visual impacts of Alternative E-3 would be the same as those of the Proposed Action for the primary IPFs related to the presence of structures, light, and vessel traffic.

Wetlands: Alternative E-3 would result in increased temporary impacts on wetlands compared to the Proposed Action because the longer onshore cable route would traverse more wetland areas. Table C-4 provides a comparison of the wetland impacts of Alternative E-3 in comparison to the Proposed Action and Alternative E. The Proposed Action and Alternative E are carried forward for detailed analysis in the Final EIS.

Table C-4 Temporary Wetland Impacts Along Onshore Export Cable Routes

Wetland Community	Proposed Action (Acres)	Alternative E (Acres)	Alternative E-3 (Acres)
Atlantic White Cedar Wetlands	--	--	0.76
Coniferous Scrub/Shrub Wetlands	--	--	--
Deciduous Scrub/Shrub Wetlands	1.06	1.06	0.58
Deciduous Wooded Wetlands	0.96	0.96	1.59
Herbaceous Wetlands	0.06	0.06	--
Mixed Scrub/Shrub Wetlands (Coniferous Dominant)	0.81	0.81	1.58
Mixed Scrub/Shrub Wetlands (Deciduous Dominant)	0.99	1.32	0.32
Mixed Wooded Wetlands (Coniferous Dominant)	--	--	1.44
Mixed Wooded Wetlands (Deciduous Dominant)	--	--	4.07
Phragmites Dominate Coastal Wetlands	0.08	0.08	--
Saline Marsh (High Marsh)	1.14	1.14	0.97
Saline Marsh (Low Marsh)	--	--	0.10
Total: Oyster Creek	**5.10**	**5.43**	**11.39**

BOEM calculated temporary wetland impacts in geographic information systems for the Proposed Action and alternatives based on the longest Oyster Creek cable route option using a 50-foot corridor width.

C.2.4 Great Egg Harbor Inlet Export Cable Route

Ocean Wind considered an export cable route through Great Egg Harbor inlet, the shipping channel, and Great Egg Harbor Bay, which would make landfall near the BL England Substation. Figure C-8 illustrates the Great Egg Harbor inlet export cable route, which was dismissed from further consideration as described in Section 2.1.7, *Alternatives Considered but not Analyzed in Detail*.

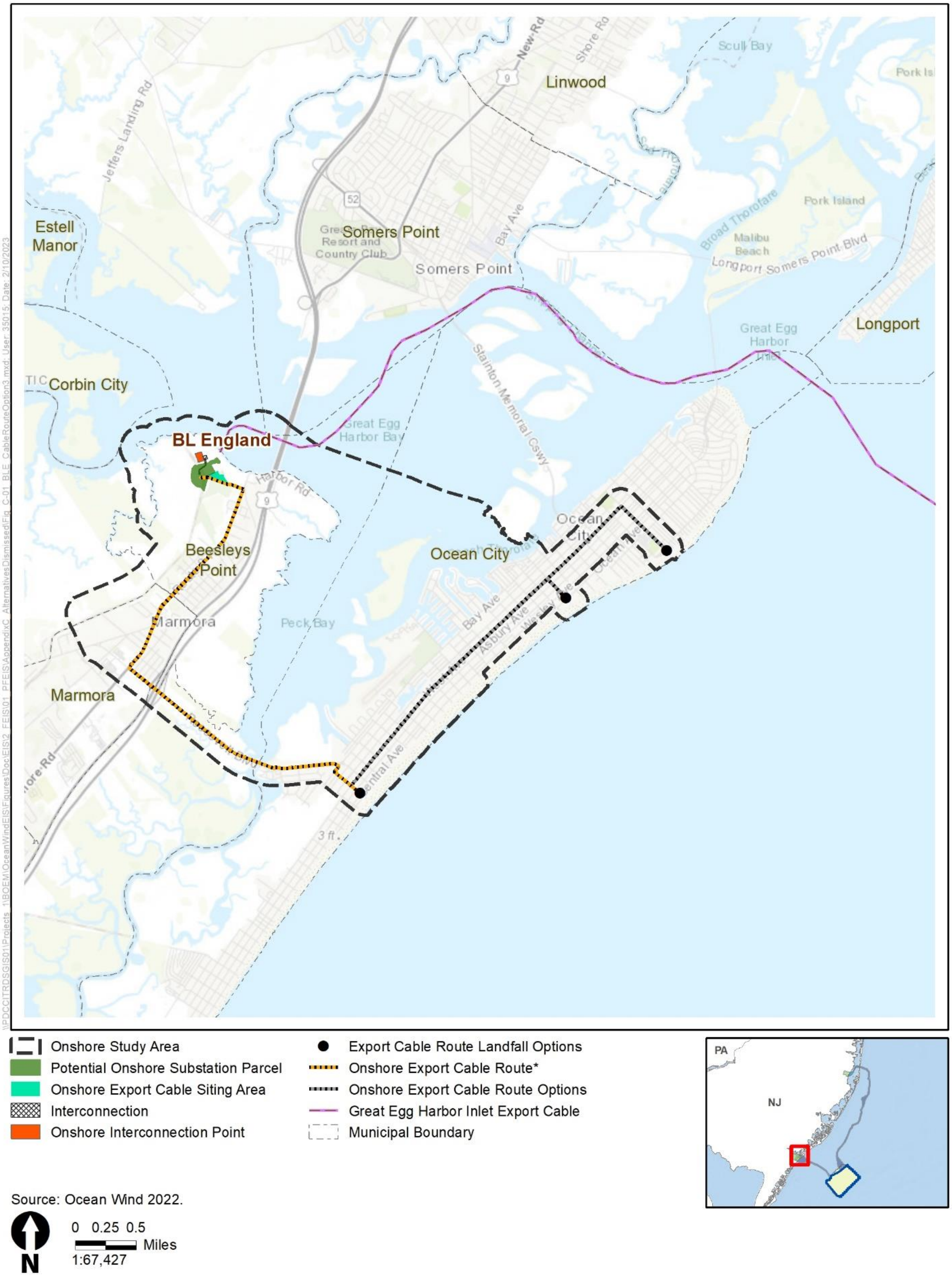


Figure C-8 Great Egg Harbor Inlet Export Cable Route

C.2.4.1. Feasibility Analysis

The Great Egg Harbor inlet export cable route was not carried forward into the Ocean Wind 1 COP as a BL England export cable route option because the route was deemed impracticable for the following reasons:

1. Sediments in the Great Egg Harbor inlet are dynamic and are maintained through maintenance dredging; therefore, placing the cable at a permitted depth below the authorized dredge depth for the entire length of the navigation channel places additional risk on the cable and may require additional cable protection such as cable mattresses, placement within an easement, or other mitigation for the export cable route within the inlet and navigation channel. Cable mattresses may also be required where the export cable crosses existing cable areas (i.e., Great Egg Harbor Inlet, from Anchorage Point to the Rainbow Islands, adjacent to the Stainton Memorial Causeway, and adjacent to the Garden State Parkway Bridge). Cable protection would result in additional impacts on natural resources and could cause permanent impacts on the navigation channel.

2. Access to the Great Egg Harbor inlet by other vessels would be restricted during construction, which would result in additional impacts on other marine uses and navigation. The Great Egg Harbor inlet export cable route would cross under three bridges with low clearance and in areas with shallow water depths, making construction challenging due to reduced draft for construction vessels, limited ability to maneuver, and modified cable burial methods.

   Due to the shallower water depths of Great Egg Harbor, the cable installation process (i.e., transporting, laying, and burying the cables) could not be completed by a cable burial vessel in a single operation. Instead, the cable would need to be converted from a single-three-phase cable to three single-core cables that would then be floated and retro-buried or individually buried. These steps are required to reduce vessel drafts to facilitate navigation within the harbor and avoid grounding cable installation vessels. These additional steps would require multiple vessels to operate in concert to store, feed, float, place, and bury the cables. Due to low water depth within Great Egg Harbor, the cables would need to be buried within the limits of the authorized federal and state channel for approximately 4 miles. The width of this channel is approximately 500 feet.

   If the cable were installed in the Great Egg Harbor inlet, a safety zone would be required around the cable-laying vessels while within the inlet and channel. Cable-laying vessels are functionally stationary within the inlet or channel (approximately 3 meters of cable per minute or less than 0.1 mile per hour) while placing submarine cable and disrupt typical vessel traffic. This may force vessels transiting into or out of Great Egg Harbor to transit more slowly, divert into auxiliary channels, or use alternative pathways while transiting the harbor. Due to the overhead clearance of the bridges within Great Egg Harbor, cable-laying procedures would be slower near the existing bridges and may require temporary closures of navigation channels to allow for cable burial and movement of construction equipment. As such, impacts on navigation resulting from the Great Egg Harbor inlet export cable route were anticipated to be significant.

3. There is an existing USACE borrow area at the mouth of the Great Egg Harbor inlet and USACE does not typically authorize crossing of borrow areas or would require mitigation that could not be implemented by the Project, including burial depths of up to 80 feet below the federal project limit.

In contrast, the proposed Oyster Creek export cable route within Barnegat Bay is in a portion of the bay where sediments are less dynamic and therefore largely avoids the need for cable mattress, minimizes co-location within a navigation channel, and does not cross a charted cable area. While the proposed export cable route within Barnegat Bay requires crossing the Intercoastal Waterway, the route minimizes the crossing length and is within a portion of Barnegat Bay that is over 1.5 miles wide. Adequate space would be available for recreational and commercial traffic to navigate safely during cable installation; therefore, impacts on navigation during construction are anticipated to be low. As the proposed export cable within

Barnegat Bay minimized environmental and navigational impacts and avoided the construction feasibility constraints that would affect the Great Egg Harbor inlet export cable route, the Great Egg Harbor inlet export cable route was dismissed from further consideration.

C.3. References Cited

Excelon Generation. 2012. *Annual sea turtle incidental take report – 2012*. Oyster Creek Nuclear Generating Station report submitted to NMFS. Prepared by M. Browne, K. Voishnis, and J. Kerr. December 2012. Available: https://www.nrc.gov/docs/ML1236/ML12361A025.pdf. Accessed: November 16, 2021.

This page intentionally left blank.

Appendix D. Analysis of Incomplete or Unavailable Information

In accordance with Section 1502.21 of the CEQ regulations implementing NEPA, when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and when information is incomplete or unavailable, the agency shall make clear that such information is lacking. When incomplete or unavailable information was identified, BOEM considered whether the information was relevant to the assessment of impacts and essential to its analysis of alternatives based upon the resource analyzed. If essential to a reasoned choice among the alternatives, BOEM considered whether it was possible to obtain the information and if the cost of obtaining it was exorbitant. If it could not be obtained or if the cost of obtaining it was exorbitant, BOEM applied acceptable scientific methodologies to inform the analysis in light of this incomplete or unavailable information. For example, conclusive information on many impacts of the offshore wind industry may not be available for years, and certainly not within the contemplated timeframe of this NEPA process. However, if this information is essential for a reasoned decision, subject matter experts have used the scientifically credible information available and generally accepted scientific methodologies to evaluate impacts on the resources while this information is unavailable.

D.1. Incomplete or Unavailable Information Analysis for Resource Areas

D.1.1 Air Quality

Although a quantitative emissions inventory analysis of the region, or regional modeling of pollutant concentrations, over the next 35 years would more accurately assess the overall impacts of the changes in emissions from the Project, any action alternative would lead to reduced emissions regionally and can only lead to a net improvement in regional air quality. The differences among action alternatives with respect to direct emissions due to construction, O&M, and decommissioning of the Project are expected to be small. As such, the analysis provided in this EIS is sufficient to support sound scientific judgments and informed decision-making related to the use of the offshore portions of the Wind Farm Area and offshore export cable route corridor. Therefore, BOEM does not believe that there is incomplete or unavailable information on air quality that is essential to a reasoned choice among alternatives.

D.1.2 Bats

There will always be some level of incomplete information on the distribution and habitat use of bats in the offshore portions of the Wind Farm Area, as habitat use and distribution varies among seasons and species. Additionally, because U.S. offshore wind development is in its infancy, with only two offshore wind projects having been constructed at the time of this analysis, there is some level of uncertainty regarding the potential collision risk to individual bats that may be present within the offshore portions of the Wind Farm Area. However, sufficient information on collision risk to bats observed at land-based U.S. wind projects exists and was used to analyze and corroborate the potential for this impact as a result of the proposed Project. In addition, as described in Section 3.5, the likelihood of a bat encountering an operating WTG during migration is very low and, therefore, the differences among action alternatives with respect to bats for the Project are expected to be small. As such, the analysis provided in this EIS is sufficient to support sound scientific judgments and informed decision-making related distribution and use of the offshore portions of the Wind Farm Area as well as to the potential for collision risk of bats. Therefore, BOEM does not believe that there is incomplete or unavailable information on bat resources that is essential to a reasoned choice among alternatives.

D.1.3 Benthic Resources

Although there is uncertainty regarding the spatial and temporal distribution of benthic (faunal) resources and periods during which they might be especially vulnerable to disturbance, Ocean Wind's surveys of benthic resources and other broad-scale studies (Guida et al. 2017; Inspire 2021) provided a suitable basis for generally predicting the species, abundances, and distributions of benthic resources within the geographic analysis area. Uncertainty also exists regarding the impact of some IPFs on benthic resources. For example, specific stimulus-response related to acoustics and EMF is not well studied, although there is some emerging information from benthic monitoring at European wind facilities and the Block Island Wind Farm in the United States that allows for a broad understanding of the impacts. Similarly, specific secondary impacts, such as changes in diets throughout the food chain resulting from habitat modification and synergistic behavioral impacts from multiple IPFs, are not fully known. Again, results of benthic monitoring at European wind facilities and the Block Island Wind Farm in the United States provide general knowledge of the overall impacts of these IPFs combined, if not individually. Therefore, the analysis provided in this EIS is sufficient to support sound scientific judgments and informed decision-making related to the overall impacts. For these reasons, BOEM does not believe that there is incomplete or unavailable information on benthic resources that is essential to a reasoned choice among alternatives.

D.1.4 Birds

Habitat use and distribution of marine birds varies between seasons, species, and years and, as a result, there will always be some level of incomplete information on the distribution and habitat use of marine birds in the offshore portions of the geographic analysis area. However, avian survey findings by NJDEP that cover the Project (see COP Volume III, Appendix H, Section 3.2.4.1.1; Ocean Wind 2023) were used to inform the predictive models and analyze the potential adverse impacts on bird resources in the EIS. In addition, because U.S. offshore wind development is in its infancy, there will always be some level of uncertainty regarding the potential for collision risk and avoidance behaviors for some of the bird species that may be present within the offshore portions of the geographic analysis area. In place of this information, subject matter experts used the data and assumptions described below and in the EIS to create models to evaluate impacts, where it was determined that the information was essential for reasoned decision-making. Bird mortality data are available for onshore wind facilities and, based on a number of assumptions regarding their applicability to offshore environments, were used to inform the analysis of bird mortality associated with the offshore WTGs analyzed in the EIS. However, uncertainties exist regarding the use of the onshore bird mortality rate to estimate the offshore bird mortality rate due to differences in species groups present and life history and behavior of species as well as differences in the offshore marine environment compared to onshore habitats. Modeling is commonly used to predict the potential mortality rates for marine bird species in Europe and the United States (BOEM 2015, 2021b). Due to inherent data limitations, these models often represent only a subset of species potentially present. However, the datasets used by both Ocean Wind and BOEM to assess the potential for exposure of marine birds to the Wind Farm Area represent the best available data and provide context at both local and regional scales. Furthermore, sufficient information on collision risk and avoidance behaviors observed in related species at European offshore wind projects is available and was used to analyze and corroborate the potential for these impacts as a result of the proposed Project (e.g., Petersen et al. 2006; Skov et al. 2018). As such, the analysis provided in the EIS is sufficient to support sound scientific judgments and informed decision-making related to distribution and use of the offshore portions of the geographic analysis area as well as to the potential for collision risk and avoidance behaviors in bird resources. Furthermore, the similarity between the layouts analyzed for the different action alternatives does not render any of this incomplete and unavailable information essential to a reasoned choice among alternatives. Therefore, BOEM does not believe that there is incomplete or unavailable information on avian resources that is essential to a reasoned choice among alternatives.

D.1.5 Coastal Habitat and Fauna

Although the preferred habitats of terrestrial and coastal fauna are generally known, specific data on abundances and distributions within the geographic analysis area of various fauna within these habitats are likely to remain unknown without site-specific surveys. However, the species inventories and other general information about the area provide an adequate basis for evaluating the fauna likely to inhabit the onshore geographic analysis area. Additionally, the onshore activities proposed involve only common, industry-standard activities for which impacts are generally understood. Therefore, BOEM believes that the analysis provided in this EIS is sufficient to make a reasoned choice among the alternatives.

D.1.6 Commercial Fisheries and For-Hire Recreational Fishing

Fisheries are managed in the context of an incomplete understanding of fish stock dynamics and effects of environmental factors on fish populations. The commercial fisheries information used in this assessment has limitations. For example, vessel trip report data are only an approximation because this information is self-reported and may not account for all trips. The vessel trip report data also do not include all commercial fishing operations that may be affected by the Proposed Action and only represent vessel logbook data for species managed by the Greater Atlantic Regional Fisheries Office. While these data include incidental catch of Atlantic menhaden, highly migratory species, or species managed by the NMFS Southeast Regional Office (e.g., wahoo and mahi mahi) when targeting other species, they are not a subset of total catch of these species within the Lease Area. Additionally, available historical data lack consistency, making comparisons challenging.

VMS data are also limited, with a number of factors contributing to their limitations.

- VMS coverage is not universal for all fisheries, with some fisheries (summer flounder, scup, black sea bass, bluefish, American lobster, spiny dogfish, skate, whiting, and tilefish) not covered at all by VMS.
- There is limited historical coverage for most fisheries (e.g., monkfish is optional and elective on a yearly basis, 2005 or earlier for herring, 2006 for groundfish and scallops, 2008 for surfclams/ocean quahogs, 2014 for mackerel, and 2016 for longfin squid/butterfish).
- Trip declaration does not necessarily correspond to actual operation.
- Hourly position pings limit area resolution based on speed.
- Fishing time/location can be mis-estimated by operational assumptions (speed and direction) that are affected by externalities (weather, sea state, mechanical issues).
- Catch data are limited for there is no information on catch rates, retained catch composition is limited to target species and some bycatch species, and the data are not universal.
- Catch information is for the full trip, not sub-trips.
- Not all information is collected from all fisheries (gear type).

However, these data represent the best available data, and sufficient information exists to support the findings presented in this EIS.

A second limitation is that recent annual revenue exposed for for-hire recreational fishing in the Lease Area is not available. The economic analysis conducted by BOEM of recreational for-hire boats, as well as for-hire and private-boat angler trips that might be affected by the overall New Jersey WEA, including the Lease Area, was conducted for 2007–2012 (Kirkpatrick et al. 2017), and the New Jersey WEA is treated as one entity with no site-specific data for the individual offshore wind lease areas that compose the New Jersey WEA. Although these data are presented in Section 3.9 and used for findings, updated data for the period of 2013 to the present are not available. BOEM supplemented the data from the economic analysis with data compiled by NMFS (2021) regarding the annual revenue (2008–2018) for for-hire recreational fishing in the Lease Area and the percentage of each permit holder's total trips coming from within the Lease Area during 2008–2018 to analyze differences in the importance of fishing grounds in the Lease Area for the for-hire recreational fishery. Using both sets of data, BOEM does not believe that there is incomplete or unavailable information on commercial fisheries and for-hire recreational fishing resources that is essential to a reasoned choice among alternatives.

D.1.7 Cultural Resources

Due to the size of the offshore remote-sensing survey areas in the marine APE, the full extent or size of individual ancient submerged landforms cannot be defined. As such, differences among alternatives with respect to cultural resources cannot be fully known. However, Ocean Wind has committed to avoiding ancient submerged landforms and, if they cannot be avoided, BOEM will specify mitigation in the ROD to resolve adverse effects on the ancient submerged landforms. Several potential submerged archaeological resources were identified within the remote-sensing survey area of the marine APE, but these resources were not definitively determined to be archaeological resources. However, these resources are assumed to be eligible, and Ocean Wind will avoid most of the resources as well as a 50-meter buffer around each resource. As a result, despite there being data gaps related to the specific nature of the potential submerged archaeological resources, there is sufficient information available to avoid these resources, or to minimize or mitigate impacts if they cannot be avoided.

Information pertaining to identification of historic properties within certain portions of the APE related to Alternatives C-1, C-2, and D will not be available until after the ROD is issued and the COP is approved. However, the differences among alternatives with respect to cultural, historic, and archaeological resources are not expected to be significant. If Alternative C-1, C-2, or D is selected, BOEM will use the ROD as an agreement document to establish commitments for deferred identification and evaluation of historic properties within the APE in accordance with BOEM's existing *Guidelines for Providing Archaeological and Historic Property Information Pursuant to Title 30 Code of Federal Regulations Part 585*, ensuring potential historic properties are identified, effects assessed, and adverse effects resolved prior to construction. If Alternative C-1 is selected, previously un-surveyed areas associated with one WTG and potentially the inter-array cable routing may need to be surveyed for marine archaeology. If Alternative C-2 with a 1.1-nm setback and any distance other than the 750-meter setback is selected, previously un-surveyed areas associated with 22 WTG positions and potentially the inter-array cable routing may need to be surveyed for marine archaeology. If Alternative D is selected, previously un-surveyed areas associated with the inter-array cable may need to be surveyed for marine archaeology. Therefore, BOEM does not believe this incomplete or unavailable information on historic properties is essential to a reasoned choice among alternatives.

D.1.8 Demographics, Employment, and Economics

Ocean Wind's economic analysis estimated the employment and outputs for the Proposed Action. This provided sufficient information for the evaluation of demographics, employment, and economics to support a reasoned choice among alternatives. There is some inherent uncertainty in forecasting how economic variables in various areas will evolve over time. However, the differences among action alternatives with respect to demographics, employment, and economics are not expected to be significant. Therefore, BOEM does not believe that there is specific incomplete or unavailable information on demographics, employment, and economics that is essential to a reasoned choice among alternatives.

D.1.9 Environmental Justice

Evaluations of impacts on environmental justice communities rely on the assessment of impacts on other resources. As a result, incomplete or unavailable information related to other resources, as described in this document, also affect the completeness of the analysis of impacts on environmental justice communities.

As discussed in other sections, BOEM has determined that incomplete and unavailable resource information for environmental justice or for other resources on which environmental justice communities rely was either not relevant to assess reasonably foreseeable significant adverse impacts, was not essential to a reasoned choice among alternatives, alternative data or methods could be used to predict potential impacts and provided the best available information, or the overall costs of obtaining the information were exorbitant or the means to do so were unknown. Therefore, the information provided in the EIS is sufficient to support sound scientific judgments and informed decision-making related to the proposed uses of the onshore and offshore portions of the geographic analysis area. Furthermore, the differences among action alternatives with respect to environmental justice are not expected to be significant.

D.1.10 Finfish, Invertebrates, and Essential Fish Habitat

Although there is some uncertainty regarding the spatial and temporal distribution of finfish and invertebrate resources and periods during which they might be especially vulnerable to disturbance, Ocean Wind's aquatic resource surveys (e.g., Inspire 2021) and other broad-scale studies (e.g., Guida et al. 2017) provided a suitable basis for general predictions of finfish and invertebrate resources with respect to species, densities, and distributions within the geographic analysis area. Additional information related to ESA-listed species and EFH will be addressed in the forthcoming BA and EFH Assessment. While impacts on these specific finfish and invertebrate species are not anticipated to vary from the general impacts provided in the EIS, specific impact discussion for ESA-listed species and EFH will be provided in the BA and EFH Assessment.

Uncertainty also exists regarding the impact of some IPFs on invertebrate resources, such as the effects of EMFs and underwater noise (e.g., generated from pile driving). The available information on invertebrate sensitivity to EMF is equivocal (Hutchinson et al. 2020), and sensitivity to sound pressure and particle motion effects is not well understood for many species, nor are synergistic or antagonistic impacts from multiple IPFs. Similarly, specific secondary impacts such as changes in diets throughout the food chain resulting from habitat modification are not well known for finfish and invertebrates. Where applicable, the assessment drew upon information in the available literature and an increasing number of monitoring and research studies related to wind development, other undersea development, or artificial reefs in Europe and the United States, several of which were recently drafted or published. These monitoring studies help provide a broad understanding of the overall impacts of these IPFs combined, if not individually.

For these reasons, the information provided in this EIS is sufficient to support sound scientific judgments and informed decision-making related to the overall impacts. Therefore, BOEM does not believe that there is incomplete or unavailable information on finfish, invertebrate, and EFH resources that is essential to a reasoned choice among alternatives.

D.1.11 Land Use and Coastal Infrastructure

There is no incomplete or unavailable information related to the analysis of impacts on land use and coastal infrastructure.

D.1.12 Marine Mammals

NMFS has summarized the most current information about marine mammal population status, occurrence, and use of the region in its 2019 stock status report for the Atlantic OCS and Gulf of Mexico (Hayes et al. 2020, 2021). These studies provided a suitable basis for predicting the species, abundances, and distributions of marine mammals in the geographic analysis area. However, population trend data from NMFS are unavailable for 14 species, and annual human-caused mortality is unknown for five species (see Table I-8 in Appendix I). The majority of species lacking population trend data are offshore species, such as blue whale, fin whale, and non-porpoise odontocetes (e.g., beaked whales and dolphins). As a result, there is uncertainty regarding how Project activities and cumulative effects may affect these populations. In addition to species distribution information, effects of some IPFs on marine mammals are also uncertain or ambiguous, as described below.

Potential effects of EMF have not been scaled to consider impacts on marine mammal populations or their prey in the geographic analysis area (Taormina et al. 2018). The widespread ranges of marine mammals and difficulty obtaining permits make experimental studies challenging. As a result, no scientific studies have been conducted that examine the effects of altered EMF on marine mammals. However, although scientific studies summarized by Normandeau et al. (2011) demonstrate that marine mammals are sensitive to, and can detect, small changes in magnetic fields (Section 3.15), potential impacts would likely only occur within a few feet of cable segments. The current literature does not support a conclusion that EMF could lead to changes in behavior that would cause significant adverse effects on marine mammal populations.

The behavioral effects of anthropogenic noises on marine mammals are increasingly being studied; however, behavioral responses vary depending on a variety of factors such as life stage, previous experience, and current behavior (e.g., feeding, nursing) and are therefore difficult to predict. In addition, the current NMFS disturbance criteria apply a single threshold for all marine mammals for impulsive noise sources and do not consider the overall duration, exposure, or frequency distribution of the sound to account for species-dependent hearing acuity. While elevated underwater sound could startle or displace animals, behavioral responses are not necessarily predictable from source levels alone (Southall et al. 2007).

In addition, research regarding the potential behavioral effects of pile-driving noise has generally focused on harbor porpoises and seals; studies that examine the behavioral responses of baleen whales to pile driving are absent from the literature. Of the available research, most studies conclude that, although pile-driving activities could cause avoidance behaviors or disruption of feeding activities, individuals would likely return to normal behaviors once the activity had stopped. However, uncertainty remains regarding the long-term cumulative acoustic impacts associated with multiple pile-driving projects that may occur over a number of years. This also applies to other project activities such as vessel movements, HRG surveys, geotechnical drilling, and dredging activities that may elicit behavioral reactions in marine mammals. As a result, it is not possible to predict with certainty the potential long-term behavioral effects on marine mammals from Project-related pile driving or other activities, as well as ongoing concurrent and cumulative pile driving and other activities.

To address this uncertainty, the assessment used the best available information when considering behavioral effects related to underwater noise. To better characterize these impacts, the behavioral response severity scores developed by Southall et al. (2021) were used in conjunction with the NMFS disturbance threshold, as described in Section 3.15.3.1. For the assessment of large baleen whales, studies on other impulsive noises (e.g., seismic sources) were used to inform the potential behavioral reactions to pile-driving noise. Monitoring studies would provide insight into species-specific behavioral reactions to Project-generated underwater noise. Long-term monitoring of concurrent and multiple projects could inform the understanding of long-term effects and subsequent consequences from cumulative underwater noise activities on marine mammal populations.

Offshore WTGs produce continuous, non-impulsive underwater noise during operation, mostly in lower-frequency bands below 1,500 Hz (summarized in Section 3.15.3.2). Current and near-term commercially available WTGs likely used for the Project range from 12.4-MW to 14.7-MW WTGs using the direct-drive GE Haliade-X 12-MW WTG. SPLs measured from direct-drive WTGs within this size range do not currently exist in the literature and modeling scenarios are limited to two studies with a high degree of uncertainty. It is likely that source levels and frequencies emitted from the larger direct-drive WTGs to be used for the Project would fall somewhere between those recorded for smaller-gear driven WTGs (e.g., 109 to 128 dB re 1 μPa SPL_{RMS} [at varying distances]) (Tougaard et al. 2009; Lindeboom et al. 2011; Pangerc et al. 2016) and those modeled in Stöber and Thomsen (2021) (e.g., 170 to 177 dB re 1 μPa SPL_{RMS}). Using the least-squares fits from Tougaard et al. (2020), SPLs from 11.5-MW turbines (in 20-meter-per-second, gale-force wind) would be expected to fall below the 120 dB re 1 μPa behavioral threshold within 245 meters (about 800 feet). In lighter, 10-meter-per-second winds (approximately 20 knots), the predicted range to threshold would be only 140 meters (about 460 feet). Effects related to the large direct-drive WTGs to be used for the Project would include behavioral and masking effects. Masking of the low-frequency calls emitted from LFC and phocid pinnipeds in water would be more likely to occur. However, without further information regarding these larger direct-drive WTGs, the extent of these effects is unknown.

There is a lack of research regarding the responses of large whale species to extensive networks of new structures due to the novelty of this type of development on the Atlantic OCS. Although new structures are anticipated from multiple offshore wind projects under the planned activities scenario, it is expected that spacing will allow large whales to access areas within and between wind facilities. No physical obstruction of marine mammal migration routes or habitat areas are anticipated, but whether avoidance of offshore wind lease areas will occur due to new structures is unknown. Additionally, while there is some uncertainty regarding how hydrodynamic changes around foundations may affect prey availability, these changes are expected to have limited impacts on the local conditions around WTG foundations. The potential consequences of these impacts on marine mammals of the Atlantic OCS are unknown. Monitoring studies would provide insight into species-specific avoidance behaviors and other potential behavioral reactions to Project structures.

At present, this EIS has no basis to conclude that these IPFs would result in significant adverse impacts on marine mammal populations.

BOEM determined that the overall costs of obtaining the missing information for or addressing these uncertainties are exorbitant, or the means to obtain it are not known. Therefore, to address these gaps as described above, BOEM extrapolated or drew assumptions from known information for similar species and studies using acceptable scientific methodologies to inform the analysis in light of this incomplete or unavailable information, as presented in Section 3.15 and in the BA submitted to NMFS (BOEM 2022). The information and methods used to predict potential impacts on marine mammals represent the best available information, and the information provided in this EIS is sufficient to support sound scientific judgments and informed decision-making. Therefore, BOEM does not believe that there is incomplete or unavailable information on marine mammal resources that is essential to a reasoned choice among alternatives.

D.1.13 Navigation and Vessel Traffic

The navigation and vessel traffic impact analysis in the EIS is based on 1 year’s (March 1, 2019, to February 29, 2020) AIS data from vessels required to carry AIS (i.e., those 65 feet [19.8 meters] or greater in length), as well as VMS data (to infer commercial fishing and recreational vessel transits).

Fishing vessels at least 65 feet long were not required to carry AIS until March 2015 (80 *Federal Register* 5282); therefore, AIS data prior to March 2015 are more limited than data available after March 2015. To account for some gaps in the data due to limitations of the AIS carriage requirements, additional vessel transits were added to the risk modeling to account for both current and future traffic not represented in the data. For example, the number of non-AIS commercial fishing transits was estimated by scaling port departures of AIS-carrying commercial fishing vessels per the ratio of registered commercial fishing vessels not required to carry AIS (less than 65 feet in length) (COP Volume III, Appendix M; Ocean Wind 2023).

The combination of AIS and VMS data described above with informed assumptions about smaller vessel numbers represents the best available vessel traffic data and is sufficient to enable BOEM to make a reasoned choice among alternatives.

As stated in Section 3.16, WTG and OSS structures could potentially interfere with marine radars. Marine radars have varied capabilities and the ability of radar equipment to properly detect objects is dependent on radar type, equipment placement, and operator proficiency; however, trained radar operators, properly installed and adjusted vessel equipment, marked wind turbines, and the use of AIS all would enable safe navigation with minimal loss of radar detection (USCG 2020). Based on the foregoing, BOEM does not believe that there is incomplete or unavailable information on navigation and vessel traffic that is essential to a reasoned choice among alternatives.

D.1.14 Other Uses

There is no incomplete or unavailable information related to the analysis of impacts on other uses.

D.1.15 Recreation and Tourism

Evaluations of impacts on recreation and tourism rely on the assessment of impacts on other resources. As a result, incomplete or unavailable information related to other resources, as described in this document, also affect the completeness of the analysis of impacts on recreational tourism. BOEM has determined that incomplete and unavailable resource information for recreation and tourism or for other resources on which the analysis of recreation and tourism impacts rely was either not relevant to reasonably foreseeable significant adverse impacts, was not essential to a reasoned choice among alternatives, alternative data or methods could be used to predict potential impacts and provided the best available information, or the overall costs of obtaining the information were exorbitant or the means to do so were unknown. Therefore, the information provided in the EIS is sufficient to support sound scientific judgments and informed decision-making related to the proposed uses of the onshore and offshore portions of the geographic analysis area.

D.1.16 Sea Turtles

There is incomplete information on the distribution and abundance of sea turtle species that occur in the Atlantic OCS and the Lease Area. The NMFS BA (BOEM 2022) provides a thorough overview of the available information about potential species occurrence and exposure to Project-related IPFs. The studies summarized therein provide a suitable basis for predicting potential species occurrence, relative abundance, and probable distribution of sea turtles in the geographic analysis area.

Some uncertainty exists about the effects of certain IPFs on sea turtles and their habitats. The effects of EMF on sea turtles are not completely understood. However, the available relevant information is summarized in the BOEM-sponsored report by Normandeau et al. (2011). Although the thresholds for EMF disturbing various sea turtle behaviors are not known, the evidence suggests that impacts may only occur on hatchlings over short distances, and no adverse effects on sea turtles have been documented to occur from the numerous submarine power cables around the world. In addition, no nesting beaches, critical habitat, or other biologically important habitats were identified in the offshore export cable corridor.

There is also uncertainty about sea turtle responses to proposed Project construction activities, and data are not available to evaluate potential changes to movements of juvenile and adult sea turtles due to elevated suspended sediments. However, although some exposure may occur, total suspended solid impacts would be limited in magnitude and duration and would occur within the range of exposures periodically experienced by these species. On this basis, any resulting impact on sea turtle behavior due to sediment plumes would likely be too small to be biologically meaningful, and no adverse impacts would be expected (NOAA 2020). Some potential exists for sea turtle displacement, but it is unclear if this would result in adverse impacts (e.g., because of lost foraging opportunities or increased exposure to potentially fatal vessel interactions). Additionally, it is currently unclear whether concurrent construction of multiple projects, increasing the extent and intensity of impacts over a shorter duration, or spreading out project construction with lower-intensity impacts over multiple years would result in the least potential harm to sea turtles. There is also uncertainty regarding the cumulative acoustic impacts associated with pile-driving activities. It is unknown whether sea turtles affected by construction activities would resume normal feeding, migrating, or breeding behaviors once daily pile-driving activities cease, or if secondary impacts would continue. Under the planned activities scenario, individual sea turtles may be exposed to acoustic impacts from multiple projects in a single day or from one or more projects over the course of multiple days. Although the consequences of these exposure scenarios have been analyzed with the best available information, some level of uncertainty remains due to the lack of observational data on species' responses to pile driving.

Some uncertainty exists regarding the potential for sea turtle responses to FAA hazard lights and navigation lighting associated with offshore wind development. Ocean Wind would limit lighting on WTGs and OSS to minimum levels required by regulation for worker safety, navigation, and aviation. Although sea turtles' sensitivity to these minimal light levels is unknown, sea turtles do not appear to be adversely affected by oil and gas platform operations, which produce far more artificial light than offshore wind structures. The placement of new structures would be far from nesting beaches, so no impacts on nesting female or hatchling sea turtles are anticipated.

Considerable uncertainty exists about how sea turtles would interact with the long-term changes in biological productivity and community structure resulting from the reef effect of offshore wind farms across the geographic analysis area. Artificial reef and hydrodynamic impacts could influence predator-prey interactions and foraging opportunities in ways that influence sea turtle behavior and distribution. Also, the extent of sea turtle entanglement on artificial reefs and shipwrecks is not captured in sea turtle stranding records and the significance and potential scale of sea turtle entanglement in lost fishing gear are not quantified. These impacts are expected to interact with the ongoing influence of climate change on sea turtle distribution and behavior over broad spatial scales, but the nature and significance of these interactions are not predictable. BOEM anticipates that ongoing monitoring of offshore energy structures will provide some useful insights into these synergistic effects.

BOEM considered the level of effort required to address the uncertainties described above for sea turtles and determined that the methods necessary to do so are lacking or the associated costs would be exorbitant. Therefore, where appropriate, BOEM inferred conclusions about the likelihood of potential biologically significant impacts from available information for similar species and situations to inform the analysis in light of this incomplete or unavailable information. These methods are described in greater detail in Section 3.19, *Sea Turtles*, and in the BA submitted to NMFS (BOEM 2022). Therefore, the analysis provided is sufficient to support sound scientific judgments and informed decision-making about the proposed Project with respect to its impacts on sea turtles. For these reasons, BOEM does not believe that there is incomplete or unavailable information on turtles that is essential to a reasoned choice among alternatives.

D.1.17 Scenic and Visual Resources

No incomplete or unavailable information related to the analysis of impacts on scenic and visual resources was identified.

D.1.18 Water Quality

No incomplete or unavailable information related to the analysis of impacts on water quality was identified.

D.1.19 Wetlands

No incomplete or unavailable information related to the analysis of impacts on wetlands was identified.

D.2. References Cited

Bureau of Ocean Energy Management (BOEM). 2015. *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia: Revised Environmental Assessment*. Office of Renewable Energy Programs. OCS EIS/EA BOEM 2015-031. Accessed: September 1, 2020. Available: https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/VA/VOWTAP-EA.pdf.

Bureau of Ocean Energy Management (BOEM). 2021b. *South Fork Wind Farm and South Fork Export Cable Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2020-057. Available: https://www.boem.gov/renewable-energy/state-activities/sfwf-feis.

Bureau of Ocean Energy Management (BOEM). 2022. *Ocean Wind Offshore Wind Farm Biological Assessment for National Marine Fisheries Service*.

Guida, V., A. Drohan, H. Welch, J. McHenry, D. Johnson, V. Kentner, J. Brink, D. Timmons, and E. Estela-Gomez. 2017. *Habitat Mapping and Assessment of Northeast Wind Energy Areas*. U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-088. November 1, 2013. Prepared in Collaboration between Gulf of Maine Research Institute and University of Maine

Hayes, S. A., E. Josephson, K. Maze-Foley, and P. E. Rosel. 2020. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2019*. NOAA Tech Memo NMFS-NE 264.

Hayes, S. A., E. Josephson, K. Maze-Foley, P. E. Rosel, and J. Turek. 2021. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2020*. NOAA Tech Memo NMFS-NE 271.

Hutchinson, Z. L., D. H. Secor, and A. B. Gill. 2020. The interaction between resource species and electromagnetic fields associated with electricity production by offshore wind farms. *Oceanography* 33(4):96–107.

Inspire. 2021. *Ocean Wind Offshore Wind Farm Benthic Habitat Mapping and Benthic Assessment to Support Essential Fish Habitat Consultation*. Prepared for HDR Engineering. June 2021. Ocean Wind COP Appendix E Supplement.

Kirkpatrick, A. J., S. Benjamin, G. S. DePiper, S. S. T. Murphy, and C. Demarest. 2017. *Socio-Economic Impact of Outer Continental Shelf Wind Energy Development on Fisheries in the U.S. Atlantic*. Vol. II—Appendices. U.S. Department of the Interior, Bureau of Ocean Energy Management, Atlantic OCS Region. Washington, D.C.

Lindeboom, H. J., H. J. Kouwenhoven, M. J. N. Bergman, S. Bouma, S. Brasseur, R. Daan, R. C. Fijn, D. de Haan, S. Dirksen, et al. 2011. Short-term ecological effects of an offshore wind farm in the Dutch coastal zone; a compilation. *Environmental Research Letters* 6(3):1–13. Available: https://doi.org/10.1088/1748-9326/6/3/035101.

National Marine Fisheries Service (NMFS). 2021. *Descriptions of Selected Fishery Landings and Estimates of Recreational Party and Charter Vessel Revenue from Areas: A Planning-level Assessment July 2021*. Available: https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/WIND/WIND_AREA_REPORTS/party_charter_reports/Ocean_Wind_1_rec.html.

National Oceanic and Atmospheric Administration (NOAA). 2020. Section 7 Effect Analysis: Turbidity in the Greater Atlantic Region. NOAA Greater Atlantic Regional Fisheries Office. Available: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effect-analysis-turbidity-greater-atlantic-region. Accessed November 11, 2021.

Normandeau Associates, Inc. (Normandeau), Exponent, Inc., T. Tricas, and A. Gill. 2011. *Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species*. OCS Study BOEMRE 2011-09. Camarillo, California: U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region.

Ocean Wind LLC. (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Pangerc, T., S. Robinson, P. Theobald, and L. Galley. 2016. Underwater sound measurement data during diamond wire cutting: First description of radiated noise. In Proceedings of the Fourth International Conference on the Effects of Noise on Aquatic Life. July 10–16. Dublin, Ireland.

Petersen, Ib Krag, Thomas Kjær Christensen, Johnny Kahlert, Mark Desholm, and Anthony D. Fox. 2006. *Final Results of Bird Studies at the Offshore Wind Farms at Nysted and Horns Rev, Denmark*. National Environmental Research Institute, Ministry of the Environment, Denmark. Available: https://tethys.pnnl.gov/sites/default/files/publications/NERI_Bird_Studies.pdf. Accessed: September 1, 2020.

Skov, H., S. Heinanen, T. Norman, R. M. Ward, S. Mendez-Roldan, and I. Ellis. 2018. *ORJIP Bird Collision and Avoidance Study*. Final report. The Carbon Trust. United Kingdom. April 2018.

Southall, B. L., A. E. Bowles, W. T. Ellison, J. J. Finneran, R. L. Gentry, C. R. Greene. Jr., and P. L. Tyack. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. *Aquatic Mammals* 33(4):411–521.

Southall, B. L., D. P. Nowacek, A. E. Bowles, V. Senigaglia, L. Bejder, and P. L. Tyack. 2021. Marine Mammal Noise Exposure Criteria: Assessing the Severity of Marine Mammal Behavioral Responses to Human Noise. *Aquatic Mammals* 47(5):421–464.

Stöber, U. and F. Thomsen. 2021. How could operational underwater sound from future offshore wind turbines impact marine life? *Journal of the Acoustical Society of America* 149(3):1791–1795.

Taormina, B., J. Bald, A. Want, G. Thouzeau, M. Lejart, N. Desroy, and A. Carlier. 2018. A review of potential impacts of submarine power cables on the marine environment: Knowledge gaps, recommendations and future directions. Renewable and Sustainable Energy Reviews, Elsevier, 2018, 96, pp. 380–391. 10.1016/j.rser.2018.07.026. hal-02405630.

Tougaard, J., L. Hermannsen, and P. T. Madsen. 2020. How loud is the underwater noise from operating offshore wind turbines? *Journal of the Acoustical Society of America* 148(5):2885–2893.

Tougaard, J., O. D. Henriksen, and Lee A. Miller. 2009. Underwater noise from three types of offshore wind turbines: Estimation of impact zones for harbor porpoises and harbor seals. *Journal of the Acoustical Society of America* 125(6):3766–3773. doi:10.1121/1.3117444.

U.S. Coast Guard (USCG). 2020. *The Areas Offshore of Massachusetts and Rhode Island Port Access Route Study. USCG 2019-0131*. May 14. Available: https://www.navcen.uscg.gov/pdf/PARS/FINAL_REPORT_PARS_May_14_2020.pdf. Accessed: October 13, 2021.

Appendix E. Project Design Envelope and Maximum-Case Scenario

Ocean Wind proposes the Project using a PDE concept. This concept allows Ocean Wind to define and bracket proposed Project characteristics for environmental review and permitting of the Project while maintaining a reasonable degree of flexibility for selection and purchase of Project components such as WTGs, foundations, export cables, and OSS.[1]

BOEM provides Ocean Wind and other lessees with the option to submit COPs using the PDE concept—providing sufficiently detailed information within a reasonable range of parameters to analyze a "maximum-case scenario" (described below) within those parameters for each affected environmental resource. BOEM identified and verified that the maximum-case scenario based on the PDE provided by Ocean Wind and analyzed in this Final EIS could reasonably occur if approved. This approach is intended to provide flexibility for lessees and allow BOEM to analyze environmental impacts in a manner that minimizes the need for subsequent environmental and technical reviews as design changes occur.

This Final EIS assesses the impacts of the reasonable range of Project designs that are described in the Ocean Wind 1 COP by using the maximum-case scenario process. The maximum-case scenario analyzes the aspects of each design parameter that would result in the greatest impact for each physical, biological, and socioeconomic resource. This Final EIS considers the interrelationship among aspects of the PDE rather than simply viewing each design parameter independently. This Final EIS also analyzes the planned action impacts of the maximum case scenario alongside other reasonably foreseeable past, present, and future actions.

A summary of Ocean Wind 1's PDE parameters is provided in Table E-1. Table E-2 details the full range of maximum-case design parameters for the proposed Project and which parameters are relevant to the analysis for each EIS section in Chapter 3, *Affected Environment and Environmental Consequences*.

Table E-1 Summary of PDE Parameters

Project Parameter Details
General (Layout and Project Size)
• Up to 98 WTGs • Project anticipated to be in service in late 2024 or early 2025
Foundations
• Monopile foundations with transition piece, or one-piece monopile/transition piece, where the transition piece is incorporated into the monopile • Foundation piles would be installed using a pile-driving hammer • Scour protection around all foundations

[1] Additional information and guidance related to the PDE concept can be found here: https://www.boem.gov/Draft-Design-Envelope-Guidance/.

Project Parameter Details
Wind Turbine Generators
• Rotor diameter up to 788 feet (240 meters) • Hub height up to 512 feet (156 meters) above MLLW • Upper blade tip height up to 906 feet (276 meters) above MLLW • Lowest blade tip height 70.8 feet (22 meters) above MLLW
Inter-Array Cables
• Target burial depth of 4 to 6 feet (1.2 to 1.8 meters) depending on site conditions, navigation risk, and third-party requirement (final burial depth dependent on CBRA and coordination with agencies) • Cables could be up to 170 kV (alternating current) • Preliminary layout available; however, final layout pending • Maximum total cable length is 190 miles (approximately 300 kilometers) • Cable lay, installation, and burial: Activities may involve use of a jetting tool (jet ROV or jet sled), vertical injection, leveling, mechanical cutting, plowing (with or without jet-assistance), pre-trenching, controlled-flow excavation
Offshore Export Cables
• Up to three maximum 275 kV alternating current export cables • Target burial depth of 4 to 6 feet (1.2 to 1.8 meters) depending on site conditions, navigation risk, and third-party requirements (final burial depth dependent on burial risk assessment and coordination with agencies) • Two export cable route corridors, Oyster Creek and BL England • Maximum total cable length is 143 miles (230 kilometers) for Oyster Creek and 32 miles (51 kilometers) for BL England • Cable lay, installation, and burial: Activities may involve use of a jetting tool (jet ROV or jet sled), vertical injection, leveling, mechanical cutting, plowing (with or without jet-assistance), pre-trenching, backhoe dredger, controlled-flow excavation
Offshore Substations
• Up to three OSS • Total structure height up to 296 feet (90 meters) above MLLW • Maximum length and width of topside structure 295 feet (90 meters; with ancillary facilities) • OSS installed atop a modular support frame and monopile substructure or atop a piled jacket foundation substructure • Foundation piles to be installed using a pile-driving hammer • Scour protection installed at foundation locations where required
Landfall for the Offshore Export Cable
• Open cut or trenchless (e.g., HDD, direct pipe, or auger bore) installation at landfall • Up to six cable ducts for landfall, if installed by trenchless technology • A reception pit (may be subsea pit, not yet finalized) would be required to be constructed at the exit end of the bore • Construction reception pit: excavator barge, land excavator mounted to a barge, sheet piling from barge used for intertidal cofferdams, swamp excavators • Sheet pile would be used at open cut landfall to stabilize trench through the shoreline

Project Parameter Details
Offshore Substations Interconnector Cable
• Maximum 275 kV alternating current cables • Target burial depth of 4 to 6 feet (1.2 to 1.8 meters) depending on conditions (final burial depth dependent on burial risk assessment and coordination with agencies) • Potential layout available; however, final layout pending • Maximum total cable length is 19 miles (approximately 30 kilometers) • Cable lay, installation, and burial: Activities may involve use of a jetting tool, vertical injection, pre-trenching, scar plow, trenching (including leveling, mechanical cutting), plowing, controlled-flow excavation
Onshore Export Cable
• Connect with offshore cables at TJB and carry electricity to the onshore substation • Would be buried at a target burial depth of 4 feet (1.2 meters) (this represents a target burial depth rather than a minimum or maximum) • Could require up to a 50-foot (15-meter) wide construction corridor and up to a 30-foot (9-meter) wide permanent easement for Oyster Creek and BL England cable corridor excluding landfall locations and cable splice locations to accommodate space for splice vaults, joint bays, and HDD. Permanent easements are expected to be larger at splice vaults and TJB locations. • Up to eight export cables circuits would be required, with each cable circuit comprising up to three single cables. The cables would consist of copper or aluminum conductors wrapped with materials for insulation protection and sealing. • TJBs, splice vaults/grounding link boxes, and fiber optic system, including manholes
Onshore Substations and Interconnector Cable
• Two onshore substations in proximity to existing substations with associated infrastructure • Each onshore substation would require a permanent site (for Oyster Creek interconnection point up to 31.5 acres and for BL England up to 13 acres), including area for the substation equipment and buildings, energy storage, and stormwater management and landscaping • During construction, up to an additional 3 acres would be required for temporary workspace • The main buildings within the substations would be up to 1,017 feet long, 492 feet wide, and 82 feet tall (310 meters long, 150 meters wide, and 25 meters tall) • Secondary buildings may be used to house reactive compensation, transformers, filters, a control room, and a site office. The external electrical equipment may include switchgear, busbars, transformers, high-voltage reactors, SVC/static synchronous compensator, synchronous condensers, harmonic filters, and other auxiliary equipment. Lightning protection would include up to 35 lightning masts at Oyster Creek and up to 25 masts at BL England for a total height up to 98 feet (30 meters). • Maximum height of overhead lines would be 115 feet (35 meters) • Interconnector cable to existing substation

ROV = remotely operated vehicle; SVC = static VAR compensator

This page intentionally left blank.

Table E-2 Maximum-Case Design Parameters for the Ocean Wind 1 Project (an "X" indicates that the parameter is relevant to an EIS resource analysis)

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
WIND FARM																				
Wind farm capacity	1,100 MW	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WIND TURBINES																				
Parameters per Turbine																				
Minimum lower blade tip height (feet) (relative to MLLW)	70.8		X		X		X	X		X		X		X	X	X		X		
Maximum upper blade tip height (feet) (relative to MLLW)	906		X		X		X	X		X		X		X	X	X		X		
Maximum rotor diameter (feet)	788		X		X			X		X		X		X	X	X		X		
Parameters per Turbine Foundation																				
Outer diameter at seabed of main tubular structure (feet)	37			X			X	X			X		X	X			X		X	
Sea surface diameter (feet)	27						X	X		X	X		X	X			X	X		
Scour protection (if required) diameter (yards)	61			X	X		X			X	X		X	X			X		X	
Scour protection (if required) layer thickness (feet)	8.2			X	X		X			X	X		X	X			X		X	
Seabed structure area per monopile (acres)	0.023			X	X		X	X		X	X		X	X			X		X	
Seabed scour protection (if required) area per monopile (acres)	0.59			X	X		X	X		X	X		X	X			X		X	
Seabed permanent area affected per monopile (acres)	0.85			X	X		X	X		X	X		X	X			X		X	
Scour protection (if required) volume per monopile (cubic yards)	7,764			X	X		X				X		X	X			X		X	
Pile structure grout volume per monopile (cubic yards)	144			X							X		X	X			X		X	
Seabed penetration (feet)	164			X			X	X		X	X		X	X			X		X	
Maximum hammer energy (kilojoules)	4,000		X	X	X		X				X		X	X			X		X	
Indicative continuous piling duration per turbine (hours)	4		X	X	X		X				X		X	X			X		X	
Maximum Total Impacts for Wind Turbine Foundations																				
Maximum number of turbines	98	X	X	X	X		X	X		X	X	X	X	X	X	X	X	X	X	
Total seabed structure area (acres)	2.3			X			X	X		X	X	X	X	X			X	X	X	
Total scour (if required) protection area (acres)	58			X	X		X			X	X		X	X			X		X	
Total permanent affected area (acres)	60.3			X	X		X	X		X	X		X	X			X	X	X	
Total scour (if required) protection volume (cubic yards)	761,000			X	X		X				X		X	X			X		X	
Total pile structure grout volume (cubic yards)	14,000			X							X		X	X			X		X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
OFFSHORE SUBSTATIONS																				
Topside Offshore Substations																				
Number of substations	3	X	X	X	X		X	X		X	X	X	X	X	X	X	X	X	X	
Length of topside main structure (feet)	230		X	X	X		X	X		X	X	X	X	X			X	X		
Width of topside main structure (feet)	230		X	X	X		X	X		X	X	X	X	X			X	X		
Length of topside main structure inclusive of ancillary structures (feet)	295		X		X		X	X		X	X	X	X	X			X	X		
Width of topside main structure inclusive of ancillary structures (feet)	295		X		X		X	X		X	X	X	X	X			X	X		
Total structure height: including ancillary structures (feet) (relative to MLLW)	296		X		X		X	X		X		X		X	X			X		
Bridge links link length (feet)	328									X		X		X				X		
Substation Foundations (Parenthesis notes Maximum Scenario Foundation Type)																				
Maximum number of structures	3	X	X	X	X		X	X		X	X	X	X	X	X	X	X		X	
Maximum scour protection (if required) dimension (yards)	72 (Monopile)			X	X		X				X		X	X			X		X	
Maximum structure dimension at seabed (yards)	77 (Piled Jacket)			X	X		X	X			X		X	X			X		X	
Maximum structure dimension at sea surface (yards)	77 (Piled Jacket)						X	X			X		X	X			X		X	
Number of Piles	16 (Piled Jacket)		X	X	X		X	X			X	X	X	X			X		X	
Seabed preparation area (acres)	0			X			X	X			X		X	X			X		X	
Seabed gravel bed area (acres)	0			X	X		X	X		X	X		X	X			X		X	
Seabed structure area (acres)	0.04 (Monopile)			X			X	X		X	X		X	X			X		X	
Seabed scour protection (if required) area (acres)	1 (Monopile)			X	X		X			X	X		X	X			X		X	
Seabed total permanent area (acres)	0.6 (Piled Jacket)			X	X		X	X		X	X		X	X			X		X	
Scour protection (if required) volume (cubic yards)	1,721 (Piled Jacket)			X	X		X				X		X	X			X		X	
Pile-structure grout volume (cubic yards)	222 (Piled Jacket)			X							X		X	X			X		X	
Piled Jacket Foundations for Substations																				
Number of legs per foundation	6		X	X	X		X	X			X		X	X			X		X	
Number of piles per foundation (4 piles per corner)	16		X	X	X		X	X			X		X	X			X		X	
Separation of adjacent legs at seabed (feet)	230			X			X				X		X	X			X			
Separation of adjacent legs at sea surface (feet)	230						X						X	X			X			
Height of platform above MLLW (feet)	131							X						X				X		
Jacket leg diameter (feet)	15			X			X	X			X		X	X			X		X	
Pin pile outer diameter at seabed (feet)	8			X			X	X			X		X	X			X		X	
Mud-mat area (square feet)	4,306			X			X	X			X		X	X			X		X	
Seabed structure area (acre)	<0.1			X	X		X	X		X	X		X	X			X		X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Seabed scour protection (if required) area (acres)	0.2			X	X		X			X	X		X	X			X		X	
Seabed total permanent area (acres)	0.6			X	X		X	X		X	X		X	X			X		X	
Scour protection (if required) volume (cubic yards)	1,721			X	X		X				X		X	X			X		X	
Pile-structure grout volume (cubic yards)	222			X							X		X	X			X		X	
Embedment depth (below seabed) (feet)	230			X			X	X		X	X		X	X			X			
Maximum hammer energy (kilojoule)	2,500		X	X	X		X				X		X	X			X		X	
Maximum piling duration per foundation (days) [1]	15		X	X	X		X				X		X	X			X		X	
Indicative continuous piling duration per pile (hours) [1]	4		X	X	X		X				X		X	X			X		X	
ARRAY CABLES																				
Cable diameter (inches)	8			X				X			X	X	X	X	X		X		X	
Estimated total length of cable (miles)	190	X		X			X	X		X	X	X	X	X	X		X		X	
Typical voltage (kV)	66			X			X				X	X	X	X			X			
Maximum voltage (kV)	170			X			X				X	X	X	X			X			
Target burial depth (feet) (final burial depth based on CBRA)	4–6			X			X	X		X	X	X	X	X	X		X		X	
Cable separation: typical (feet)	328			X			X				X	X	X	X			X			
Offshore Cable disturbance corridor width (feet)	82			X			X	X		X	X	X	X	X	X		X		X	
Maximum Total Impacts for Array Cables																				
Full corridor width seabed disturbance (acres)	1,850 [2]			X			X	X		X	X		X	X			X		X	
Boulder clearance: seabed disturbance (acres)	2,220 [3]			X			X	X		X	X		X	X			X		X	
Sand wave clearance: seabed disturbance (acres)	220 [3]			X			X	X		X	X		X	X			X		X	
Sand wave clearance: material volume (cubic yards)	588,580 [4]			X			X	X			X		X	X			X		X	
Burial spoil: jetting/plowing/control flow excavation material volume (cubic yards)	2,354,000 [5]			X			X				X		X	X			X		X	
Percent of cable requiring protection	10%			X			X				X		X	X			X		X	
Cable protection area (acres) [6]	77			X			X	X		X	X		X	X			X		X	
Cable protection volume (cubic yards)	341,000			X			X				X		X	X			X		X	
Cable/pipe crossings: pre- and post-lay rock berm area (acres)	0			X			X			X	X		X	X			X		X	
Cable/pipe crossings: pre- and post-lay rock berm volume (cubic yards)	0			X			X				X		X	X			X		X	
SUBSTATION INTERCONNECTOR CABLE																				
Number of substation interconnector cables	2			X			X	X			X	X	X	X	X		X		X	
Estimated total length of cable (miles)	19	X		X			X	X		X	X	X	X	X	X		X		X	
Cable diameter (inches)	13			X			X	X			X	X	X	X			X			
Maximum voltage (kV)	275			X			X				X	X	X	X			X			

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Target burial depth (feet) (final burial depth dependent on CBRA and coordination with agencies)	4–6			X			X	X			X	X	X	X	X		X		X	
Cable seabed disturbance width (feet)	82			X			X	X		X	X	X	X	X	X		X		X	
Maximum Total Impacts for Substation Interconnection Cables																				
Total seabed disturbed: full corridor width (acres)	185 [7]			X			X	X		X	X		X	X			X		X	
Seabed disturbed: boulder clearance (acres)	222 [8]			X			X	X		X	X		X	X			X		X	
Seabed disturbed: sand wave clearance (acres)	2 [8]			X			X	X		X	X		X	X			X		X	
Sand wave clearance volume (cubic yards)	58,860 [9]			X			X	X			X		X	X			X		X	
Burial spoil: jetting/plowing/control flow excavation volume (cubic yards)	235,000 [10]			X			X				X		X	X			X		X	
Cable protection area (acres) [11]	8			X			X	X		X	X		X	X			X		X	
Cable protection volume (cubic yards)	34,000			X			X	X			X		X	X			X		X	
Percent of cable requiring protection	10%			X			X				X		X	X			X		X	
Cable/pipe crossing- pre- and post-lay rock berm area (acres)	0			X			X			X	X		X	X			X		X	
Cable/pipe crossing- pre- and post-lay rock berm volume (cubic yards)	0			X			X				X		X	X			X		X	
OFFSHORE EXPORT CABLE																				
Offshore export cable diameter (inches)	13			X				X			X		X	X			X		X	
Typical export cable voltage (kV)	275			X			X				X		X	X			X			
Cable seabed disturbance width per cable (feet)	82			X			X	X		X	X		X	X			X		X	
Target burial depth (feet)	4–6			X			X	X		X	X		X	X			X		X	
Cable weight in air (kilogram per meter)	138			X			X				X		X				X		X	
Cable weight in water (kilogram per meter)	90			X			X				X		X				X		X	
Maximum Total Impacts for Offshore Export Cables																				
Oyster Creek																				
Number of cable sections per cable	4			X							X		X	X			X			
Number of cable joints	3			X							X		X	X			X			
Offshore cables	2			X			X	X			X		X	X			X		X	
Length of offshore export cable route (miles)	72	X		X			X	X		X	X		X	X	X	X	X		X	
Length of offshore export cable (miles) (2 cables within corridor)	143	X		X			X	X			X		X	X	X	X	X		X	
Full corridor width seabed disturbance (acres)	1,430 [12]			X			X	X		X	X		X	X			X		X	
Boulder clearance: seabed disturbance (acres)	1,710 [13]			X			X	X		X	X		X	X			X		X	
Sand wave clearance: seabed disturbance (acres)	17 [13]			X			X	X		X	X		X	X			X		X	
Sand wave clearance: material volume (cubic yards)	451,240 [14]			X			X	X			X		X	X			X		X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Burial spoil: vertical injection material volume (cubic yards)	665,000 [15]			X			X				X		X	X			X		X	
Burial spoil: plowing/control flow excavation material volume (cubic yards)	1,805,000			X			X				X		X	X			X		X	
Cable protection area (acres) [16]	70			X	X		X	X		X	X		X	X			X		X	
Cable protection volume (cubic yards)	400,000			X	X		X	X			X		X	X			X		X	
Percent of cable requiring protection	10%			X	X		X				X		X	X			X		X	
Cable/pipe crossings: pre- and post-lay rock berm area (acres)	48			X			X			X	X		X	X			X		X	
Cable/pipe crossings: pre- and post-lay rock berm volume (cubic yards)	279,000			X			X				X		X	X			X		X	
BL England																				
Number of cable sections per cable	3			X							X		X	X			X			
Number of cable joints	2			X							X		X	X			X			
Offshore cables	1			X			X	X			X		X	X			X		X	
Length of offshore export cable route (miles)	32	X		X			X	X		X	X		X	X			X		X	
Length of offshore export cable (miles) (1 cable within corridor)	32	X		X			X	X			X		X	X			X		X	
Full corridor width seabed disturbance (acres)	320 [12]			X			X	X		X	X		X	X			X		X	
Boulder clearance: seabed disturbance (acres)	400 [13]			X			X	X		X	X		X	X			X		X	
Sand wave clearance: seabed disturbance (acres)	4 [13]			X			X	X		X	X		X	X			X		X	
Sand wave clearance: material volume (cubic yards)	100,060 [14]			X			X	X			X		X	X			X		X	
Burial spoil: vertical injection material volume (cubic yards)	148,000 [15]			X			X				X		X	X			X		X	
Burial spoil: plowing/control flow excavation material volume (cubic yards)	400,000			X			X				X		X	X			X		X	
Cable protection area (acres) [16]	16			X	X		X	X		X	X		X	X			X		X	
Cable protection volume (cubic yards)	87,000			X	X		X	X			X		X	X			X		X	
Percent of cable requiring protection	10%			X	X		X				X		X	X			X		X	
Cable/pipe crossings: pre- and post-lay rock berm area (acres)	12.6			X			X			X	X		X	X			X		X	
Cable/pipe crossings: pre- and post-lay rock berm volume (cubic yards)	75,000			X			X				X		X	X			X		X	
WIND TURBINE VESSEL TRIPS																				
Wind Turbine Foundation Installation – Maximum Number of Simultaneous Vessels																				
Scour Protection Vessel	1	X	X	X	X		X				X		X	X	X		X	X	X	
Installation Vessel	4	X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels	16	X	X	X	X		X				X		X	X	X		X	X	X	
Transport / Feeder Vessels (including tugs)	40	X	X	X	X		X				X		X	X	X		X	X	X	
- of which are anchored	2	X	X	X	X		X				X		X	X	X		X	X	X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Wind Turbine Foundation Installation – Maximum Number of Trips per Vessel Type																				
Scour Protection Vessel	50	X	X	X	X		X				X		X	X	X		X	X	X	
Installation Vessel	99	X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels	396	X	X	X	X		X				X		X	X	X	X	X	X	X	
Transport / Feeder Vessels (including tugs)	396	X	X	X	X		X				X		X	X	X	X	X	X	X	
- of which are anchored	198	X	X	X	X		X				X		X	X	X		X	X	X	
Structure Installation – Maximum Number of Simultaneous Vessels																				
Installation Vessels	2	X	X	X	X		X				X		X	X	X		X	X	X	
Transport / Feeder Vessels	12	X	X	X	X		X				X		X	X	X		X	X	X	
Other Support Vessels	24	X	X	X	X		X				X		X	X	X		X	X	X	
Structure Installation – Maximum Number of Trips per Vessel Type																				
Installation Vessels	99	X	X	X	X		X				X		X	X	X		X	X	X	
Transport / Feeder Vessels	99	X	X	X	X		X				X		X	X	X		X	X	X	
Other Support Vessels	594	X	X	X	X		X				X		X	X	X	X	X	X	X	
VESSELS REQUIRED FOR SUBSTATION INSTALLATION																				
Maximum Design Parameters																				
Primary Installation Vessels	2	X	X	X	X		X				X		X	X	X		X		X	
Support Vessels	11	X	X	X	X		X				X		X	X	X		X		X	
Transport Vessels	4	X	X	X	X		X				X		X	X	X		X		X	
Maximum Duration (days)	67	X	X	X	X		X				X		X	X	X		X		X	
Maximum Return Trips per Vessel Type																				
Primary Installation Vessels	12	X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels	72	X	X	X	X		X				X		X	X	X		X	X	X	
Transport Vessels	24	X	X	X	X		X				X		X	X	X		X	X	X	
VESSELS REQUIRED FOR ARRAY CABLE INSTALLATION																				
Maximum Number of Simultaneous Vessels																				
Main Laying Vessels	3	X	X	X	X		X				X		X	X	X		X	X	X	
Main Burial Vessels	3	X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels	12	X	X	X	X		X				X		X	X	X		X	X	X	
Maximum Number of Return Trips per Vessel Type																				
Main Laying Vessels	99	X	X	X	X		X				X		X	X	X		X	X	X	
Main Burial Vessels	99	X	X	X	X		X				X		X	X	X		X	X	X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Support Vessels	594	X	X	X	X		X				X		X	X	X		X	X	X	
Duration per cable section (days)	3.5	X	X	X	X		X				X		X	X	X		X	X	X	
Total Duration (months)	12	X	X	X	X		X				X		X	X	X		X	X	X	
VESSELS REQUIRED FOR SUBSTATION INTERCONNECTION CABLE INSTALLATION																				
Maximum Number of Simultaneous Vessels																				
Main Laying Vessels	Included In numbers for export and array cables	X	X	X	X		X				X		X	X	X		X	X	X	
Main Burial Vessels		X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels		X	X	X	X		X				X		X	X	X		X	X	X	
Duration: per cable (days)		X	X	X	X		X				X		X	X	X		X	X	X	
Duration: total (months)		X	X	X	X		X				X		X	X	X		X	X	X	
Maximum Number of Return Trips per Vessel Type																				
Main Laying Vessels	8	X	X	X	X		X				X		X	X	X		X	X	X	
Main Burial Vessels	8	X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels	12	X	X	X	X		X				X		X	X	X		X	X	X	
Duration: per cable (days)	20	X	X	X	X		X				X		X	X	X		X	X	X	
Duration: total (months)	1	X	X	X	X		X				X		X		X		X	X	X	
VESSELS REQUIRED FOR OFFSHORE EXPORT CABLE INSTALLATION																				
Maximum Design Parameters																				
Main Cable Laying Vessels	3	X	X	X	X		X				X		X	X	X		X	X	X	
Main Cable Jointing Vessels	3	X	X	X	X		X				X		X	X	X		X	X	X	
Main Cable Burial Vessels	3	X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels	15	X	X	X	X		X				X		X	X	X		X	X	X	
Maximum Number of Return Trips per Vessel Type																				
Main Cable Laying Vessels	48	X	X	X	X		X				X		X	X	X		X	X	X	
Main Cable Jointing Vessels	36	X	X	X	X		X				X		X	X	X		X	X	X	
Main Cable Burial Vessels	48	X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels	72	X	X	X	X		X				X		X	X	X		X	X	X	
Duration per cable section (days)	59	X	X	X	X		X				X		X	X	X		X	X	X	
Typical Duration (months)	6	X	X	X	X		X				X		X	X	X		X	X	X	
TOTAL PROJECT OFFSHORE SURVEYS OF FOUNDATIONS, BATHYMETRY, SCOUR PROTECTION AND CABLE BURIAL																				
All Offshore Facilities: Seabed Surveys: for Bathymetry, Cable Burial Depth, Scour during Project lifetime (events)	38		X	X	X		X				X		X	X			X	X	X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
OFFSHORE FOUNDATION OPERATION AND MAINTENANCE ACTIVITIES																				
Wind Turbine Foundations																				
Repainting (events)	347			X			X						X	X			X	X	X	
Cleaning (guano removal) (events)	17,325			X			X						X	X			X	X	X	
Access Ladder Replacement (events)	693			X			X						X	X			X	X		
Anode Replacement (events)	693			X			X				X		X	X			X	X		
J-tube Replacement (events)	198			X			X				X		X	X			X	X		
Concrete Crack Repairs (events)	99			X			X						X	X			X	X	X	
Offshore Substations																				
Repainting (events)	3			X			X				X		X	X			X	X	X	
Cleaning (guano removal) (events)	525			X			X				X		X	X			X	X	X	
Access Ladder Replacement (events)	21			X			X				X		X	X			X	X		
Anode Replacement (events)	21			X			X				X		X	X			X	X		
J-tube Replacement (events)	6			X			X				X		X	X			X	X		
TOTAL WTG OPERATION AND MAINTENANCE ACTIVITIES																				
WTGs: Major Component Replacement (events)	966			X			X				X		X	X			X	X	X	
TOTAL PROJECT OSS OPERATION AND MAINTENANCE ACTIVITIES																				
OSS: Major Faults/Component Replacements (events)	6			X			X				X		X	X			X	X	X	
TOTAL PROJECT OFFSHORE CABLE OPERATION AND MAINTENANCE ACTIVITIES																				
Array Cable																				
Remedial Burial for the life of the Project (miles)	13			X			X	X			X		X	X			X	X	X	
Jetting Remedial Burial: Length per event (miles)	1.24			X			X	X			X		X	X			X		X	
Jetting Remedial Burial: Width per event (feet)	328			X			X	X			X		X	X			X		X	
Jetting Remedial Burial: Seabed disturbance area (acres per event)	49.4			X			X	X			X		X	X			X		X	
Cable Faults (number of events)	6			X			X				X		X	X			X		X	
Cable Faults: Seabed disturbance area per event (acres)	4.9			X			X	X			X		X	X			X		X	
Cable Faults: Rock berm area per event (acres)	1.5			X			X				X		X	X			X		X	
Cable Faults: Rock berm volume per event (cubic yards)	8,800			X			X				X		X	X			X		X	
Substation Interconnector Cables																				
Remedial Burial for the life of the Project (miles)	1.9			X			X	X			X		X	X			X		X	
Jetting Remedial Burial: Length per event (miles)	1.2			X			X	X			X		X	X			X		X	
Jetting Remedial Burial: Width per event (feet)	328			X			X	X			X		X	X			X		X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Jetting Remedial Burial: Seabed disturbance area (acres per event)	49.4			X			X	X			X		X	X			X		X	
Cable Faults (number of events)	2			X			X				X		X	X			X		X	
Cable Faults: Seabed disturbance area per event (acres)	4.9			X			X	X			X		X	X			X		X	
Cable Faults: Rock berm area per event (acres)	1.5			X			X				X		X	X			X		X	
Cable Faults: Rock berm volume per event (cubic yards)	8,800			X			X				X		X	X			X		X	
Offshore Export Cables																				
Jetting Remedial Burial: Length per event (miles)	1.24			X			X	X			X		X	X			X		X	
Jetting Remedial Burial: Width per event (feet)	328			X			X	X			X		X	X			X		X	
Jetting Remedial Burial: Seabed disturbance area (acres per event)	49.4			X			X	X			X		X	X			X		X	
Cable Faults: Seabed disturbance area per event (acres)	4.9			X			X	X			X		X	X			X		X	
Cable Faults: Rock berm area per event (acres)	1.5			X			X				X		X	X			X		X	
Cable Faults: Rock berm volume per event (cubic yards)	8,800			X			X				X		X	X			X		X	
Oyster Creek Export Cables																				
Remedial Burial for the life of the Project (miles)	3.1			X			X	X			X		X	X			X		X	
Cable Faults (number of events)	13			X			X				X		X	X			X		X	
BL England Export Cables																				
Remedial Burial for the life of the Project (miles)	1.2			X			X	X			X		X	X			X		X	
Cable Faults (number of events)	3			X			X				X		X	X			X		X	
OFFSHORE OPERATION AND MAINTENANCE VESSEL SUMMARY OF MAXIMUM ANNUAL VISITS																				
Crew transfer vessels, or service operation vessels	2,278	X	X	X	X		X				X		X	X	X	X	X	X	X	
Jack-Up Vessels	102	X	X	X	X		X				X		X	X	X	X	X	X	X	
Crew Vessels	908	X	X	X	X		X				X		X	X	X	X	X	X	X	
Supply Vessels	104	X	X	X	X		X				X		X	X	X	X	X	X	X	
OPERATIONS JACK-UP AND ANCHORED VESSEL PARAMETERS																				
Number of jack-up vessel legs	6			X			X				X		X	X			X		X	
Area of each leg base at the seabed (square feet)	1,830			X			X				X		X	X			X		X	
Anchored vessel: anchor dimensions (feet)	32.8 x 32.8			X			X				X		X	X			X		X	
Anchored vessel: number of anchors per vessel	8			X			X				X		X	X			X		X	
ONSHORE EXPORT CABLE PARAMETERS																				
Type of cable	XLPE, FF Copper, and Aluminum											X								
Diameter of cable (inches)	8					X		X				X								

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Diameter of cable ducts (inches)	13					X		X				X								
Maximum voltage (kV)	275					X						X								
Target burial depth (feet)	4 [17]					X		X				X								
Oyster Creek Construction Areas and Volumes																				
Length of onshore cable route (miles)	5.3	X	X		X	X		X		X		X						X	X	X
Cable trenches	2					X		X				X						X	X	X
Total onshore cables	6		X		X	X		X				X						X	X	X
Corridor width: permanent (feet)	30		X		X	X		X				X						X	X	X
Corridor width: temporary and permanent used for construction (feet)	50		X		X	X		X				X						X	X	X
Corridor area: permanent (acres)	9		X		X	X		X				X			X	X		X	X	X
Corridor area: temporary and permanent used for construction (acres)	32	X	X		X	X		X		X		X			X	X		X	X	X
Number of joint bays and splice vaults/grounding link boxes	34					X		X				X						X	X	X
Joint bays total area (acres)	2		X		X	X		X				X							X	X
Joint bays spoil volume per pit (cubic yards)	3,000					X						X							X	X
Joint bays spoil total volume (cubic yards)	97,200					X						X							X	X
Link bays total area (acres)	0.03		X		X	X		X				X							X	X
Link bays spoil volume per pit (cubic yards)	9					X						X							X	X
Link bays spoil total volume (cubic yards)	311					X						X							X	X
Utility bridge length (feet)	200					X		X				X						X		
Utility bridge height and width (feet)	10					X		X				X						X		
BL England Construction Areas and Volumes																				
Length of onshore cable route (miles) [18]	8	X	X		X	X		X	X	X		X			X	X			X	X
Cable trenches	1					X		X	X			X			X	X		X	X	X
Total onshore cables	3		X		X	X		X				X						X	X	X
Corridor width: permanent (feet)	30		X		X	X		X				X						X	X	X
Corridor width: temporary and permanent used for construction (feet)	50		X		X	X		X	X	X		X			X	X		X	X	X
Corridor area: permanent (acres) [18]	29		X		X	X		X		X		X							X	X
Corridor area: temporary and permanent used for construction (acres) [18]	48	X	X		X	X		X	X	X		X			X	X			X	X
Number of joint bays and splice vaults/grounding link boxes [18]	26					X						X						X	X	X
Joint bays total area (acres) [18]	1.5		X		X	X		X				X							X	X
Joint bays spoil volume per pit (cubic yards)	3,000					X						X							X	X
Joint bays spoil total volume (cubic yards) [18]	19,000					X						X							X	X

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Link bays total area (acres) [18]	0.02		X		X	X		X				X							X	X
Link bays spoil volume per pit (cubic yards)	9					X						X							X	X
Link bays spoil total volume (cubic yards)	55					X						X							X	X
ONSHORE SUBSTATION PARAMETERS																				
Oyster Creek																				
Permanent site area (acres)	31.5	X	X		X	X		X	X	X		X			X	X		X	X	X
Temporary construction workspace (acres)	2	X	X		X	X		X	X	X		X			X	X		X	X	X
Main building length (feet)	1,017		X		X	X		X		X		X						X		
Main building width (feet)	492		X		X	X		X		X		X						X		
Main building area (acres)	11.5		X		X	X		X		X		X							X	X
Main building height (feet)	82		X		X			X		X		X						X		
Maximum secondary building(s) length (feet)	105		X		X	X		X		X		X						X		
Maximum secondary building(s) width (feet)	105		X		X	X		X		X		X						X		
Secondary building(s) height (feet)	33		X		X			X		X		X						X		
Fire-wall height (feet)	82		X		X			X		X		X								
Number of lightning masts	35		X		X	X		X		X		X						X		
Lightning protection height (feet)	98		X		X			X		X		X						X		
Power mast infrastructure height (feet)	115		X		X			X		X		X						X		
Transformer height (feet) [19]	46		X		X			X		X		X						X		
High-voltage reactor height (feet) [19]	46		X		X			X		X		X						X		
SVC/Statcom height (feet) [19]	39		X		X			X		X		X						X		
Harmonic filter height (feet) [19]	49		X		X			X		X		X						X		
Bus duct height (feet) [19]	49		X		X			X		X		X						X		
Other auxiliary equipment height (feet) [19]	33		X		X			X		X		X						X		
BL England																				
Permanent site area (acres)	13	X	X		X	X		X	X	X		X			X	X			X	X
Temporary construction workspace (acres)	3	X	X		X	X		X	X	X		X			X	X			X	X
Main building length (feet)	656		X		X	X		X		X		X						X		
Main building width (feet)	525		X		X	X		X		X		X						X		
Main building area (acres)	7.9		X		X	X		X		X		X							X	X
Main building height (feet)	82		X		X			X		X		X						X		
Maximum secondary building(s) length (feet)	154		X		X	X		X		X		X						X		

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Maximum secondary building(s) width (feet)	105		X		X	X		X		X		X						X		
Secondary building(s) height (feet)	33		X		X			X		X		X						X		
Fire-wall height (feet)	82		X		X			X		X		X								
Number of lightning masts	25		X		X	X		X		X		X						X		
Lightning protection height (feet)	98		X		X			X		X		X						X		
Power mast infrastructure height (feet)	115		X		X			X		X		X						X		
Transformer height (feet) [19]	46		X		X			X		X		X						X		
High-voltage reactor height (feet) [19]	46		X		X			X		X		X						X		
SVC/Statcom height (feet) [19]	39		X		X			X		X		X						X		
Harmonic filter height (feet) [19]	49		X		X			X		X		X						X		
Bus duct height (feet) [19]	49		X		X			X		X		X						X		
Other auxiliary equipment height (feet) [19]	35		X		X			X		X		X						X		
UNDERGROUND AND OVERHEAD TRANSMISSION LINE PARAMETERS																				
Underground Option																				
Maximum trench depth (feet)	10.25		X		X	X		X	X	X		X				X			X	X
Average trench width (feet)	4.25		X		X	X		X	X	X		X				X		X	X	X
Maximum temporary work space, offset from centerline on each side (feet)	30		X		X	X		X	X	X		X				X		X	X	X
Oyster Creek																				
Maximum length of onshore interconnection cable (miles)	0.5	X	X		X	X		X	X	X		X			X	X			X	X
Number of splice vaults/grounding link boxes associated with interconnection cable	2		X		X			X		X		X				X		X		X
Number of poles	1		X		X			X		X		X				X		X		
Maximum pole height (feet)	117		X		X			X		X		X				X		X		
BL England																				
Maximum length of onshore interconnection cable (miles)	0.5	X	X		X	X		X	X	X		X			X	X			X	X
Number of splice vaults/grounding link boxes associated with interconnection cable	2		X		X			X		X		X				X		X		X
Number of poles	1		X		X			X		X		X				X		X		
Maximum pole height (feet)	117		X		X			X		X		X				X		X		
Overhead Option																				
Oyster Creek																				
Maximum Length of onshore interconnection cable route (miles)	0.5	X	X		X	X		X	X	X		X			X	X			X	X

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Number of poles	6		X		X	X		X		X		X						X	X	X
Maximum pole height (feet)	115		X		X			X		X		X				X		X		
BL England																				
Maximum Length of onshore interconnection cable route (miles)	0.5	X	X		X	X		X	X	X		X			X	X			X	X
Number of poles	6		X		X	X		X		X		X						X	X	X
Maximum pole height (feet)	115		X		X			X		X		X				X		X		
LANDFALL PARAMETERS																				
Landfall type	Open cut or trenchless technology			X		X			X	X		X			X	X		X	X	X
HDD noise (decibels) [20]	120		X		X	X			X	X		X				X				
Number of personnel	60		X		X	X			X	X		X							X	
Daily vehicle movements (non-HGV)	10	X	X		X	X				X		X						X		
Daily vehicle movements (HGV)	5	X	X		X	X				X		X						X		
Inadvertent return contingency vehicles	4		X		X	X				X		X								
HDD exit pit depth (feet)	15					X		X				X								
HDD exit pit (acres)	0.4 (164 feet x 98 feet)					X		X				X							X	X
HDD onshore workspace (acres)	15		X		X	X		X				X							X	X
TJB depth (feet)	20					X		X				X						X		
TJB area (acres)	0.06 (33 feet x 82 feet)					X		X				X							X	X
TJB workspace (acres)	0.4 (131 feet x 131 feet)		X		X	X		X				X							X	X
Oyster Creek																				
Number of TJBs	8					X		X				X						X	X	X
Landfall width (feet)	262					X		X				X						X	X	X
BL England																				
Number of TJBs	3					X	X	X				X						X	X	X
Landfall width (feet)	131					X	X	X				X						X	X	X

[1] The 15 days is inclusive of activities (i.e., mobilization, clearance times, demobilization) and not just pile driving. The indicative piling duration per pile is 4 hours. The maximum active piling duration per foundation would be up to 64 hours (16 piles per foundation x 4 hours per pile) spread over up to 15 days.
[2] Assumes 82-foot-wide corridor disturbed.
[3] Assumes 98-foot-wide corridor and 100% of route affected.
[4] Assumes 98-foot-wide corridor, 17-foot average height, and 100% of route affected.
[5] Assumes 95% with shallow burial depth (4 to 6 feet) and 5% with deep burial (33 feet).
[6] Could be rock, mattress, frond mattress, rock bags, or seabed spacers as described in Section 2.1.2.2.3, *Offshore and Nearshore Activities and Facilities*, of the Final EIS.
[7] Assumes 82-foot-wide corridor disturbed.
[8] Assumes 98-foot-wide corridor and 1% of route affected.

[9] Assumes 98-foot-wide corridor, 17-foot average height, and 1% of route affected.
[10] Assumes 95% with shallow burial depth (4 to 6 feet) and 5% with deep burial (33 feet).
[11] Could be rock, mattress, frond mattress, rock bags, or seabed spacers as described in Section 2.1.2.2.3, *Offshore and Nearshore Activities and Facilities*, of the Final EIS.
[12] Assumes 82-foot-wide corridor disturbed.
[13] Assumes 98-foot-wide corridor and 1% of route affected.
[14] Assumes 98-foot-wide corridor, 17-foot average height, and 1% of route affected.
[15] Assumes 95% with shallow burial depth (4–6 feet) and 5% with deep burial (33 feet).
[16] Could be rock, mattress, frond mattress, rock bags, or seabed spacers as described in Section 2.1.2.2.3, *Offshore and Nearshore Activities and Facilities*, of the Final EIS.
[17] Burial depth is target burial rather than maximum burial depth.
[18] Increases reflected for identified parameters are related to removal of the Great Egg Harbor Bay inshore route, with a subsequent use of West Avenue for the eastern two landfall options.
[19] Where located in the open.
[20] Depends on rig spread to be used, phase of drilling, ground conditions, ancillary equipment, etc.
FF = foundation fieldbus; HGV = heavy goods vehicle; Statcom = statis synchronous compensator; SVC = static VAR compensator; XLPE = cross-linked polyethylene

Appendix F. Planned Activities Scenario

This page intentionally left blank.

TABLE OF CONTENTS

LIST OF ATTACHMENTS

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

Abbreviation	Definition
FERC	Federal Energy Regulatory Commission

F.1. Ongoing and Planned Activities Scenario

This appendix describes the other ongoing and planned activities that could occur within the analysis area for each resource and contribute to baseline conditions and trends for resources considered in this EIS. The *Project* here is the construction, O&M, and conceptual decommissioning of a wind energy facility within BOEM's Renewable Energy Lease Area OCS-A 0498, approximately 13 nm (15 statute miles) southeast of Atlantic City, New Jersey.

The geographic analysis area varies for each resource as described in the individual resource sections of Chapter 3. BOEM anticipates that impacts could occur from the start of Project construction in 2023 through Project decommissioning in approximately 2058.[1] The geographic analysis area is defined by the anticipated geographic extent of impacts for each resource. For the mobile resources—bats, birds, finfish, and invertebrates; marine mammals; and sea turtles—the species potentially affected are those that occur within the area of impact of the Proposed Action. The geographic analysis area for these mobile resources is the general range of the species. The purpose is to capture the cumulative impacts on each of those resources that would be affected by the Proposed Action as well as the impacts that would still occur under the No Action Alternative.

In this appendix, distances in miles are in statute miles (miles used in the traditional sense) or nm (miles used specifically for marine navigation). This appendix uses statute miles more commonly and refers to them simply as *miles*, whereas nm are referred to by name.

F.2. Ongoing and Planned Activities

This section includes a list and description of ongoing and planned activities that could contribute baseline conditions and trends within the geographic analysis area for each resource topic analyzed in this EIS. Projects or actions that are considered speculative per the definition provided in 43 CFR 46.30[2] are noted in subsequent tables but excluded from the cumulative impact analysis in Chapter 3.

Ongoing and planned activities described in this section consist of 10 types of actions: (1) other offshore wind energy development activities; (2) undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); (3) tidal energy projects; (4) marine minerals use and ocean-dredged material disposal; (5) military use; (6) marine transportation (commercial, recreational, and research-related); (7) fisheries use, management, and monitoring surveys; (8) global climate change; (9) oil and gas activities; and (10) onshore development activities.

BOEM analyzed the possible extent of future other offshore wind energy development activities on the Atlantic OCS to determine reasonably foreseeable cumulative effects measured by installed power

[1] Ocean Wind's lease with BOEM (Lease OCS-A 0498) has an operations term of 25 years that commences on the date of COP approval (see https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/NJ/NJ-SIGNED-LEASE-OCS-A-0498.pdf; see also 30 CFR 585.235(a)(3).) Ocean Wind would need to request and be granted an extension of its operations term from BOEM in order to operate the proposed Project for 35 years. While Ocean Wind has not made such a request, this EIS uses the longer period in order to avoid possibly underestimating any potential effect.

[2] 43 CFR 46.30 – Reasonably foreseeable future actions include those federal and non-federal activities not yet undertaken, but sufficiently likely to occur, that a responsible official of ordinary prudence would take such activities into account in reaching a decision. The federal and non-federal activities that BOEM must take into account in the analysis of cumulative impacts include, but are not limited to, activities for which there are existing decisions, funding, or proposals identified by BOEM. Reasonably foreseeable future actions do not include those actions that are highly speculative or indefinite.

capacity. Table F2-1 in Attachment 2 represents the status of projects as of August 1, 2021. The methodology for developing the scenario is the same as for the Vineyard Wind 1 project and details of the scenario development are described in the Vineyard Wind 1 Final EIS (BOEM 2021a).

F.2.1 Offshore Wind Energy Development Activities

F.2.1.1. Site Characterization Studies

A lessee is required to provide the results of site characterization activities with its SAP and COP. For the purposes of the cumulative impact analysis, BOEM makes the following assumptions, which represent the maximum-case scenario for survey and sampling activities:

- Site characterization would occur on all existing leases and potential export cable routes.
- Site characterization would likely take place in the first 3 years following execution of a lease, based on the fact that a lessee would likely want to generate data for its COP at the earliest possible opportunity.
- Lessees would likely survey most or all of the proposed Lease Area during the 5-year site assessment term to collect required geophysical information for siting of a meteorological tower, two buoys, and commercial facilities (wind turbines). The surveys may be completed in phases, with the meteorological tower and buoy areas likely to be surveyed first.
- Lessee would not use air guns, which are typically used for deep-penetration two-dimensional or three-dimensional exploratory seismic surveys to determine the location, extent, and properties of oil and gas resources (BOEM 2016).

Table F-1 describes the typical site characterization surveys, the types of equipment and method used, and which resources the survey information would inform.

Table F-1 Site Characterization Survey Assumptions

Survey Type	Survey Equipment and Method	Resource Surveyed or Information Used to Inform
HRG surveys	Side-scan sonar, sub-bottom profiler, magnetometer, multi- beam echosounder	Shallow hazards, archaeological, bathymetric charting, benthic habitat
Geotechnical/sub-bottom sampling	Vibracores, deep borings, cone penetration tests	Geological, marine archaeology
Biological	Grab sampling, benthic sled, underwater imagery/sediment profile imaging	Benthic habitat
	Aerial digital imaging; visual observation from boat or airplane	Birds, marine mammals, sea turtles
	Ultrasonic detectors installed on survey vessels used for other surveys	Bat
	Visual observation from boat or airplane	Marine fauna (marine mammals and sea turtles)
	Direct sampling of fish and invertebrates	Fish and invertebrates

Source: BOEM 2016.

F.2.1.2. Site Assessment Activities

After SAP approval, a lessee can evaluate the meteorological conditions, such as wind resources, with the approved installation of meteorological towers and buoys. Meteorological buoys have become the preferred meteorological and oceanographic (metocean) data collection platform for developers, and

BOEM expects that most future site assessments will use buoys instead of towers (BOEM 2021d). The installation and operation of meteorological buoys involves substantially less activity and a much smaller footprint than the construction and operation of a meteorological tower. Site assessment activities have been approved or are in the process of being approved for multiple lease areas consisting of one to three meteorological buoys per SAP (Table F2-1 in Attachment 2). Site assessment would likely take place starting within 1 to 2 years of lease execution, because preparation of an SAP (and subsequent BOEM review) takes time. The No Action Alternative and cumulative analyses consider these site assessment activities.

F.2.1.3. Construction and Operation of Offshore Wind Facilities

Table F2-1 in Attachment 2 lists all offshore wind development activities that BOEM considers reasonably foreseeable by lease areas and projects.

F.2.2 Commercial Fisheries Cumulative Fishery Effects Analysis

Table F-2 depicts construction of offshore wind projects from Maine to North Carolina including Atlantic Shores South and Ocean Wind 2 that are proposed offshore New Jersey adjacent to Ocean Wind 1, and Empire Wind 1 and Empire Wind 2 that are proposed offshore New York. Also included are all of the projects currently in various stages of planning within BOEM’s offshore leases from Massachusetts to North Carolina, including the future development of Atlantic Shores North. Projected construction dates for each offshore wind project are listed in Table F2-1 in Attachment 2, and each project will require a NEPA process with an EIS or environmental assessment prior to approval.

Table F-2 summarizes (1) the incremental number of construction locations that are projected to be active in each region during each year between 2021 and 2030; (2) the number of operational turbines in each region at the beginning of each year between 2021 and 2030; and (3) the total number of active construction locations and operational turbines across the Atlantic OCS by year.

Note that the Kitty Hawk project is included despite its location in the NMFS South Atlantic Region. Fishing vessels operating in fisheries managed by the NMFS Greater Atlantic Regional Office regularly harvest in this area. It is also likely that vessels participating in fisheries managed by the NMFS Southeast Regional Office will be affected by the Kitty Hawk project, although revenues from these fisheries have not been included in the Fishery Management Plan revenue exposure analysis.

Table F-2 Offshore Wind Project Construction Schedule (dates shown as of January 15, 2023)

Project/Region	Number of Foundations										
	Before 2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 and Beyond
Aquaventis (state waters)	-	-	-	2	-	-	-	-	-	-	-
Total Other State Waters Projects	-	-	-	*2*	-	-	-	-	-	-	-
Estimated Other State Waters Construction	**-**	**-**	**-**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Estimated O&M Total	**-**	**-**	**-**	**0**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
Existing and Ongoing Projects											
Block Island (state waters)	5	-	-	-	-	-	-	-	-	-	-
Vineyard Wind 1 part of OCS-A 0501	-	-	-	63	-	-	-	-	-	-	-
South Fork, OCS-A 0517	-	-	-	13	-	-	-	-	-	-	-
CVOW, OCS-A 0497	2	-	-	-	-	-	-	-	-	-	-
Estimated Existing and Ongoing Project Construction	**7**	**0**	**0**	**76**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Estimated O&M Total	**0**	**7**	**7**	**7**	**83**	**83**	**83**	**83**	**83**	**83**	**83**
Planned Projects											
Massachusetts/Rhode Island Region											
Sunrise, OCS-A 0487	-	-	-	-	95	-	-	-	-	-	-
Revolution, part of OCS-A 0486	-	-	-	102	-	-	-	-	-	-	-
New England Wind, OCS-A 0534 and portion of OCS-A 0501 (Phase 1 [i.e., Park City Wind])	-	-	-	-	64	-	-	-	-	-	-
New England Wind, OCS-A 0534 and portion of OCS-A 0501 (Phase 2 [i.e., Commonwealth Wind])	-	-	-	-	82	-	-	-	-	-	-
SouthCoast OCS-A 0521	-	-	-	-	-	149	-	-	-	-	-
Beacon Wind, part of OCS-A 0520	-	-	-	-	79	-	-	-	-	-	-
Beacon Wind 2, part of OCS-A 0520	-	-	-	-	-	78	-	-	-	-	-
Bay State Wind, part of OCS-A 0500	-	-	-	-	-	112	-	-	-	-	-
OCS-A 0500 remainder	-	-	-	-	-	232	-	-	-	-	-

Project/Region	Number of Foundations										
	Before 2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 and Beyond
OCS-A 0487 remainder	-	-	-	-	-	-	-	-	-	-	-
Liberty Wind, part of OCS-A 0522	-	-	-	-		-		-	-	-	-
Estimated annual Massachusetts/Rhode Island construction	**0**	**0**	**0**	**102**	**320**	**571**	**0**	**0**	**0**	**0**	**0**
Estimated O&M Total	**0**	**0**	**0**	**0**	**102**	**422**	**993**	**993**	**993**	**993**	**993**
New York/New Jersey Region											
Ocean Wind 1, OCS-A 0498	-	-	-	-	101		-	-	-	-	-
Atlantic Shores South, OCS-A 0499	-	-	-	-	-	11	200	-	-	-	-
Ocean Wind 2, part of OCS-A 0532, and remainder	-	-	-	-	-	-	113	-	-	-	-
Empire Wind 1, part of OCS-A 0512	-	-	-	58	-	-	-	-	-	-	-
Empire Wind 2, part of OCS-A 0512	-	-	-	91	-	-	-	-	-	-	-
Atlantic Shores North, OCS-A 0549	-	-	-	-	-	-	160	-	-	-	-
OW Ocean Winds East LLC, OCS-A 0537	-	-	-	-	-	-	102	-	-	-	-
Attentive Energy LLC, OCS-A 0538	-	-	-	-	-	-	104	-	-	-	-
Bight Wind Holdings, LLC, OCS-A 0539	-	-	-	-	-	-	148	-	-	-	-
Atlantic Shores Offshore Wind Bight, LLC, OCS-A 0541	-	-	-	-	-	-	95	-	-	-	-
Invenergy Wind Offshore LLC, OCS-A 0542	-	-	-	-	-	-	99	-	-	-	-
Vineyard Mid-Atlantic LLC, OCS-A 0544	-	-	-	-	-	-	104	-	-	-	-
Estimated annual New York/New Jersey construction	**0**	**0**	**0**	**149**	**101**	**11**	**1,125**	**0**	**0**	**0**	**0**
Estimated O&M Total	**0**	**0**	**0**	**0**	**149**	**250**	**261**	**1,386**	**1,386**	**1,386**	**1,386**
Delaware/Maryland Region											
Skipjack, OCS-A 0519	-	-	-	-	17	-	-	-	-	-	-
US Wind, OCS-A 0490	-	-	-	-	126	-	-	-	-	-	-
GSOE I, OCS-A 0482	-	-	-	93							
OCS-A 0519 remainder	-	-	-								

Project/Region	Number of Foundations										
	Before 2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 and Beyond
Estimated annual Delaware/Maryland construction	**0**	**0**	**0**	**93**	**143**	**0**	**0**	**0**	**0**	**0**	**0**
Estimated O&M total	**0**	**0**	**0**	**0**	**93**	**236**	**236**	**236**	**236**	**236**	**236**
Virginia/North Carolina Region											
CVOW-C, OCS-A 0483	-	-	-	208	-	-	-	-	-	-	-
Kitty Hawk North, OCS-A 0508	-	-	-	-	70	-	-	-	-	-	-
Kitty Hawk South, OCS-A 0508	-	-	-	-	-	-	-	123	-	-	-
Estimated annual Virginia/North Carolina construction:	**0**	**0**	**0**	**208**	**70**	**0**	**0**	**123**	**0**	**0**	**0**
Estimated O&M Total	**0**	**0**	**0**	**0**	**208**	**278**	**278**	**278**	**401**	**401**	**401**
Total											
Estimated annual total construction	**7**	**0**	**0**	**630**	**634**	**582**	**1,125**	**123**	**0**	**0**	**0**
Estimated O&M total	**7**	**7**	**7**	**7**	**637**	**1,271**	**1,853**	**2,978**	**3,101**	**3,101**	**3,101**

CVOW = Coastal Virginia Offshore Wind

BOEM assumes proposed offshore wind projects will include the same or similar components as the proposed Project: wind turbines, offshore and onshore cable systems, OSS, onshore O&M facilities, and onshore interconnection facilities. BOEM further assumes that other potential offshore wind projects will employ the same or similar construction, O&M, and conceptual decommissioning activities as the proposed Project. However, offshore wind projects would be subject to evolving economic, environmental, and regulatory conditions. Lease areas may be split into multiple projects, expanded, or removed, and development within a particular lease area may occur in phases over long periods of time. Research currently being conducted in combination with data gathered regarding physical, biological, socioeconomic, and cultural resources during development of initial offshore wind projects in the United States could affect the design and implementation of future projects, as could advancements in technology. For the analysis of ongoing and planned activities, the proposed projects included in Table F2-1 in Attachment 2 are analyzed in Chapter 3 of this EIS. For a list of mitigation measures that were considered in the impact analysis in Chapter 3 of this EIS, please see the Project EIS's Appendix H (*Mitigation and Monitoring*).

F.2.3 Incorporation by Reference of Cumulative Impacts Study and the Analyses Therein

BOEM has completed a study of IPFs on the North Atlantic OCS to consider in an offshore wind development cumulative impacts scenario (BOEM 2019). The study is incorporated in this document by reference. The study identifies cause-and-effect relationships between renewable energy projects and resources potentially affected by such projects. It further classifies those relationships into a manageable number of IPFs through which renewable energy projects could affect resources. It also identifies the types of actions and activities to be considered in a cumulative impact scenario. The study identifies actions and activities that may affect the same physical, biological, economic, or cultural resources as renewable energy projects and states that such actions and activities may have the same IPFs as offshore wind projects.

The BOEM (2019) study identifies the relationships between IPFs associated with specific ongoing and planned activities in the North Atlantic OCS to consider in a NEPA cumulative impacts scenario. These IPFs and their relationships were utilized in the EIS analysis of cumulative impacts, and the application of which IPF applied to which resource was decided by BOEM.

As discussed in the BOEM (2019) study, reasonably foreseeable activities other than offshore wind projects may also affect the same resources as the proposed Project or other offshore wind projects, possibly via the same IPFs or via IPFs through which offshore wind projects do not contribute. This appendix lists reasonably foreseeable non-offshore wind activities that may contribute to the cumulative impacts of the proposed Project.

F.2.4 Undersea Transmission Lines, Gas Pipelines, and Other Submarine Cables

Several in-service and abandoned submarine telecommunication cables are present in the offshore export cable corridor and in the vicinity of the Lease Area. In-service cables along the offshore export cable corridor include the TAT 14 Seg G, TAT 12 Seg L, GlobeNet Seg 1, and GlobeNet Seg 5. Out-of-service cables along the offshore export cable corridor include the TAT 3, TAT 4, TAT 7, TAT 8, TAT 9, and TAT 11. NOAA navigation charts identify a number of sewer pipelines, stormwater outfalls, and intake structures along the coast of New Jersey that begin onshore and extend offshore. No undersea transmission lines or gas pipelines have been identified offshore near the Project (Ocean Wind 2023). In compliance with Federal Energy Regulatory Commission (FERC) Order No. 1000, PJM developed the State Agreement Approach to provide for the consideration of transmission needs driven by Public Policy Requirements in the regional transmission planning processes, known as its Regional Transmission

Expansion Plan. BPU/PJM solicited competitive transmission proposals under the State Agreement Approach for four distinct options that include a combination of onshore and offshore transmission lines and substations in April 2021. The solicitation identified possible points of interconnect at Deans, Smithburg, Larrabee, and Cardiff. On October 26, 2023, BPU selected Mid-Atlantic Offshore Development, LLC's and Jersey Central Power & Light Company's jointly submitted Larrabee Tri-Collector Solution (BPU Docket No. QO20100630), consisting of onshore new transmission connection facilities. The offshore wind projects listed in Table F2-1 in Attachment 2 that have a COP under review are presumed to include at least one identified cable route. Cable routes have not yet been announced for the remainder of the projects.

F.2.5 Tidal Energy Projects

The following tidal energy projects have been proposed or studied on the U.S. East Coast and are in operation or considered reasonably foreseeable:

- The Bourne Tidal Test Site, located in the Cape Cod Canal near Bourne, Massachusetts, is a testing platform for tidal turbines that was installed in late 2017 by the Marine Renewable Energy Collaborative.
- Western Passage Tidal Energy Project, a proposed tidal energy site in the Western Passage, received a preliminary permit from FERC in 2016. The preliminary permit allows developers to study a project but does not authorize construction.

F.2.6 Dredging and Port Improvement Projects

The following dredging projects have been proposed or studied at ports that may be used by the Project in New Jersey, Virginia, and South Carolina, and are either in operation or are considered reasonably foreseeable:

- The State of New Jersey is planning to build an offshore wind port on the eastern shore of the Delaware River in Lower Alloways Creek, Salem County, approximately 7.5 miles southwest of the city of Salem. The New Jersey Economic Development Authority is leading the development of the project on behalf of the state, working alongside key departments and agencies such as the Governor's Office, the Department of the Treasury, and the BPU. The development plan includes dredging the Delaware River Channel and construction is planned to commence in 2021 with a targeted completion date of late 2023 (New Jersey Wind Port 2021).
- The City of Atlantic City intends to secure authorization for marina upgrades, namely dredging in the marina and at Absecon Inlet, for the benefit of multiple marina users, and both this in-water activity and upland improvements by Ocean Wind (including office and warehouse) are being separately reviewed and authorized by USACE and state and local agencies (Ocean Wind 2023).
- A channel deepening project at the Port of Virginia is currently underway with USACE and a private contractor engaged in dredging approximately 1.1 million cubic yards of sediment from the federal channel in Norfolk Harbor and Newport News, Virginia (USACE 2019). The project is anticipated to be completed in 2024, resulting in a channel depth of over 50 feet in the harbor, which will allow it to accommodate two ultra-large container vessels simultaneously (Virginia Port Authority 2021).
- USACE has proposed maintenance dredging of portions of the Newark Bay, New Jersey Federal navigation channel, including the removal of material from the Port Elizabeth Channel. Maintenance dredging and associated upland placement activities are planned to occur between July 2021 and February 2022 (USACE 2021a).
- In 2017, the USACE Charleston District awarded contracts as part of the Charleston Harbor Deepening Project, which will create a 52-foot depth at the entrance channel to Charleston Harbor in South Carolina. The project also involves widening a turning basin in the port. The project will

support and enhance the military readiness of Charleston Harbor and joint base Charleston and allow Post-Panamax vessels to call upon the harbor (USACE 2021b).

- In 2018, two New Jersey Department of Transportation projects—High Bar Harbor channel and Barnegat Light Stake channel, both near Barnegat Inlet in Ocean and Long Beach Townships, New Jersey—underwent dredging of approximately 39,150 cubic yards and 3,230 cubic yards, respectively, to maintain the depths of these channels. Maintenance dredging for both projects is authorized until December 2025 and is expected to occur before the permits expire (USACE 2015a, 2015b).
- USACE has also received numerous permit applications for private dock, boat lift, and bulkhead repairs in Barnegat Bay (USACE 2022).
- Maintenance dredging of Barnegat Inlet and the Oyster Creek Channel in Barnegat Bay (Barnegat Inlet Federal Navigation Project) by USACE was conducted in November 2022 and is planned for November 2023.

F.2.7 Marine Minerals Use and Ocean Dredged Material Disposal

The closest previous lease in BOEM's Marine Minerals Program for sand borrow areas for beach replenishment is known as the D2 borrow area, offshore New Jersey near Harvey Cedars, Surf City, Long Beach Township, Ship Bottom, and Beach Haven (Lease Number OCS-A-0505; executed 7/1/2014). The lessee (USACE and NJDEP) was approved through September 30, 2018, for the use of up to 10,000,000 cubic yards of material to be used for the Long Beach Island Coastal Storm Risk Management Project, Barnegat Inlet to Little Egg Inlet. Dredging associated with this lease concluded on September 30, 2018, with a reported total dredge volume of approximately 9,217,383 cubic yards. Periodic nourishment for this project has been authorized in a 7-year cycle, with an estimated final nourishment year of 2055 (Cresitello 2020).

Due to the depletion of sand sources in state waters, it is highly likely that OCS material will be sought for future nourishment cycles on Long Beach Island as well as for projects to the south on Absecon Island and along beaches stretching from Great Egg Harbor Inlet to Townsends Inlet, and to the north along beaches stretching from Barnet Inlet to Sandy Hook (Cresitello 2020).

To help meet the sand resource needs of coastal communities, BOEM-funded reconnaissance or design-level OCS studies along the East Coast from Rhode Island to Florida have identified potential future sand resources in many areas. Sand resources identified nearest the Project include OCS locations offshore of all of the beaches noted above; many of these potential sand resources are within 5 miles of the Project Lease Area and associated planned infrastructure (e.g., export cables).

USEPA Region 2 is responsible for designating and managing ocean disposal sites for materials offshore in the region of the Project. USACE issues permits for ocean disposal sites; all ocean sites are for the disposal of dredged material permitted or authorized under the Marine Protection, Research, and Sanctuaries Act (16 USC 1431 et seq. and 33 USC 1401 et seq.). There are four active projects along the New Jersey Coast, with the closest dredge disposal site offshore Atlantic City, New Jersey (USACE 2021c).

F.2.8 Military Use

The Lease Area is within the Atlantic City Range Complex and the Atlantic City OPAREA. The Atlantic City OPAREA extends from the shoreline seaward to approximately 100 nm from land at its farthest point; the subsurface portion of the Atlantic City OPAREA has the same boundaries as the surface water portion. This range complex is used for U.S. Atlantic Fleet training and testing exercises and supports training and testing by other services, primarily the U.S. Air Force. The AEGIS Combat Systems Center conducts operations in this area. It is controlled by the Fleet Area Control and Surveillance Facility Virginia Capes, Naval Air Station, Oceana. In addition, the complex is composed of Warning Area 107, which is a special-use airspace used for surface and surface-to-air exercises. Subsurface operations are typically not conducted in the area. An aircraft training route is located along the westerly edge of the Lease Area and the U.S. Marine Corps uses a military flight route (VR-1709) that crosses the western portion of the Lease Area (Ocean Wind 2023).

Naval Weapons Station Earle is in Colts Neck, New Jersey. It provides all the ordnance for the Atlantic Fleet Carrier and Expeditionary Strike Groups and supports strategic ordnance requirements. The DOD also operates the North American Aerospace Defense Command national defense radar in the Project vicinity. Joint Base McGuire-Dix-Lakehurst is a military installation approximately 18 miles south of Trenton, New Jersey. Additionally, the Manasquan Inlet USCG is approximately 60 miles north of Oyster Creek in Point Pleasant. Military activities at the Manasquan Inlet Station could include various vessel training exercises, submarine and antisubmarine training, and U.S. Air Force exercises. Even though this installation is north of the Lease Area, vessel training exercises may be conducted closer to the Project (Ocean Wind 2023).

The Atlantic City International Airport is the base for the New Jersey Air National Guard's 177th Fighter Wing and the USCG Air Station Atlantic City. Military activities at these facilities could include squadron training by the New Jersey Air National Guard and SAR missions conducted by USCG (Ocean Wind 2023).

F.2.9 Marine Transportation

Marine transportation in the region is diverse and sourced from many ports and private harbors. Commercial vessel traffic in the region includes research, tug/barge, tankers (such as those used for liquid petroleum), cargo, cruise ships, smaller passenger vessels, and commercial fishing vessels. Recreational vessel traffic includes private motor boats and sailboats. A number of federal agencies, state agencies, educational institutions, and environmental non-governmental organizations participate in ongoing research offshore including oceanographic, biological, geophysical, and archaeological surveys. Most vessel traffic, excluding recreational vessels, tends to travel within established vessel traffic routes and the number of trips, as well as the number of unique vessels, has remained consistent (USCG 2021). In response to future offshore wind projects in the New York Bight, multiple additional fairways and a new anchorage may be established to route existing vessel traffic around wind energy projects (USCG 2021). One new regional maritime highway project received funding from the Maritime Administration. A new barge service (Davisville/Brooklyn/Newark Container-on-Barge Service) is proposed to run twice each week in state waters between Newark, New Jersey and Brooklyn, New York.

USCG chartered a workgroup on May 11, 2011, to gather data, identify existing and future waterway usage, and conduct modeling and analysis of traffic patterns in light of the complex interactions of the various factors that would affect navigational safety along the Atlantic Coast of the United States including potential navigational conflicts with various planned WEAs. USCG published the workgroup's Interim Report (77 *Federal Register* 55781; September 11, 2012) and a notification (81 *Federal Register* 13307; March 14, 2016) that announced the availability of the final report (the Atlantic Port Access Route Study) issued by the Atlantic Coast Port Access Route Study workgroup. USCG announced the final report to be complete as published on April 5, 2017 (82 *Federal Register* 16510). Similarly, and especially relevant to this EIS analysis, USCG completed a Port Access Route Study for the Seacoast of New Jersey including Offshore Approaches to the Delaware Bay, Delaware in 2022 (87 *Federal Register* 16759). The information in the New Jersey Port Access Route Study and the Atlantic Coast Port Access Route Study Final Reports along with the other Port Access Route Studies referenced in Section 3.16, including the *Consolidated Port Approaches and International Entry and Departure Transit Areas Port*

Access Route Studies, served to gauge and inform the navigational assessment of the Proposed Action and cumulative impacts.

F.2.10 National Marine Fisheries Service and New Jersey Department of Environmental Protection Activities

Research and enhancement permits may be issued for marine mammals protected by the MMPA and for threatened and endangered species protected under the ESA. NMFS is anticipated to continue issuing research permits under Section 10(a)(1)(A) of the ESA to allow take of certain ESA-listed species for scientific research. Scientific research permits issued by NMFS currently authorize studies on ESA-listed species in the Atlantic Ocean. Current fisheries management and ecosystem monitoring surveys conducted by or in coordination with NEFSC could overlap with offshore wind lease areas in the New England region and south into the Mid-Atlantic region. Surveys include (1) the NEFSC Bottom Trawl Survey, a more than 50-year multispecies stock assessment tool using a bottom trawl; (2) the NEFSC Sea Scallop/Integrated Habitat Survey, a sea scallop stock assessment and habitat characterization tool, using a bottom dredge and camera tow; (3) the NEFSC Surfclam/Ocean Quahog Survey, a stock assessment tool for both species using a bottom dredge; and (4) the NEFSC Ecosystem Monitoring Program, a more than 40-year shelf ecosystem monitoring program using plankton tows and conductivity, temperature, and depth units. Additionally, NJDEP has conducted the New Jersey Ocean Trawl Program annually for over 30 years to document the occurrence, distribution, and relative abundance of marine recreational and non-recreational fish species in New Jersey coastal waters. Similarly, the NJDEP surfclam surveys were performed annually from 1988–2019 to document the occurrence, distribution, and abundance of surfclams in New Jersey coastal waters. Nearshore survey activities associated with the NEAMAP overlap with the western edge of the Project area. These surveys are anticipated to continue within the region, regardless of offshore wind development.

The regulatory process administered by NMFS, which includes stock assessments for all marine mammals and 5-year reviews for all ESA-listed species, assists in informing decisions on take authorizations and the assessment of project-specific and cumulative impacts that consider ongoing and planned activities in biological opinions. Stock assessments completed regularly under the MMPA include estimates of potential biological removal that stocks of marine mammals can sustainably absorb. MMPA take authorizations require that a proposed action have no more than a negligible impact on species or stocks, and that a proposed action impose the least practicable adverse impact on the species. MMPA authorizations are reinforced by monitoring and reporting requirements so that NMFS is kept informed of deviations from what has been approved. Biological opinions for federal and non-federal actions are similarly grounded in status reviews and conditioned to avoid jeopardy and to allow continued progress toward recovery. These processes help to ensure that, through compliance with these regulatory requirements, a proposed action would not have a measurable impact on the conservation, recovery, and management of the resource.

F.2.10.1. Directed Take Permits for Scientific Research and Enhancement

NMFS issues permits for scientific research on protected species. These research permits include the authorization of directed take for activities such as capturing animals and taking measurements and biological samples to study their health, tagging animals to study their distribution and migration, photographing and counting animals to get population estimates, taking animals in poor health to an animal hospital, and filming animals. NMFS also issues permits for enhancement purposes; these permits are issued to enhance the survival or recovery of a species or stock in the wild by taking actions that increase an individual’s or population’s ability to recover in the wild. Scientific research and enhancement permits have been issued previously for satellite, acoustic, and multi-sensor tagging studies on large and small cetaceans; research on reproduction, mortality, health, and conservation issues for NARWs; and research on population dynamics of harbor and gray seals. Reasonably foreseeable future impacts from scientific research and enhancement permits include physical and behavioral stressors (e.g., restraint and capture, marking, implantable and suction tagging, biological sampling).

F.2.10.2. Fisheries Use and Management

NMFS implements regulations to manage commercial and recreational fisheries in federal waters, including those within which the Project would be located; the State of New Jersey regulates commercial fisheries in state waters (within 3 nm of the coastline). No shellfish aquaculture leases presently occur in the vicinity of the BL England onshore interconnection. Four shellfish leases (37 acres) and one research lease occur in the vicinity of Oyster Creek with the primary shellfish growout of oysters and hard clams; however, these areas would be avoided (Ocean Wind 2023). The Project overlaps two of NMFS's eight regional councils to manage federal fisheries: MAFMC, which includes New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina; and NEFMC, which includes Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut (NEFMC 2016). The councils manage species with many FMPs that are frequently updated, revised, and amended and coordinate with each other to jointly manage species across jurisdictional boundaries (MAFMC 2019). Many of the fisheries managed by the councils are fished for in state waters or outside of the Mid-Atlantic region, so the council works with ASMFC. ASMFC is composed of the 15 Atlantic coast states and coordinates the management of marine and anadromous resources found in the states' marine waters. In addition, the states and NMFS, under the framework of ASMFC's *Amendment 3 to the Interstate Fishery Management Plan for American Lobster*, cooperatively manage the American lobster resource and fishery (NOAA 1997).

The FMPs of the councils and ASMFC were established, in part, to manage fisheries to avoid overfishing. They accomplish this through an array of management measures, including annual catch quotas, minimum size limits, and closed areas. These various measures can further reduce (or increase) the size of landings of commercial fisheries in the Northeast and Mid-Atlantic regions.

NMFS also manages highly migratory species, such as tuna and sharks, that can travel long distances and cross domestic boundaries. Table F-3 summarizes other FMPs and actions in the region.

Table F-3 Other Fishery Management Plans

Area	Plan and Projects
ASMFC	ASMFC *Five-Year Strategic Plan 2014–2018* (ASMFC 2014); Draft 2019 strategic management plan under review *Management, Policy and Science Strategies for Adapting Fisheries Management to Changes in Species Abundance and Distribution Resulting from Climate Change* (ASMFC 2018)
New York	*New York Ocean Action Plan 2017–2027*: adaptive management plan (NYSDEC 2017) New York State filed a petition with NOAA, NMFS, and MAFMC to demand that commercial fluke allocations be revised to provide fishers with equitable access to summer flounder. New York is also reviewing other species where there is an unfair allocation, including black sea bass and bluefish, and may pursue similar actions (BOEM 2021b).
Long Island Regional Development Council	East Hampton Shellfish Hatchery project to consolidate the hatchery's municipal hatchery and nursing facilities. Haskell's seafood facility in East Quogue is proposed become a fully functioning seafood processing plant. Shinnecock Dock Revitalization to provide better processing and packing facilities for local fishermen (LIRDC 2018).

Area	Plan and Projects
New Jersey	NJDEP Division of Fish and Wildlife Marine Fisheries Management Rule Amendment Proposal with amendments to rules governing crab and lobster management, commercial Atlantic menhaden fishery, marine fisheries, and fishery management in New Jersey was published in the March 1, 2021, New Jersey Register (New Jersey Division of Fish and Wildlife 2021).

F.2.11 Global Climate Change

Climate change results primarily from the increasing concentration of GHGs in the atmosphere, which causes planet-wide physical, chemical, and biological changes, substantially affecting the world's oceans and lands. Changes include increases in global atmospheric and oceanic temperature, shifting weather patterns, rising sea levels, and changes in atmospheric and oceanic chemistry (Blunden and Arndt 2020). Section 7.6.1.4 of the *Programmatic EIS for Alternative Energy Development and Production and Alternate Use of Activities on the Outer Continental Shelf* (Minerals Management Service 2007) describes global climate change with respect to assessing renewable energy development. Key drivers of climate change are increasing atmospheric concentrations of CO_2 and other GHGs, such as methane and nitrous oxide. These GHGs reduce the ability of solar radiation to re-radiate out of Earth's atmosphere and into space. Although all three of these GHGs have natural sources, the majority of these GHGs are released from anthropogenic activity. Since the industrial revolution, the rate at which solar radiation is re-radiated back into space has slowed, resulting in a net increase of energy in Earth's system (Solomon et al. 2007). This energy increase presents as heat, raising the planet's temperature and causing climate change.

Fluorinated gases are a type of GHG released in trace amounts but are highly efficient at preventing solar radiation from being re-radiated back into space. They have a much longer lifespan than CO_2, methane, and nitrous oxide. Fluorinated gases have no natural sources, are either a product or byproduct of manufacturing, and can have 23,000 times the warming potential of an equal amount of CO_2. These gases include hydrofluorocarbons, perfluorocarbons, nitrogen trifluoride, and sulfur hexafluoride. These gases are currently being phased out; however, sulfur hexafluoride is still used in WTG switchgears and OSS high-voltage and medium-voltage gas-insulated switchgears.

Local emissions, such as those from wind energy projects, would contribute to global emissions and those global emissions do have impacts whose local effects are increasingly elucidated through research. For example, a recent study concerning the NARW provides evidence that the whale's feeding area moved north following relocation of its food source related to climate change, and whale mortality may have increased because of fewer controls on fishing activities in the new, more northerly area (Meyer-Gutbrod et al. 2021). Climate change is predicted to affect Northeast fishery species in different ways (Hare et al. 2016), and the NMFS biological opinion discusses in detail the potential impacts of global climate change on protected species that occur within the Proposed Action area (NMFS 2013).

The Intergovernmental Panel on Climate Change released a special report in October 2018 that compared risks associated with an increase of global warming of 1.5 degrees Celsius (°C) and an increase of 2°C. The report found that climate-related risks depend on the rate, peak, and duration of global warming, and that an increase of 2°C was associated with greater risks associated with climatic changes such as extreme weather and drought; global sea level rise; impacts on terrestrial ecosystems; impacts on marine biodiversity, fisheries, and ecosystems and their functions and services to humans; and impacts on health, livelihoods, food security, water supply, and economic growth (IPCC 2018). High global temperatures increase the chances of sea level rise by the end of the century, with a projected relative seal level rise of 0.6 to 2.2 meters along the contiguous United States coastline by 2100 (NOAA 2022). Expected relative sea level rise would cause tide and storm surge heights to increase, leading to a shift in the U.S. coastal flood regimes by 2050 with major and moderate high tide flood events occurring as frequently as moderate and minor high tide flood events occur today (NOAA 2022).

New Jersey has been warming faster than the rest of the Northeast region, with annual average temperatures increasing by 4.1 to 5.7 degrees Fahrenheit (°F) by 2050 (NJDEP 2020). Sea levels have also increased at a greater rate in New Jersey as compared to the global change in mean sea level and are likely to experience a sea level rise of 0.9 to 2.1 feet between 2000 and 2050 (Kopp et al. 2019).

Table F-4 summarizes regional plans and policies that are in place to address climate change, and Table F-5 summarizes resiliency plans.

Table F-4 Climate Change Plans and Policies

Plans and Policies	Summary/Goal
New York	
Reforming the Energy Vision (New York State 2014)	State's energy policy to build integrated energy network; clean energy goal to reduce GHGs 40% by 2030 and 80% by 2050.
Order Adopting a Clean Energy Standard (State of New York Public Service Commission 2016)	Requirement that 50% of New York's electricity come from renewable energy sources by 2030.
New York State Energy Plan 2015; 2017 Biennial Report to 2015 Plan (NYSERDA 2015, 2017a)	Requires 40% reduction in GHG from 1990 levels, 50% electricity to come from renewable energy resources, and a 600-trillion-British-thermal-unit increase in statewide energy efficiency.
Governor Cuomo State of State Address 2017, 2018, 2021	2017: Set offshore wind energy development goal of 2,400 MW by 2030 (Governor's Office 2017). 2018: Procurement of at least 800 MW of offshore wind power between two solicitations in 2018 and 2019; new energy efficiency target for investor-owned utilities to more than double utility energy efficiency progress by 2025; energy storage initiative to achieve 1,500 MW of storage by 2025 and up to 3,000 MW by 2030 (Governor's Office 2018). 2021: The governor's 2021 agenda—Reimagine | Rebuild | Renew—establishes a goal of building out the renewable energy program. The agenda notes the development of two new offshore wind farms more than 20 miles offshore of Long Island, as well as the creation of dedicated offshore port facilities and additional transmission capacity development.
New York State Offshore Wind Master Plan (2017) (NYSERDA 2017b)	Grants NYSERDA ability to award 25-year long-term contracts for projects ranging from approximately 200 MW to approximately 800 MW, with an ability to award larger quantities if sufficiently attractive proposals are received. Each proposer is also required to submit at least one proposal of approximately 400 MW. Bids are due in February 2019; awards are expected in spring 2019; and contracts are expected to be executed thereafter.

Plans and Policies	Summary/Goal
2020 Offshore Wind Solicitation	As noted above, NYSERDA has provisionally awarded two offshore wind projects, totaling 2,490 MW. Empire Wind 2 (1,260 MW) and Beacon Wind (1,230 MW) of Equinor Wind US, LLC will generate enough clean energy to power 1.3 million homes and will be major economic drivers, supporting the following: • More than 5,200 direct jobs • Combined economic activity of $8.9 billion in labor, supplies, development, and manufacturing statewide • $47 million in workforce development and just access funding
The Climate Leadership and Community Protection Act, enacted on July 18, 2019, signed into law in July 2019, and effective January 1, 2020	The act establishes economy-wide targets to reduce GHG emissions by 40% of 1990 levels by 2030 and 85% of 1990 levels by 2050.
New Jersey	
New Jersey Energy Master Plan (New Jersey State 2019)	Updated in 2019, the plan sets the framework to implement Executive Order 28 by decarbonizing and modernizing New Jersey's energy system, expanding the clean energy innovation economy, and accelerating the deployment of renewable energy resources to meet the offshore wind energy generation goal established in Executive Order 92.
Executive Order 28: Measures to Advance New Jersey's Clean Energy Economy (2018)	Sets target of total conversion of the state's energy production profile to 100% clean energy sources on or before January 1, 2050.
Executive Order 92: Increase Offshore Wind Goal to 7,500 Megawatts by 2036 (2019)	Establishes a goal of 3,500 MW of offshore wind energy generation by 2030.
Executive Order 100: Protecting Against Climate Threats (PACT); Land Use Regulations and Permitting (2020)	Establishes a GHG monitoring and reporting program, establishes criteria to govern and reduce emissions, and integrates climate change considerations, such as sea level rise, into regulatory and permitting programs.
South Carolina	
None identified.	Not applicable.
Virginia	
Virginia Carbon Rule (June 25, 2020)	Under the Virginia Carbon Rule, Virginia is to establish a GHG cap-and-trade program and is to join the Regional Greenhouse Gas Initiative, a regional cap-and trade-program that reduces climate pollution from fossil fuel-fired power plants.
Virginia Clean Economy Act (April 12, 2020)	The Virginia Clean Economy Act establishes an electric power renewable portfolio standard for Virginia electric power companies to become 100% carbon-free by 2050 and requires closure of coal-fired electric power plants, establishes energy efficiency standards, and promotes offshore wind development and solar and distributed generation (Virginia State 2020).

Plans and Policies	Summary/Goal
Virginia Department of Environmental Quality Strategic Plan (2021)	The Virginia Department of Environmental Quality Strategic Plan establishes the objective to support the Commonwealth's resilience efforts by encouraging climate adaption through programmatic outreach and requirements, and strategies to make climate change adaptation an explicit, expected outcome of appropriate Virginia agency programs and initiatives. The Strategic Plan incorporates climate resilience, adaptation, and mitigation.

NYSERDA = New York State Energy Research and Development Authority

Table F-5 Resiliency Plans and Policies in the Lease Area

Plans and Policies	Summary
New York	
Part 490 of Community Risk and Resiliency Act of 2014	Establishes statewide science-based sea-level rise projections for coastal regions of the state. As of 2019, NYSDEC is in the process of developing a State Flood Risk Management Guidance document for state agencies (NYSDEC n.d.).
NY Rising Community Reconstruction Program (2018)	$20.4 million in projects on Long Island to help flood-prone communities plan and prepare for extreme weather events as they continue projects to recover from Superstorm Sandy, Hurricane Irene, and Tropical Storm Lee. Three projects were announced for Suffolk County and five for Nassau County (BOEM 2021b).
New Jersey	
New Jersey Draft Climate Change Resilience Strategy (NJDEP 2021)	This is New Jersey's first statewide climate resiliency strategy and was released as a draft in April 2021. The *Draft Climate Change Resilience Strategy* develops a framework for policy, regulatory, and operational changes to support the resilience of New Jersey's communities, economy, and infrastructure. It includes 125 recommended actions across the following six priority areas: build resilient and healthy communities, strengthen the resilience of New Jersey's ecosystems, promote coordinated governance, invest in information, increase public understanding, promote climate-informed investments and innovative financing, and coastal resilience plan.
South Carolina	
South Carolina Disaster Relief and Resilience Act (2020)	This act established the South Carolina Office of Resilience to coordinate disaster recovery and resilience efforts within the state, created the Disaster Relief and Resilience Reserve Fund to finance disaster recovery efforts and hazard mitigation projects, and created the Resilience Revolving Fund to provide low-interest loans to local governments performing floodplain buyouts and restoration.
Virginia	
Virginia Coastal Zone Management Program 2020 Coastal Needs Assessment and Fiscal Year 2021–2025 Strategies (Section 309)	The Virginia Coastal Zone Management Program assesses Virginia's coastal resources and management efforts every 5 years, including coastal hazards and ocean resources (Virginia Department of Environmental Quality 2021). The 5-year grant strategies are applied to result in new enforceable policies to better manage high-priority resources or issues; initiatives include responses to results of the Virginia Coastal Zone Management Program Phase I Coastal Hazards Assessment. Climate resiliency was selected by the Coastal Policy Team as a Fiscal Year 2020–2023 focal area theme to help meet the goals and needs in the statewide resiliency plan.

Plans and Policies	Summary
Virginia Clean Energy and Community Flood Preparedness Act	This act creates a Virginia Community Flood Preparedness Fund to enhance flood prevention, flood protection, and coastal resilience.

NYSDEC = New York State Department of Environmental Conservation

F.2.12 Oil and Gas Activities

The proposed Project area is in the North Atlantic Planning Area of the OCS Oil and Gas Leasing Program (National OCS Program). On September 8, 2020, the White House issued a presidential memorandum for the Secretary of the Interior on the withdrawal of certain areas of the United States OCS from leasing disposition for 10 years, including the areas currently designated by BOEM as the South Atlantic and Straits of Florida Planning Areas (The White House 2020a). The South Atlantic Planning Area includes the OCS off South Carolina, Georgia, and northern Florida. On September 25, 2020, the White House issued a similar memorandum for the Mid-Atlantic Planning Area that lies south of the northern administrative boundary of North Carolina (The White House 2020b). This withdrawal prevents consideration of these areas for any leasing for purposes of exploration, development, or production during the 10-year period beginning July 1, 2022 and ending June 30, 2032. However, currently, there has been no decision by the Secretary of the Interior regarding future oil and gas leasing in the North Atlantic or remainder of the Mid-Atlantic Planning Areas. Existing leases in the withdrawn areas are not affected.

BOEM issues geological and geophysical permits to obtain data for hydrocarbon exploration and production; locate and monitor marine mineral resources; aid in locating sites for alternative energy structures and pipelines; identify possible manmade, seafloor, or geological hazards; and locate potential archaeological and benthic resources. Geological and geophysical surveys are typically classified into categories by equipment type and survey technique. There are currently no such permits under review for areas offshore New York and New Jersey (BOEM 2021c).

Several liquefied natural gas ports are on the East Coast of the United States. Table F-6 lists existing, approved, and proposed liquified natural gas ports on the East Coast that provide (or may provide in the future) services such as natural gas export, natural gas supply to the interstate pipeline system or local distribution companies, storage of liquified natural gas for periods of peak demand, or production of liquified natural gas for fuel and industrial use (FERC 2018).

Table F-6 Liquid Natural Gas Terminals in the Northeastern United States

Terminal Name	Type	Company	Jurisdiction	Distance from Project (approximate)	Status
Everett, MA	Import terminal	GDF SUEZ—DOMAC	FERC	90 miles north	Existing
Offshore Boston, MA	Import terminal	Neptune LNG	MARAD/ USCG	100 miles north	Existing
Offshore Boston, MA	Import terminal, authorized to re-export delivered LNG	Excelerate Energy—Northeast Gateway	MARAD/ USCG	95 miles north (Buoy B)	Existing
Cove Point, MD (Chesapeake Bay)	Import terminal	Dominion—Cove Point LNG	FERC	340 miles southwest	Existing
Elba Island, GA (Savannah River)	Import terminal	El Paso—Southern LNG	FERC	835 miles southwest	Existing

Terminal Name	Type	Company	Jurisdiction	Distance from Project (approximate)	Status
Elba Island, GA (Savannah River)	Export terminal	Southern LNG Company	FERC	835 miles southwest	Approved
Jacksonville, FL	Export terminal	Eagle LNG Partners	FERC	960 miles southwest	Proposed

Source: FERC 2018.
DOMAC = Distrigas of Massachusetts; FL = Florida; GA = Georgia; LNG = liquified natural gas; MA = Massachusetts; MARAD = U.S. Department of Transportation Maritime Administration; MD = Maryland

F.2.13 Onshore Development Activities

Onshore development activities that may contribute to cumulative impacts include visible infrastructure such as onshore wind turbines and cell towers, port development, and other energy projects such as transmission and pipeline projects. Coastal development projects permitted through regional planning commissions, counties, and towns may also contribute to cumulative impacts. These may include residential, commercial, and industrial developments spurred by population growth in the region (Table F-7).

Table F-7 Existing, Approved, and Proposed Onshore Development Activities

Type	Description
Local planning documents	*Ocean County Planning Board Comprehensive Master Plan* (Ocean County 2011) *Cape May County Comprehensive Plan* (Cape May County 2005) City of Sea Isle City *2017 Master Plan Reexamination Report* (City of Sea Isle City 2017) Berkeley Township *General Reexamination of the Master Plan* (Berkeley Township 2019) City of Ocean City *Master Plan Reexamination Report* (City of Ocean City 2019)
Onshore wind projects	According to the U.S. Geological Survey, there is one onshore wind project within the 40-mile viewshed of the Project. The Jersey Atlantic Wind Farm consists of five 1.5 MW turbines with a tip height of 118.6 meters and rotor diameter of 77.0 meters (Hoen et al. 2021).
Communications towers	There are numerous communication towers in communities within the viewshed of the Project. For example, there are 102 communication towers within a 3-mile radius of Atlantic City; 78 communication towers within a 3-mile radius of Ocean City; and 23 communication towers within a 3-mile radius of Cape May (AntennaSearch.com 2023).

Type	Description
Development projects	As part of New York State's $100 billion infrastructure project, $5.6 billion will go to transform the Long Island Railroad to improve system connectivity. Within Suffolk County, the following stations will receive funds for upgrades: Brentwood, Deer Park, East Hampton, Northport, Ronkonkoma, Stony Brook, Port Jefferson, and Wyandanch. The East Hampton historic Long Island Railroad station will undergo upgrades and modernizations (Metropolitan Transit Authority 2017; BOEM 2021b). Additional plans for transit-oriented design and highway improvements are planned in Suffolk County in state and county planning documents. The Fire Island Inlet to Montauk Point Project is a $1.2 billion project by USACE, NYSDEC, and Long Island, New York municipalities to engage in inlet management; beach, dune, and berm construction; breach response plans; raising and retrofitting 4,400 homes; road-raising; groin modifications; and coastal process features. Within Suffolk County, portions of the Towns of Babylon, Islip, Brookhaven, Southampton, and East Hampton; 12 incorporated villages along Long Island's south shore (mainland); Fire Island National Seashore; and the Poospatuck and Shinnecock Indian Reservations will be involved in this project (USACE 2018). As part of a comprehensive flood-control strategy, Ocean City, New Jersey is spending $25 million over the next 5 years to build new pumping stations, drainage systems, berms and retention walls, and new elevated road construction to control flooding in low-lying areas.
Port studies/ upgrades	The State of New Jersey is planning to build an offshore wind port on the eastern shore of the Delaware River in Lower Alloways Creek, Salem County, approximately 7.5 miles southwest of the city of Salem. The port site is adjacent to PSEG's Hope Creek Nuclear Generating Station. NJEDA is leading the development of the project on behalf of the state, working alongside key departments and agencies such as the Governor's Office, the Department of the Treasury, and BPU. Construction is planned to commence in 2021 with a targeted completion date of late 2023. The development plan includes construction of a heavy-lift wharf with a dedicated delivery berth and an installation berth that can accommodate jack-up vessels, a 30-acre marshalling area for component assembly and staging, a dedicated overland heavy-haul transportation corridor, and potential for additional laydown areas. NJEDA estimates the project will cost $300 to $400 million (New Jersey Wind Port 2021). Both the Atlantic Shores South and Ocean Wind 2 projects have committed to building a nacelle assembly facility at the New Jersey Wind Port. The nacelle houses the components that convert the mechanical energy of the rotating blades into electrical energy and is the highest value-added offshore wind component. Atlantic Shores plans to partner with MHI Vestas for this facility while Ocean Wind will collaborate with General Electric (BPU 2021). In 2020, the State of New Jersey announced a $250 million investment in a manufacturing facility to build steel components for offshore wind turbines at the Port of Paulsboro on the Delaware River in New Jersey (New Jersey State 2020). Construction on the facility began in January 2021, with production anticipated to begin in 2023 (New Jersey Business 2020). Both the Atlantic Shores South and Ocean Wind 2 projects will utilize the foundation manufacturing facility at the Port of Paulsboro (BPU 2021). Ports in New York may require upgrades to support the offshore wind industry developing in the northeastern United States. Upgrades may include onshore developments or underwater improvements (such as dredging). In December 2017, NYSERDA issued an offshore wind master plan that assessed 54 distinct waterfront sites along the New York Harbor and Hudson River and 11 distinct areas with multiple small sites along the Long Island coast. Twelve waterfront areas and five distinct areas were singled out for "potential to be used or developed into facilities capable of supporting OSW projects" (Table 26, NYSERDA

Type	Description
	2017b). Nearly all identified sites would require some level of infrastructure upgrade (from minimal to significant) depending on offshore wind activities intended for the site. Particular sites of interest include Red Hook-Brooklyn, South Brooklyn Marine Terminal, and the Port of Coeymans (NYSERDA 2017b). For additional information regarding specific proposed improvements to these ports, see Capital Region Economic Development Council 2018, American Association of Port Authorities 2016, Rulison 2018, and NYCEDC 2018. New York State proposed port improvements include the governor's 2021 agenda "Reimagine | Rebuild | Renew," which includes upgrades to create five dedicated port facilities for offshore wind, including the following: • The nation's first offshore wind tower manufacturing facility, to be built at the Port of Albany • An offshore wind turbine staging facility and O&M hub to be established at the South Brooklyn Marine Terminal • Increasing the use of the Port of Coeymans for cutting-edge turbine foundation manufacturing • Buttressing ongoing O&M out of Port Jefferson and Port of Montauk Harbor in Long Island A study commissioned by the Virginia Department of Mines Minerals and Energy and published in 2015 evaluated 10 Virginia ports for their readiness to accommodate offshore wind manufacturing and construction activities and also evaluated five commercial shipyards for their readiness to manufacture offshore electrical substations. Using requirements including water-side infrastructure, onshore infrastructure, and access requirements, five ports in Virginia identified with a high level of readiness to support offshore wind, including the following: • Portsmouth Marine Terminal • Newport News Marine Terminal • Peck Marine Terminal • Virginia Renaissance Center • BASF Portsmouth Portsmouth and Newport News Marine Terminals were identified by the study team to have the highest level of port readiness due to the ample space available to accommodate multiple co-located offshore wind construction and deployment activities (BVG Associates 2015). Following the study, the State of Virginia plans to invest $40 million from its 2021 budget to upgrade the Portsmouth Marine Terminal, near Norfolk, Virginia to handle offshore wind manufacturing, handling, and transportation (Reuters 2021).

NJEDA = New Jersey Economic Development Authority; NYSDEC = New York State Department of Environmental Conservation; NYSERDA = New York State Energy Research and Development Authority; PSEG = Public Service Enterprise Group

F.3. References Cited

American Association of Port Authorities. 2016. *Port-Related Projects Awarded $61.8 Million in TIGER VIII Infrastructure Grants*. Available: https://www.aapa-ports.org/advocating/PRDetail.aspx?ItemNumber=21393. Accessed: December 20, 2018.

AntennaSearch.com. 2023. Tower and Antenna Database. Available: www.antennasearch.com. Accessed: January 22, 2023.

Atlantic States Marine Fisheries Commission (ASMFC). 2014. *Five-Year Strategic Plan 2014–2018*. Available: http://www.asmfc.org/files/pub/2014-2018StrategicPlan_Final.pdf. Accessed: January 7, 2019.

Atlantic States Marine Fisheries Commission (ASMFC). 2018. *Management, Policy and Science Strategies for Adapting Fisheries Management to Changes in Species Abundance and Distribution Resulting from Climate Change*. February. Available: http://www.asmfc.org/files/pub/ClimateChangeWorkGroupGuidanceDocument_Feb2018.pdf. Accessed: January 7, 2019.

Berkeley Township. 2019. *General Reexamination of the Master Plan*. March. Available: https://cms6.revize.com/revize/berkeleynj/document_center/planning%20agendas/2019/Reexamination%20Report_signed.pdf. Accessed: July 22, 2021.

Blunden, J., and D. S. Arndt. 2020. State of the climate in 2019. *Bulletin of the American Meteorological Society* 101(8):S1–S429.

Bureau of Ocean Energy Management (BOEM). 2016. *Revised Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York*. OCS EIS/EA BOEM 2016-070. October 2016.

Bureau of Ocean Energy Management (BOEM). 2019. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Continental Shelf*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, VA. OCS Study 2019-036.

Bureau of Ocean Energy Management (BOEM). 2021a. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement*. OCS EIS/EA, BOEM 2021-0012. March.

Bureau of Ocean Energy Management (BOEM). 2021b. *South Fork Wind Farm and South Fork Export Cable Project Final Environmental Impact Statement*. OCS EIS/EA, BOEM 2020-057. August.

Bureau of Ocean Energy Management (BOEM). 2021c. Submitted Atlantic OCS Region Permit Requests. Available: https://www.boem.gov/submitted-atlantic-ocs-region-permit-requests. Accessed: July 16, 2021.

Bureau of Ocean Energy Management (BOEM). 2021d. *Commercial and Research Wind Lease and Grant Issuance and Associated Site Assessment Activities on the Atlantic Outer Continental Shelf of the New York Bight*. OCS EIS/EA BOEM 2021-073. December.

BVG Associates. 2015. *Virginia offshore port readiness evaluation. Report 1: An evaluation of 10 Virginia ports.* A report to the Virginia Department of Mines, Minerals and Energy. April. Available: https://www.dmme.virginia.gov/de/LinkDocuments/OffshoreWind/PortsStudy-Report1.pdf. Accessed: July 22, 2021.

Cape May County, New Jersey. 2005. *Cape May County Comprehensive Plan*. Available: https://www.capemaycountynj.gov/DocumentCenter/View/422/Comprehensive-Plan-2002-PDF?bidId=. Accessed: July 22, 2021.

Capital Region Economic Development Council. 2018. *Capital Region Creates 2018 Progress Report*. Available: http://www.regionalcouncils.ny.gov/sites/default/files/2018-10/CapitalRegion2018ProgressReport.pdf. Accessed: December 18, 2018.

City of Ocean City. 2019. *Master Plan Reexamination Report.* January. Available: https://services.ocnj.us/government/documents/department-documents/planning-department/93-2018-master-plan-re-examination-adopted-1-10-19-1/file. Accessed: July 22, 2021.

City of Sea Isle City. 2017. *2017 Master Plan Reexamination Report.* August. Available: https://drive.google.com/file/d/12A9D8hpf34is4hCL1ODlMmGZ6RuXjUPh/view. Accessed: July 21, 2021.

Cresitello, Donald E. 2020. Senior Coastal Planner, Planning and Policy Division, U.S. Army Corps of Engineers – North Atlantic Division. Emailed transmittal of unpublished NAD Sediment Needs Analysis to Jeffrey Waldner, P.G., Physical Scientist/Oceanographer, Bureau of Ocean Energy Management, Marine Minerals Division on September 1, 2020.

Federal Energy Regulatory Commission (FERC). 2018. Website for Liquefied Natural Gas with Listings for Existing, Approved, and Proposed LNG Import/Export Terminals. Available: https://www.ferc.gov/industries/gas/indus-act/lng.asp. Accessed: October 30, 2018.

Governor's Office. 2017. 2017 *State of the State Book.* Available: https://www.governor.ny.gov/sites/governor.ny.gov/files/atoms/files/2017StateoftheStateBook.pdf. Accessed: January 9, 2019.

Governor's Office. 2018. *2018 State of the State Book.* Available: https://www.governor.ny.gov/sites/governor.ny.gov/files/atoms/files/2018-stateofthestatebook.pdf. Accessed: January 9, 2019.

Hare, J. A., W. E. Morrison, M. W. Nelson, M. M. Stachura, E. J. Teeters, and R. B. Griffis. 2016. A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast U.S. Continental Shelf. *PLoS ONE* 11(2): e0146756. DOI:10.1371/journal.pone.0146756.

Hoen, B. D., J. E. Diffendorfer, J. T. Rand, L. A. Kramer, C. P. Garrity, and H. E. Hunt. 2021. United States Wind Turbine Database V4.0 (April 9, 2021): U.S. Geological Survey, American Clean Power Association, and Lawrence Berkeley National Laboratory data release. Available: https://doi.org/10.5066/F7TX3DN0.

Intergovernmental Panel on Climate Change (IPCC). 2018. *IPCC Special Report on Impacts of Global Warming of 1.5 Degrees Celsius Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty: Summary for Policymakers*. Available: http://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf. Accessed: November 5, 2018.

Kopp, R. E, C. Andrews, A. Broccoli, A. Garner, D. Kreeger, R. Leichenko, N. Lin, C. Little, J. A. Miller, J. K. Miller, K. G. Miller, R. Moss, P. Orton, A. Parris, D. Robinson, W. Sweet, J. Walker, C. P. Weaver, K. White, M. Campo, M. Kaplan, J. Herb, and L. Auermuller. 2019. *New Jersey's Rising Seas and Changing Coastal Storms: Report of the 2019 Science and Technical Advisory Panel*. Rutgers, The State University of New Jersey. Prepared for the New Jersey Department of Environmental Protection. Available: https://climatechange.rutgers.edu/images/STAP_FINAL_FINAL_12-4-19.pdf.

Long Island Regional Development Council (LIRDC). 2018. *Long Island Completing the Puzzle 2018 Update*. Available: http://regionalcouncils.ny.gov/sites/default/files/2018-10/LongIsland2018REDCReport_0.pdf. Accessed: December 20, 2018.

Metropolitan Transit Authority. 2017. "Governor Cuomo Proposes $120 Million to Enhance 16 LIRR Stations and Improve System Connectivity with MacArthur Airport and Brookhaven National Laboratory." January 10. Available: http://www.mta.info/news/2017/01/10/governor-cuomo-proposes-120-million-enhance-16-lirr-stations-and-improve-system. Accessed: December 19, 2018.

Meyer-Gutbrod, E. L., C. H. Greene, K. T. A. Davies, and D. G. Johns. 2021. Ocean Regime Shift is Driving Collapse of the North Atlantic Right Whale Population. *Oceanography* 34(3):22–31 (September 2021). Available: https://tos.org/oceanography/assets/docs/34-3_meyer-gutbrod.pdf. Accessed: January 27, 2022.

Mid-Atlantic Fishery Management Council (MAFMC). 2019. "About the Council." Available: http://www.mafmc.org/about/. Accessed: January 8, 2019.

Minerals Management Service. 2007. *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf*. Available: https://www.boem.gov/Guide-To-EIS/. Accessed: January 1, 2019.

National Marine Fisheries Service (NMFS). 2013. *Endangered Species Act Section 7 Consultation Biological Opinion for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf in Massachusetts, Rhode Island, New York and New Jersey Wind Energy Areas*. NER-2012-9211.

National Oceanic and Atmospheric Administration (NOAA). 1997. *Amendment 3 to the Interstate Fishery Management Plan for American Lobster*. Available: http://www.asmfc.org/uploads/file/lobsterAmendment3.pdf. Accessed: February 28, 2019.

National Oceanic and Atmospheric Administration (NOAA). 2022. *Global and Regional Sea Level Rise Scenarios for the United States*. Available: https://oceanservice.noaa.gov/hazards/sealevelrise/sealevelrise-tech-report-sections.html. Accessed: March 24, 2022.

New England Fishery Management Council (NEFMC). 2016. *Omnibus Essential Fish Habitat Amendment 2, Volume 6: Cumulative Effects, Compliance with Applicable Law and References*. Available: https://s3.amazonaws.com/nefmc.org/OA2-FEIS_Vol_6_FINAL_170303.pdf. Accessed: October 30, 2018.

New Jersey Board of Public Utilities (BPU). 2021. *NJBPU Approves Nation's Largest Combined Offshore Wind Award to Atlantic Shores and Ocean Wind II.* Press Release. Available: https://www.bpu.state.nj.us/bpu/newsroom/2021/approved/20210630.html. Accessed: July 28, 2021.

New Jersey Business. 2020. *Paulsboro Marine Terminal Gets Record Offshore Wind Manufacturing Investment.* Available: https://njbmagazine.com/njb-news-now/paulsboro-marine-terminal-gets-biggest-offshore-wind-manufacturing-investment-in-us-history/. Accessed: July 22, 2021.

New Jersey Department of Environmental Protection (NJDEP). 2020. *New Jersey Scientific Report on Climate Change*. Available: https://nj.gov/dep/climatechange/docs/nj-scientific-report-2020.pdf. Accessed: March 24, 2022.

New Jersey Department of Environmental Protection (NJDEP). 2021. *Draft Climate Change Resilience Strategy.* Available: https://www.nj.gov/dep/climatechange/resilience-strategy.html. Accessed: July 21, 2021.

New Jersey Division of Fish and Wildlife. 2021. *Marine Fisheries Management Rule Amendment Proposal with Amendments to Rules governing Crab and Lobster Management, Commercial Atlantic Menhaden Fishery, Marine Fisheries, and Fishery Management in New Jersey*. Published March 1, 2021, NJ Register. Available: https://www.nj.gov/dep/fgw/news/2021/marine_rules_proposed.htm. Accessed: July 22, 2021.

New Jersey State. 2019. *Energy Master Plan Pathway to 2050*. Available: https://nj.gov/emp/docs/pdf/2020_NJBPU_EMP.pdf. Accessed: July 20, 2021.

New Jersey State. 2020. Governor Murphy Announces $250 Million Total Investment in State-of-the-Art Manufacturing Facility to Build Wind Turbine Components to Serve Entire U.S. Offshore Wind Industry. December 21. Available: https://www.nj.gov/governor/news/news/562020/20201222a.shtml. Accessed: July 22, 2021.

New Jersey Wind Port. 2021. "About the New Jersey Wind Port." Available: https://nj.gov/windport/about/index.shtml. Accessed: July 16, 2021.

New York City Economic Development Corporation (NYCEDC). 2018. *New York Works: NYCDC Announces Transformation of South Brooklyn Maritime Shipping Hub, Creating over 250 Jobs in the Near-Term*. May 8, 2018. Available: https://www.nycedc.com/press-release/new-york-works-nycedc-announces-transformation-south-brooklyn-maritime-shipping-hub. Accessed: December 19, 2018.

New York State. 2014. Reforming the Energy Vision. Available: https://rev.ny.gov. Accessed: February 24, 2019.

New York State Department of Environmental Conservation (NYSDEC). No date. Community Risk and Resiliency Act (CRRA). Available: https://www.dec.ny.gov/energy/102559.html. Accessed: January 17, 2019.

New York State Department of Environmental Conservation (NYSDEC). 2017. *New York Ocean Action Plan 2017–2027*. Available: https://www.dec.ny.gov/docs/fish_marine_pdf/nyoceanactionplan.pdf. Accessed: January 13, 2019.

New York State Energy Research and Development Authority (NYSERDA). 2015. *Clean Energy Plan*. Available: https://energyplan.ny.gov/-/media/nysenergyplan/2015-state-energy-plan.pdf. Accessed: January 5, 2019.

New York State Energy Research and Development Authority (NYSERDA). 2017a. *Biennial Report to the 2015 State Energy Plan*. Available: https://energyplan.ny.gov/-/media/nysenergyplan/2017-BiennialReport-printer-friendly.pdf. Accessed: February 1, 2019.

New York State Energy Research and Development Authority (NYSERDA). 2017b. *New York State Offshore Wind Master Plan*. NYSERDA Report 17-25b. Available: https://www.nyserda.ny.gov/All-Programs/Programs/Offshore-Wind/Offshore-Wind-in-New-York-State-Overview/NYS-Offshore-Wind-Master-Plan. Accessed: December 20, 2018.

Ocean County, New Jersey. 2011. *Ocean County Planning Board Comprehensive Master Plan*. December. Available: https://www.co.ocean.nj.us/WebContentFiles/fedb8826-cb81-4b9f-be8d-e71e4fcd1fa4.pdf. Accessed: July 22, 2021.

Ocean Wind LLC (Ocean Wind). 2023. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

Reuters. 2021. *US port spend brings offshore wind factories closer*. Reporting by: Neil Ford. Editing by: Robin Sayles. Available: https://www.reutersevents.com/renewables/wind/us-port-spend-brings-offshore-wind-factories-closer. Accessed: July 22, 2021.

Rulison, L. 2018. Port of Albany Plans Giant Warehouse in Bethlehem. *Times Union.* Published August 24, 2018. Available: https://www.timesunion.com/business/article/Port-of-Albany-plans-giant-warehouse-in-Bethlehem-13180505.php. Accessed: December 20, 2018.

Solomon, S., D. Qin, M. Manning, R. B. Alley, T. Berntsen, et al. 2007. Technical summary. Climate change 2007: the physical science basis In: Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, and H. L. Miller, editors. *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. p. 75.

State of New York Public Service Commission. 2016. Order Adopting a Clean Energy Standard. 8/1/2016.

The White House. 2020a. Memorandum on the Withdrawal of Certain Areas of the United States Outer Continental Shelf from Leasing Disposition. Available: https://www.whitehouse.gov/presidential-actions/memorandum-withdrawal-certain-areas-united-states-outer-continental-shelf-leasing-disposition/. Accessed: September 25, 2020.

The White House. 2020b. Presidential Determination on the Withdrawal of Certain Areas of the United States Outer Continental Shelf from Leasing Disposition. Available: https://www.whitehouse.gov/presidential-actions/presidential-determination-withdrawal-certain-areas-united-states-outer-continental-shelf-leasing-disposition/. Accessed: October 8, 2020.

U.S. Army Corps of Engineers (USACE). 2015a. New Jersey Department of Transportation, Permit CENAP-OP-R-2015-510-35.

U.S. Army Corps of Engineers (USACE). 2015b. New Jersey Department of Transportation, Permit CENAP-OP-R-2015-511-35.

U.S. Army Corps of Engineers (USACE). 2018. Fire Island Inlet to Montauk Point (FIMP) Project. Available: https://www.nan.usace.army.mil/Missions/Civil-Works/Projects-in-New-York/Fire-Island-to-Montauk-Point-Reformulation-Study/. Accessed: December 2018.

U.S. Army Corps of Engineers (USACE). 2019. *Dredging to start in Norfolk Harbor inner channels*. U.S. Army Corps of Engineers Headquarters Website. By: Vince Little. December 26. Available: https://www.usace.army.mil/Media/News/NewsSearch/Article/2047595/dredging-to-start-in-norfolk-harbor-inner-channels/. Accessed: July 22, 2021.

U.S. Army Corps of Engineers (USACE). 2021a. *Newark Bay, New Jersey Federal Navigation Project Maintenance Dredging*. Public Notice No. Newark Bay, NJ FY21. May.

U.S. Army Corps of Engineers (USACE). 2021b. *Charleston Harbor Post 45 Overview*. Charleston District Website. Available: https://www.sac.usace.army.mil/Missions/Civil-Works/Charleston-Harbor-Post-45/. Accessed: July 22, 2021.

U.S. Army Corps of Engineers (USACE). 2021c. Ocean Dredged Material Disposal Site Database. Available: https://odd.el.erdc.dren.mil/ODMDSSearch.cfm. Accessed: July 15, 2021.

U.S. Army Corps of Engineers (USACE). 2022. USACE project list for Barnegat Bay. Personal communication with Brian R. Anthony, Senior Staff Biologist, U.S. Army Corps of Engineers, Philadelphia District, Regulatory Branch. April 1.

U.S. Coast Guard (USCG). 2021. *Port Access Route Study: Northern New York Bight.* USCG-2020-0278. December 2021. Available: https://www.regulations.gov/document/USCG-2020-0278-0067. Accessed: March 23, 2022.

Verdant Power. 2018. Roosevelt Island Tidal Energy Project – FERC No. P-12611. Available: https://www.verdantpower.com/rite. Accessed: December 21, 2018.

Virginia Department of Environmental Quality. 2021. *Virginia Section 309 Coastal Needs Assessment.* Virginia Department of Environmental Quality, Coastal Zone Management Program. Approved by NOAA February 4, 2021. Available: https://www.deq.virginia.gov/home/showpublisheddocument/8346/637540014441970000. Accessed: March 24, 2022.

Virginia Port Authority. 2021. *Dredging to Make Virginia the East Coast's Deepest Port is Underway*. Port of Virginia Press Release. Contact Joseph D. Harris. Available: https://www.portofvirginia.com/who-we-are/newsroom/dredging-to-make-virginia-the-east-coasts-deepest-port-is-underway/. Accessed: July 22, 2021.

Virginia State. 2020. *Governor Northam Signs Clean Energy Legislation. Press Release.* State of Virginia, Office of the Governor, April 12, 2020. Available: https://www.governor.virginia.gov/newsroom/all-releases/2020/april/headline-856056-en.html. Accessed: March 24, 2022.

This page intentionally left blank.

ATTACHMENT 1
ONGOING AND FUTURE NON-OFFSHORE WIND ACTIVITY ANALYSIS

This page intentionally left blank.

LIST OF TABLES

BOEM developed the following tables based on its 2019 study *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf* (BOEM 2019), which evaluates potential impacts associated with ongoing and future non-offshore wind activities.

Table F1-1 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Air Quality

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	Accidental releases of air toxics HAPs are due to potential chemical spills. Ongoing releases occur in low frequencies. These may lead to short-term periods of toxic pollutant emissions through surface evaporation. According to the U.S. Department of Energy, 31,000 barrels of petroleum are spilled into U.S. waters from vessels and pipelines in a typical year. Approximately 40.5 million barrels of oil were lost as a result of tanker incidents from 1970 to 2009, according to International Tanker Owners Pollution Federation Limited, which collects data on oil spills from tankers and other sources. From 1990 to 1999, the average annual input to the coastal Northeast was 220,000 barrels of petroleum and offshore it was up to less than 70,000 barrels.	Accidental releases of air toxics or HAPs will be due to potential chemical spills. See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. These may lead to short-term periods of toxic pollutant emissions through evaporation. Air quality impacts will be short-term and limited to the local area at and around the accidental release location.
Air emissions: Construction and decommissioning	Air emissions originate from combustion engines and electric power generated by burning fuel. These activities are regulated under the CAA to meet set standards. Air quality has generally improved over the last 35 years; however, some areas in the Northeast have experienced a decline in air quality over the last 2 years. Some areas of the Atlantic coast remain in nonattainment for ozone, with the source of this pollution from power generation. Many of these states have made commitments toward cleaner energy goals to improve this, and offshore wind is part of these goals. Primary processes and activities that can affect the air quality impacts are expansions and modifications to existing fossil fuel power plants, onshore and offshore	The largest air quality impacts over the next 35 years will occur during the construction phase of any one project; however, projects will be required to comply with the CAA. During the limited construction and decommissioning phases, emissions may occur that are above *de minimis* thresholds and will require offsets and mitigation. Primary emission sources will be increased commercial vehicular traffic, air traffic, public vehicular traffic, and combustion emissions from construction equipment and fugitive emissions from construction-generated dust. As projects come online, power generation emissions overall will decline and the industry as a whole will have a net benefit on air quality.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Air emissions: O&M	activities involving renewable energy facilities, and various construction activities.	Activities associated with O&M of onshore wind projects will have a proportionally very small contribution to emissions compared to the construction and decommissioning activities over the next 35 years. Emissions will largely be due to commercial vehicular traffic and operation of emergency diesel generators. Such activity will result in short-term, intermittent, and widely dispersed emissions and small air quality impacts.
Air emissions: Power generation emissions reductions		Many Atlantic states have committed to clean energy goals, with offshore wind being a large part of that. Other reductions include transitioning to onshore wind and solar. The No Action Alternative without implementation of other future offshore wind projects would likely result in increased air quality impacts regionally due to the need to construct and operate new energy generation facilities to meet future power demands. These facilities may consist of new natural-gas-fired power plants, coal-fired, oil-fired, or clean-coal-fired plants. These types of facilities would likely have larger and continuous emissions and result in greater regional scale impacts on air quality.
Climate change	The construction, operation, and decommissioning of offshore wind projects would produce GHG emissions (nearly all CO_2) that can contribute to climate change; however, these contributions would be minuscule compared to aggregate global emissions. CO_2 is relatively stable in the atmosphere and generally mixed uniformly throughout the troposphere and stratosphere. Hence the impact of GHG emissions does not depend upon the source location. Increasing energy production from offshore wind projects will likely decrease GHGs emissions by replacing energy from fossil fuels.	Development of future onshore wind projects will produce a small overall increase in GHG emissions over the next 35 years. However, these contributions would be very small compared to the aggregate global emissions. The impact on climate change from these activities would be very small. As more projects come online, some reduction in GHG emissions from modifications of existing fossil fuel facilities to reduce power generation. Overall, it is anticipated that there would be no cumulative impact on global warming as a result of onshore wind project activities.

CAA = Clean Air Act; hazmat = hazardous materials

Table F1-2 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Bats

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded and would result in high-intensity, low-exposure level, long-term, but localized intermittent risk to bats in nearshore waters. Direct 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). Indirect 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 (Schaub et al. 2008). Construction activity would be temporary and highly localized.	Similar to ongoing activities, noise associated with pile driving activities would be limited to nearshore waters, and these high-intensity, but low-exposure risks would not be expected to result in direct impacts. Some indirect impacts (i.e., displacement from potentially suitable foraging habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior (Schaub et al. 2008). Construction activity would be temporary and highly localized, and no population-level effects would be expected.
Noise: Construction	Onshore construction occurs regularly for generic infrastructure projects in the bats geographic analysis area. There is a potential for displacement caused by equipment if construction occurs at night (Schaub et al. 2008). Any displacement would only be temporary. No individual or population level impacts would be expected. 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 common component of a bat's life history (Hann et al. 2017; Whitaker 1998).	Onshore construction is expected to continue at current trends. Some behavioral responses and avoidance of construction areas may occur (Schaub et al. 2008). However, no injury or mortality would be expected.
Presence of structures: Migration disturbances	There may be few structures scattered throughout the offshore bats geographic analysis area, such as navigation and weather buoys and light towers. Migrating bats can easily fly around or over these sparsely distributed structures, and no migration disturbance would be expected. Bat use of offshore areas is very limited and generally restricted to spring and fall migration. Very few bats would be expected to encounter structures on the OCS and no population-level effects would be expected.	The infrequent installation of future new structures in the marine environment of the next 35 years is expected to continue. As described under Ongoing Activities, these structures would not be expected to cause disturbance to migrating tree bats in the marine environment.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Turbine strikes	There may be few structures in the offshore bats geographic analysis area, such as navigation and weather buoys, turbines, and light towers. Migrating tree bats can easily fly around or over these sparsely distributed structures, and no strikes would be expected.	The infrequent installation of future new structures in the marine environment of the next 35 years is expected to continue. As described under Ongoing Activities, these structures would not be expected to result in increased collision risk to migrating tree bats in the marine environment.
Land disturbance: onshore construction	Onshore construction activities are expected to continue at current trends. Potential direct effects on individuals may occur if construction activities include tree removal when bats are potentially present. Injury or mortality may occur if trees being removed are occupied by bats at the time of removal. While there is some potential for indirect impacts associated with habitat loss, no individual or population-level effects would be expected.	Future non-offshore wind development would continue to occur at the current rate. This development has the potential to result in habitat loss and could result in injury or mortality of individuals.
Climate change: Warming and sea level rise, storm severity/frequency	Storms during breeding and roosting season can reduce productivity and increase mortality. Intensity of this impact is speculative.	No future activities were identified within the bats geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change: Ocean acidification; warming and sea level rise, altered habitat/ecology; warming and sea level rise, altered migration patterns; warming and sea level rise, property/ infrastructure damage; warming and sea level rise, protective measures (barriers, sea walls); warming and sea level rise, storm severity/frequency, sediment erosion, deposition	These sub-IPFs would have no impacts on bats.	No future activities were identified within the bats geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, increased disease frequency	Disease can weaken, lower reproductive output, and/or kill individuals. Some tropical diseases will move northward. Extent and intensity of this impact is highly speculative.	No future activities were identified within the bats geographic analysis area other than ongoing activities.

Table F1-3 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Benthic Resources

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-22 for a discussion of ongoing accidental releases. Accidental releases of hazmat occur periodically, mostly consisting of fuels, lubricating oils, and other petroleum compounds. Because most of these materials tend to float in seawater, they rarely contact benthic resources. The chemicals with potential to sink or dissolve rapidly often dilute to non-toxic levels before they affect benthic resources. The corresponding impacts on benthic resources are rarely noticeable.	Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. See previous cell and Table F1-22 on water quality for details.
Accidental releases: Invasive species	Invasive species are periodically released accidentally during ongoing activities, including the discharge of ballast water and bilge water from marine vessels. The impacts on benthic resources (e.g., competitive disadvantage, smothering) depend on many factors, but can be noticeable, widespread, and permanent.	No future activities were identified within the geographic analysis area other than ongoing activities.
Accidental releases: Trash and debris	Ongoing releases of trash and debris occurs from onshore sources, fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying. However, there does not appear to be evidence that ongoing releases have detectable impacts on benthic resources.	No future activities were identified within the geographic analysis area other than ongoing activities.
Anchoring	Regular vessel anchoring related to ongoing military, survey, commercial, and recreational activities continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. These impacts include increased turbidity levels and the potential for direct contact to cause injury and mortality of benthic resources, as well as physical damage to their habitats. All impacts are localized; turbidity is temporary; injury and mortality are recovered in the short term; and physical damage can be permanent if it occurs in eelgrass beds or hard bottom.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Activities Intensity/Extent
EMFs	EMFs continuously emanate from existing telecommunication and electrical power transmission cables. New cables generating EMFs are infrequently installed in the geographic analysis area. Some benthic species can detect EMFs, although EMFs do not appear to present a barrier to movement. The extent of impacts (behavioral changes) is likely less than 50 feet (15.2 meters) from the cable and the intensity of impacts on benthic resources is likely undetectable.	No future activities were identified within the geographic analysis area other than ongoing activities.
New cable emplacement/ maintenance	Cable maintenance activities infrequently disturb benthic resources and cause temporary increases in suspended sediment; these disturbances would be local and limited to the emplacement corridor. New cables are infrequently added near shore. Cable emplacement/maintenance activities injure and kill benthic resources, and result in temporary to long-term habitat alterations. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur. (See also the IPFs of Seabed profile alterations and Sediment deposition and burial.)	No future activities were identified within the geographic analysis area other than ongoing activities.
Noise: Onshore/ offshore construction	See Table F1-11 on finfish, invertebrates, and EFH. Detectable impacts of construction noise on benthic resources rarely, if ever, overlap from multiple sources.	See Table F1-11 on finfish, invertebrates, and EFH. Detectable impacts of construction noise on benthic resources would rarely, if ever, overlap from multiple sources.
Noise: G&G	See Table F1-11 on finfish, invertebrates, and EFH. Detectable impacts of G&G noise on benthic resources rarely, if ever, overlap from multiple sources.	See Table F1-11 on finfish, invertebrates, and EFH. Detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources.
Noise: O&M	See Table F1-11 on finfish, invertebrates, and EFH.	See Table F1-11 on finfish, invertebrates, and EFH.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to benthic resources in a small area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Cable laying/ trenching	Infrequent trenching activities for pipeline and cable laying, as well as other cable burial methods, emit noise. These disturbances are local, temporary, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines are likely to occur in the geographic analysis area. These disturbances would be infrequent over the next 35 years, local, temporary, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.
Port utilization: Expansion	See Table F1-11 on finfish, invertebrates, and EFH.	See Table F1-11 on finfish, invertebrates, and EFH.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear are periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb, injure, or kill benthic resources, creating small, short-term, localized impacts.	Future new cables would present additional risk of gear loss, resulting in small, short-term, localized impacts (disturbance, injury).
Presence of structures: Hydrodynamic disturbance	See Table F1-11 on finfish, invertebrates, and EFH.	See Table F1-11 on finfish, invertebrates, and EFH.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables continuously create uncommon relief in a mostly sandy seascape. Structure-oriented fishes are attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes can adversely affect populations and communities of benthic resources. These impacts are local and permanent.	New cables installed in the geographic analysis area over the next 35 years would likely require hard protection atop portions of the route (see the “new cable emplacement/maintenance” row in this table). Any new towers, buoy, or piers would also create uncommon relief in a mostly flat, sandy seascape. Structure-oriented fishes could be attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes could adversely affect populations and communities of benthic resources. These impacts are expected to be local and to be permanent as long as the structures remain.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Habitat conversion	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables continuously provide uncommon hard-bottom habitat. A large portion is homogeneous sandy seascape but there is some other hard and/or complex habitat. Benthic species dependent on hard-bottom habitat can benefit on a constant basis, although the new habitat can also be colonized by invasive species (e.g., certain tunicate species). Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat.	See above for quantification and timing. Any new towers, buoy, piers, or cable protection structures would create uncommon relief in a mostly sandy seascape. Benthic species dependent on hard-bottom habitat could benefit, although the new habitat could also be colonized by invasive species (e.g., certain tunicate species). Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010).
Presence of structures: Cable infrastructure	The presence of cable infrastructure, especially hard protection atop cables, causes impacts through entanglement/gear loss/damage, fish aggregation, and habitat conversion.	See other sub-IPFs within Presence of structures.
Discharges	The gradually increasing amount of vessel traffic is increasing the cumulative permitted discharges from vessels. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. However, there does not appear to be evidence that the volumes and extents have any impact on benthic resources.	There is the potential for new ocean dumping/dredge disposal sites in the Northeast. Impacts (disturbance, reduction in fitness) of infrequent ocean disposal to benthic resources are short-term because spoils are typically recolonized naturally. In addition, USEPA has established dredge spoil criteria and it regulates the disposal permits issued by USACE; these discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated.
Regulated fishing effort	Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by states, towns, and/or NOAA, depending on jurisdiction, affect benthic resources by modifying the nature, distribution and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing).	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Activities Intensity/Extent
Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized short-term impacts (habitat alteration, injury, and mortality) on benthic resources through this IPF. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance. Therefore, such impacts, while locally intense, have little impact on benthic resources in the geographic analysis area.	No future activities were identified within the geographic analysis area other than ongoing activities.
Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. Sediment deposition could have adverse impacts on some benthic resources, especially eggs and larvae, including smothering and loss of fitness. Impacts may vary based on season/time of year. Where dredged materials are disposed, benthic resources are smothered. However, such areas are typically recolonized naturally in the short term. Most sediment dredging projects have time-of-year restrictions to minimize impacts on benthic resources. Most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area.	USACE and/or private ports may undertake dredging projects periodically. Where dredged materials are disposed, benthic resources are buried. However, such areas are typically recolonized naturally in the short term. Most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area.
Climate change: Ocean acidification	Ongoing CO_2 emissions causing ocean acidification may contribute to reduced growth or the decline of benthic invertebrates that have calcareous shells, as well as reefs and other habitats formed by shells.	No future activities were identified within the geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat, ecology, and migration patterns	Climate change, influenced in part by ongoing GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the distributions of benthic species and altering ecological relationships, likely causing permanent changes of unknown intensity gradually over the next 35 years.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by ongoing GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of benthic species, and likely causing permanent changes of unknown intensity over the next 35 years.	No future activities were identified within the geographic analysis area other than ongoing activities.

hazmat = hazardous materials

Table F1-4 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Birds

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-22 for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Ingestion of hydrocarbons can lead to morbidity and mortality due to 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 feather oiling 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). These impacts rarely result in population-level impacts.	See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the potential risk of accidental releases and associated impacts, including mortality, decreased fitness, and health effects on individuals. Impacts are unlikely to affect populations.
Accidental releases: Trash and debris	Trash and debris are accidentally discharged through onshore sources; fisheries use; dredged material ocean disposal; marine minerals extraction; marine transportation, navigation, and traffic; survey activities; and cables, lines, and pipeline laying on an ongoing basis. In a study from 2010, students at sea collected more than 520,000 bits of plastic debris per square mile. In addition, many fragments come from consumer products blown out of landfills or tossed out as litter (Law et al. 2010). Birds may accidentally ingest trash mistaken for prey. Mortality is typically a result of blockages caused by both hard and soft plastic debris (Roman et al. 2019).	As population and vessel traffic increase gradually over the next 35 years, accidental release of trash and debris may increase. This may result in increased injury or mortality of individuals. However, there does not appear to be evidence that the volumes and extents would have any impact on bird populations.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Light: Vessels	Ocean vessels have an array of lights including navigational lights, deck lights, and interior lights. Such lights can attract some birds. The impact is localized and temporary. This attraction would not be expected to result in an increased risk of collision with vessels. Population-level impacts would not be expected.	Gradually increasing vessel traffic over the next 35 years would increase the potential for bird and vessel interactions. While birds may be attracted to vessel lights, this attraction would not be expected to result in increased risk of collision with vessels. No population-level impacts would be expected.
Light: Structures	Buoys, towers, and onshore structures with lights can attract birds. Onshore structures like houses and ports emit a great deal more light than offshore buoys and towers. This attraction has the potential to result in an increased risk of collision with lighted structures (Hüppop et al. 2006). Light from structures is widespread and permanent near the coast, but minimal offshore.	Light from onshore structures is expected to gradually increase in proportion with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Cable emplacement and maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be temporary and generally limited to the emplacement corridor. Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances will be temporary and limited to the emplacement corridor. Suspended sediment could impair the vision of diving birds that are foraging in the water column (Cook and Burton 2010). However, given the localized nature of the potential impacts, individuals would be expected to successfully forage in nearby areas not affected by increased sedimentation and no biologically significant impacts on individuals or populations would be expected.	Future new cables, would occasionally disturb the seafloor and cause temporary increases in suspended sediment, resulting in localized, short-term impacts. Impacts would be temporary and localized, with no biologically significant impacts on individuals or populations.
Noise: Aircraft	Aircraft routinely travel in the geographic analysis area for birds. With the possible exception of rescue operations and survey aircraft, no ongoing aircraft flights would occur at altitudes that would elicit a response from birds. If flights are at a sufficiently low altitude, birds may flush, resulting in non-biologically significant increased energy expenditure. Disturbance, if any, would be localized and temporary and impacts would be expected to dissipate once the aircraft has left the area.	Aircraft noise is likely to continue to increase as commercial air traffic increases; however, very few flights would be expected to be at a sufficiently low altitude to elicit a response from birds. If flights are at a sufficiently low altitude, birds may flush, resulting in non-biologically significant increased energy expenditure. Disturbance, if any, would be localized and temporary and impacts would be expected to dissipate once the aircraft has left the area.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities could result in diving birds leaving the local area. Non-diving birds would be unaffected. Any displacement would only be temporary during non-migratory periods, but impacts could be greater if displacement were to occur in preferred feeding areas during seasonal migration periods.	Same as ongoing activities, with the addition of possible future oil and gas surveys.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water could result in intermittent, temporary, localized impacts on diving birds due to displacement from foraging areas if birds are present in the vicinity of pile-driving activity. The extent of these impacts depends on pile size, hammer energy, and local acoustic conditions. No biologically significant impacts on individuals or populations would be expected.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Noise: Onshore construction	Onshore construction is routinely used in generic infrastructure projects. Equipment could potentially cause displacement. Any displacement would only be temporary and no individual fitness or population-level impacts would be expected.	Onshore construction will continue at current trends. Some behavior responses could range from escape behavior to mild annoyance, but no individual injury or mortality would be expected.
Noise: Vessels	Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Sub-surface noise from vessels could disturb diving birds foraging for prey below the surface. The consequence to birds would be similar to noise from G&G but likely less because noise levels are lower.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Presence of structures: Entanglement, gear loss, gear damage	Each year, 2,551 seabirds die annually from interactions with U.S. commercial fisheries on the Atlantic (Sigourney et al. 2019). Even more die due to abandoned commercial fishing gear (nets). In addition, recreational fishing gear (hooks and lines) is periodically lost on existing buoys, pilings, hard protection, and other structures and has the potential to entangle birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various hard protections atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these objects. These impacts are local and can be short-term to permanent. These fish aggregations can provide localized, short-term to permanent, beneficial impacts on some bird species because it could increase prey species availability.	New cables, installed incrementally in the geographic analysis area for birds over the next 20 to 35 years, would likely require hard protection atop portions of the cables (see New cable emplacement/maintenance row). Any new towers, buoys, or piers would also create uncommon relief in a mostly flat seascape. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase. These impacts are expected to be local and may be short-term to permanent. These fish aggregations can provide localized, short-term to permanent beneficial impacts on some bird species due to increased prey species availability.
Presence of structures: Migration disturbances	A few structures may be scattered about the offshore geographic analysis area for birds, such as navigation and weather buoys and light towers. Migrating birds can easily fly around or over these sparsely distributed structures.	The infrequent installation of future new structures in the marine or onshore environment over the next 35 years would not be expected to result in migration disturbances.
Presence of structures: Turbine strikes, displacement, and attraction	A few structures may be in the offshore geographic analysis area for birds, such as navigation and weather buoys, turbines, and light towers. Given the limited number of structures currently in the geographic analysis area, individual- and population-level impacts due to displacement from current foraging habitat would not be expected. Stationary structures in the offshore environment would not be expected to pose a collision risk to birds. Some birds like cormorants and gulls may be attracted to these structures and opportunistically roost on these structures.	The installation of future new structures in the marine or onshore environment over the next 35 years would not be expected to result in an increase in collision risk or to result in displacement. Some potential for attraction and opportunistic roosting exists but would be expected to be limited given the anticipated number of structures.
Traffic: Aircraft	General aviation accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2019). In addition to general aviation, aircraft are used for scientific and academic surveys in marine environments.	Bird fatalities associated with general aviation would be expected to increase with the current trend in commercial air travel. Aircraft will continue to be used to conduct scientific research studies as well as wildlife monitoring and pre-construction surveys. These flights would be well below the 100,000 flights and no bird strikes would be expected to occur.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Land disturbance: Onshore construction	Onshore construction activity will continue at current trends. There is some potential for indirect impacts associated with habitat loss and fragmentation.	Future non-offshore wind development would continue to occur at the current rate. This development has the potential to result in habitat loss but would not be expected to result in injury or mortality of individuals.
Climate change: Warming and sea level rise, storm severity/frequency	Increased storm frequency and severity during the breeding season can reduce productivity of bird nesting colonies and kill adults, eggs, and chicks.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Ocean acidification	Increasing ocean acidification may affect prey species upon which some birds feed and could lead to shifts in prey distribution and abundance. Intensity of impacts on birds is speculative.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 35 years, influencing the distribution of bird prey resources.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Warming and sea level rise, altered migration patterns	Birds rely on cues from the weather to start migration. Wind direction and speed influence the amount of energy used during migration. For nocturnal migrants, wind assistance is projected to increase across eastern portions of the continent (0.32 m/s; 9.6%) during spring migration by 2091, and wind assistance is projected to decrease within eastern portions of the continent (0.17 m/s; 6.6%) during autumn migration (La Sorte et al. 2018).	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Warming and sea level rise, property/ infrastructure damage	This sub-IPF would have no impacts on birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Warming and sea level rise, protective measures (barriers, seawalls)	The proliferation of coastline protections have the potential to result in long-term, high-consequence, impacts on bird nesting habitat.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change: Warming and sea level rise, increased disease frequency	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 35 years, influencing the frequencies and distributions of various diseases of birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.

hazmat = hazardous materials

Table F1-5 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Coastal Habitat and Fauna

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Onshore construction	Onshore construction noise is expected to result in short-term, temporary, localized impacts. Impacts are expected to be limited to avoidance of construction activity and noise.	Onshore residential, commercial, and industrial development are expected to continue at current trends. Impacts would be similar to those from ongoing activities.
Land disturbance: Onshore construction	Onshore residential, commercial, and industrial development are expected to continue at current trends. Construction activities may result in loss of coastal habitat and temporary or permanent displacement and injury to or mortality of individual animals, but population-level effects would not be expected.	Onshore residential, commercial, and industrial development are expected to continue at current trends. Impacts would be similar to those from ongoing activities.
Land disturbance: Onshore, land use changes	Ongoing development of onshore properties, especially shoreline parcels, periodically causes the conversion of onshore coastal habitats to developed space.	No future activities were identified within the geographic analysis area other than ongoing activities.
Traffic: Vehicle collisions	Vehicle collisions may result in injury to or mortality of individual animals, but population-level effects would not be expected.	Impacts from vehicle collisions with wildlife are expected to continue and to be similar to those from ongoing activities.
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change and associated sea level rise results in dieback of coastal habitats caused by rising groundwater tables and increased saltwater inundation from storm surges and exceptionally high tides. Climate change may also affect coastal habitats through increases in instances and severity of droughts and range expansion of invasive 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.	Impacts from climate change are expected to continue. Impacts are the same as those described under ongoing activities.

Table F1-6 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Commercial Fisheries and For-Hire Recreational Fishing

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Anchoring	Impacts from anchoring occur due to ongoing military, survey, commercial, and recreational activities. The short-term, localized impact on this resource is the presence of a navigational hazard (anchored vessel) to fishing vessels.	Impacts from anchoring may occur on a semi-regular basis over the next 35 years due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. Anchoring could pose a temporary (hours to days), localized (within a few hundred meters of anchored vessel) navigational hazard to fishing vessels.
New cable emplacement/ maintenance	New cable emplacement and infrequent cable maintenance activities disturb the seafloor, increase suspended sediment, and cause temporary displacement of fishing vessels. These disturbances would be local and limited to the emplacement corridor.	Future new cables and cable maintenance would occasionally disturb the seafloor and cause temporary displacement in fishing vessels and increases in suspended sediment resulting in local, short-term impacts. If the cable routes enter the geographic analysis area for this resource, short-term disruption of fishing activities would be expected.
Noise: Construction, trenching, O&M	Noise from construction occurs frequently in coastal habitats in populated areas in New England and the Mid-Atlantic, but infrequently offshore. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary. Infrequent offshore trenching could occur in connection with cable installation. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Low levels of elevated noise from operational WTGs likely have low to no impacts on fish and no impacts at a fishery level. Noise is also created by O&M of marine minerals extraction, which has small, local impacts on fish, but likely no impacts at a fishery level.	Noise from construction near shore is expected to gradually increase in line with human population growth along the coast of the geographic analysis area for this resource. Noise from dredging and sand and gravel mining could occur. New or expanded marine minerals extraction may increase noise during their O&M over the next 35 years. Impacts from construction, operations, and maintenance would likely be small and local on fish, and not seen at a fishery level. Periodic trenching would be needed for repair or new installation of underground infrastructure. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on commercial fish species are typically less prominent than the impacts of the physical disturbance and sediment suspension. Therefore, fishery-level impacts are unlikely.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: G&G	Ongoing site characterization surveys and scientific surveys produce noise around sites of investigation. These activities can disturb fish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes. The extent depends on equipment used, noise levels, and local acoustic conditions.	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 35 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise to penetrate deep into the seabed, potentially resulting in injury or mortality to finfish and invertebrates in a small area around each sound source and short-term stress and behavioral changes to individuals over a greater area. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves more similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize but are likely local and temporary.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when ports or marinas, piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to finfish and invertebrates in a small area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area, leading to temporary local impacts on commercial fisheries and for-hire recreational fishing. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the analysis area other than ongoing activities.
Noise: Vessels	Vessel noise is anticipated to continue at levels similar to current levels. While vessel noise may have some impact on behavior, it is likely limited to brief startle and temporary stress responses. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels.	Planned new barge route and dredging disposal sites would generate vessel noise when implemented.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 35 years.	Ports would need to perform maintenance and upgrades to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size. Port utilization is expected to increase over the next 35 years, with increased activity during construction. The ability of ports to receive the increase in vessel traffic may require port modifications, such as channel deepening, leading to local impacts on fish populations. Port expansions could also increase vessel traffic and competition for dockside services, which could affect fishing vessels.
Presence of structures: Navigation hazard and allisions	Structures within and near the cumulative lease areas that pose potential navigation hazards include offshore wind turbines, buoys, and shoreline developments such as docks and ports. An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. Two types of allisions occur: drift and powered. A drift allision generally occurs when a vessel is powered down due to operator choice or power failure. A powered allision generally occurs when an operator fails to adequately control their vessel movements or is distracted.	No known reasonably foreseeable structures are proposed to be located in the geographic analysis area that could affect commercial fisheries. Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb habitats and potentially harm individuals, creating small, localized, short-term impacts on fish, but likely no impacts at a fishery level.	No future activities were identified within the analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Habitat conversion and fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. A large portion is homogeneous sandy seascape but there is some other hard and/or complex habitat. Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat. Structure-oriented fishes are attracted to these locations. These impacts are local and can be short-term to permanent. Fish aggregation may be considered adverse, beneficial, or neither. Commercial and for-hire recreational fishing can occur near these structures. For-hire recreational fishing is more popular, as commercial mobile fishing gear risk snagging on the structures.	New cables, installed incrementally in the analysis area over the next 20 to 35 years, would likely require hard protection atop portions of the route (see New cable emplacement/maintenance IPF above). Any new towers, buoys, or piers would also create uncommon relief in a mostly flat seascape. Structure-oriented species could be attracted to these locations. Structure-oriented species would benefit (Claisse et al. 2014; Smith et al. 2016). This may lead to more and larger structure-oriented fish communities and larger predators opportunistically feeding on the communities, as well as increased private and for-hire recreational fishing opportunities. Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). These impacts are expected to be local and may be long term.
Presence of structures: Migration disturbances	Human structures in the marine environment, e.g., shipwrecks, artificial reefs, buoys, and oil platforms, can attract finfish and invertebrates that approach the structures during their migrations. This could slow species migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure (Secor et al. 2018). There is no evidence to suggest that structures pose a barrier to migratory animals.	The infrequent installation of future new structures in the marine environment over the next 35 years may attract finfish and invertebrates that approach the structures during their migrations. This could tend to slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement (Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, fishery-level impacts are not anticipated.
Presence of structures: Space-use conflicts	Current structures do not result in space-use conflicts.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Presence of structures: Cable infrastructure	The existing offshore cable infrastructure supports the economy by transmitting electric power and communications between mainland and islands. Shoreline developments are ongoing and include docks, ports, and other commercial, industrial, and residential structures.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Traffic: Vessels and vessel collisions	No substantial changes are anticipated to the vessel traffic volumes. The geographic analysis area would continue to have numerous ports and the extensive marine traffic related to shipping, fishing, and recreation would continue to be important to the region's economy. The region's substantial marine traffic may result in occasional collisions. Vessels need to navigate around structures to avoid allisions. When multiple vessels need to navigate around a structure, then navigation is more complex, as the vessels need to avoid both the structure and each other. The risk for collisions is ongoing but infrequent.	New vessel traffic in the geographic analysis area would consistently be generated by proposed barge routes and dredging demolition sites. Marine commerce and related industries would continue to be important to the regional economy.
Climate change	Impacts to commercial fisheries and for-hire recreational fishing are expected to result from climate change events such as increased magnitude or frequency of storms, shoreline changes, ocean acidification, and water temperature changes. Risks to fisheries associated with these events include habitat/distribution shifts, disease incidence, and risk of invasive species. If these risk factors result in a decrease in catch and/or an increase in fishing costs (e.g., transiting time), the profitability of businesses engaged in commercial fisheries and for-hire recreational fishing would be adversely affected. While climate change is predicted to have adverse impacts on the distribution and/or productivity of some stocks targeted by commercial fisheries and for-hire recreational fishing, other stocks may be beneficially affected. The economies of communities reliant on marine species that are vulnerable to the effects of climate change could be adversely affected. If the distribution of important stocks changes, it could affect where commercial and for-hire recreational fisheries are located. Furthermore, coastal communities with fishing businesses that have infrastructure near the shore could be adversely affected by sea level rise.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Regulated fishing effort	Commercial and recreational regulations for finfish and shellfish implemented and enforced by NMFS and coastal states, affect how the commercial and for-hire recreational fisheries operate. Commercial and recreational for-hire fisheries are managed by FMPs, which are established to manage fisheries to avoid overfishing through catch quotas, special management areas, and closed area regulations. These can reduce or increase the size of available landings to commercial and for-hire recreational fisheries. For example, ongoing fishing restrictions designed to rebuild depleted stocks in the Northeast Multispecies (large-mesh) fishery will continue to reduce landings in that fishery.	Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the NARW by 60% (McCreary and Brooks 2019). This will likely have a have a major adverse impact on fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area for this resource. As discussed in Karp et al. (Karp et al. 2019), changing climate and ocean conditions and the resultant effects on species distributions and productivity can have significant effects on management decisions, such as allocation, spatiotemporal closures, stock status determinations, and catch limits. See No Action alternative for additional fishery management actions that will affect commercial fisheries and for-hire recreational fishing.

Table F1-7 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Cultural Resources

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-22 for water quality for a quantitative analysis of these risks. Accidental releases of fuel/fluids/hazmat occur during vessel use for recreational, fisheries, marine transportation, or military purposes, and other ongoing activities. Both released fluids and cleanup activities that require the removal of contaminated soils and/or seafloor sediments can cause impacts on cultural resources because resources are affected during by the released chemicals as well as the ensuing cleanup activities.	Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases within the geographic analysis area for cultural resources, increasing the frequency of small releases. Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill, could have significant impacts on marine and coastal cultural resources. A large-scale release would require extensive cleanup activities to remove contaminated materials resulting in damage to or the complete removal of terrestrial and marine cultural resources. In addition, the accidentally released materials in deep water settings could settle on seafloor cultural resources such as wreck sites, accelerating their decomposition and/or covering them and making them inaccessible/unrecognizable to researchers, resulting in a significant loss of historic information. As a result, although considered unlikely, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale impacts on cultural resources.

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Trash and debris	Accidental releases of trash and debris occur during vessel use for recreational, fisheries, marine transportation, or military purposes and other ongoing activities. While the released trash and debris can directly affect cultural resources, the majority of impacts associated with accidental releases occur during cleanup activities, especially if soil or sediment removed during cleanup affect known and undiscovered archaeological resources. In addition, the presence of large amounts of trash on shorelines or the ocean surface can impact the cultural value of TCPs for stakeholders. State and federal laws prohibiting large releases of trash would limit the size of any individual release and ongoing local, state, and federal efforts to clean up trash on beaches and waterways would continue to mitigate the effects of small-scale accidental releases of trash.	Future activities with the potential to result in accidental releases include construction and operations of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications). Accidental releases would continue at current rates along the northeast Atlantic coast.
Anchoring	The use of vessel anchoring and gear (i.e., wire ropes, cables, chain, sweep on the seafloor) that disturbs the seafloor, such as bottom trawls and anchors, by military, recreational, industrial, and commercial vessels can impact cultural resources by physically damaging maritime archaeological resources such as shipwrecks and debris fields.	Future activities with the potential to result in anchoring/ gear utilization include construction and operations of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); military use; marine transportation; fisheries use and management; and oil and gas activities. These activities are likely to continue to occur at current rates along the entire coast of the eastern United States.
Gear utilization: Dredging	Activities associated with dredge operations and activities could damage marine archaeological resources. Ongoing activities identified by BOEM with the potential to result in dredging impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities.	Dredging activities would gradually increase through time as new offshore infrastructure is built, such as gas pipelines and electrical lines, and as ports and harbors are expanded or maintained.

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Light: Vessels	Light associated with military, commercial, or construction vessel traffic can temporarily affect coastal historic structures and TCP resources when the addition of intrusive, modern lighting changes the physical environment ("setting") of cultural resources. The impacts of construction and operational lighting would be limited to cultural resources on the shoreline for which a nighttime sky is a contributing element to historic integrity. This excludes resources that are closed at night, such as historic buildings, lighthouses, and battlefields, and resources that generate their own nighttime light, such as historic districts. Offshore construction activities that require increased vessel traffic, construction vessels stationed offshore, and construction area lighting for prolonged periods can cause more sustained and significant visual impacts on coastal historic structure and TCP resources.	Future activities with the potential to result in vessel lighting impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities. Light pollution from vessel traffic would continue at the current intensity along the northeast coast, with a slight increase due to population increase and development over time.
Light: Structures	The construction of new structures that introduce new light sources into the setting of historic architectural properties or TCPs can result in impacts, particularly if the historic and/or cultural significance of the resource is associated with uninterrupted nighttime skies or periods of darkness. Any tall structure (commercial building, radio antenna, large satellite dishes, etc.) requiring nighttime hazard lighting to prevent aircraft collision can cause these types of impacts.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
Port utilization: Expansion	Major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Expansion of port facilities can introduce large, modern port infrastructure into the viewsheds of nearby historic properties, affecting their setting and historic significance.	Future activities with the potential to result in port expansion impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities. Port expansion would continue at current levels, which reflect efforts to capture business associated with the offshore wind industry (irrespective of specific projects).

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures	The only existing offshore structures within the viewshed of the geographic analysis area are minor features such as buoys.	Non-offshore wind structures that could be viewed would be limited to meteorological towers. Marine activity would also occur within the marine viewshed of the geographic analysis area.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and could cause impacts on submerged archaeological resources. These disturbances would be local and limited to emplacement corridors.	Future activities with the potential to result in seafloor disturbances similar to offshore impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; and oil and gas activities. Such activities could cause impacts on submerged archaeological resources including shipwrecks and formerly subaerially exposed pre-contact Native American archaeological sites.
Land disturbance: Onshore construction	Onshore construction activities can affect archaeological resources by damaging or removing resources.	Future activities that could result in terrestrial land disturbance impacts include onshore residential, commercial, industrial, and military development activities in central Cape Cod, particularly those proximate to OECRs and interconnection facilities. Onshore construction would continue at current rates.
Climate change: Warming and sea level rise, storm severity/frequency	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, architectural, and TCP resources. Increased storm frequency and severity would also result in damage to or destruction of architectural properties. Sea level rise would increase erosion-related impacts on archaeological and architectural resources, while sea level rise would inundate archaeological, architectural, and TCP resources.	Sea level rise and storm severity/frequency would increase due to the effects of climate change.
Climate change: Warming and sea level rise, altered habitat/ecology	Altered habitat/ecology related to warming seas and sea level rise would impact the ability of Native Americans and other communities to use maritime TCPs for traditional fishing, shell fishing, and fowling activities.	The rate of change to habitats/ecology would increase as a result of climate change.

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change: Warming and sea level rise, altered migration patterns	Altered migration patterns related to warming seas and sea level rise would impact the ability of Native Americans and other communities to use maritime TCPs for traditional fishing, shell fishing, and fowling activities.	The rate of change to migratory animal patterns would increase as a result of climate change.
Climate change: Warming and sea level rise, property/ infrastructure damage	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, architectural, and TCP resources. Increased storm frequency and severity would result in damage to and/or destruction of architectural properties. Sea level rise would increase erosion-related impacts on archaeological and architectural resources while sea level rise would inundate archaeological, architectural, and TCP resources.	The rate of property and infrastructure damage would increase as a result of climate change.
Climate change: Warming and sea level rise, protective measures (barriers, sea walls)	The installation of protective measures such as barriers and sea walls would impact archaeological resources during associated ground-disturbing activities. Construction of these modern protective structures would alter the viewsheds from historic properties and/or TCPs, resulting in impacts on the historic and/or cultural significance of resources.	The installation of coastal protective measures would increase as a result of climate change.
Climate change: Warming and sea level rise, storm severity/frequency, sediment erosion, deposition	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, architectural, and TCP resources. Increased storm frequency and severity would result in damage to and/or destruction of architectural properties. Sea level rise would increase erosion related impacts on archaeological and architectural resources while sea level rise would inundate archaeological, architectural, and TCP resources.	Sea level rise and storm severity/frequency would increase due to the effects of climate change.

hazmat = hazardous materials; OECR = onshore export cable route

Table F1-8 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Demographics, Employment, and Economics

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Energy generation/ security	In 2019, New Jersey energy production totaled 328 trillion Btu, of which 13.8 trillion Btu was from renewable sources, including geothermal, hydroelectric, wind, solar, and biomass (U.S. Energy Information Administration 2020).	Ongoing development of onshore solar and wind energy would provide diversified, small-scale energy generation. State and regional energy markets would require additional peaker plants and energy storage to meet the electricity needs when utility scale renewables are not producing.
Light: Structures	Offshore buoys and towers emit low-intensity light, while onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
Light: Vessels	Ocean vessels have an array of lights including navigational lights and deck lights.	Anticipated modest growth in vessel traffic would result in some growth in the nighttime traffic of vessels with lighting.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors. In the geographic analysis area for demographics, employment, and economics there are six existing power cables.	Future new cables would disturb the seafloor and cause temporary increases in suspended sediment resulting in infrequent, localized, short-term impacts over the next 35 years.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the geographic analysis area for demographics, employment, and economics other than ongoing activities.
Noise: Cable laying/ trenching	Infrequent trenching for pipeline and cable laying activities emit noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Periodic trenching would be needed over the next 35 years for repair or new installation of underground infrastructure.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels.	Planned new barge route and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The New Jersey Wind Port is being developed and the Port of Paulsboro is being upgraded specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities over the next 35 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Port utilization: Maintenance/ dredging	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. As ports expand, maintenance dredging of shipping channels is expected to increase.	Ports would need to perform maintenance and upgrades over the next 35 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. The likelihood of allisions is expected to continue at or near current levels.	Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. Such loss and damage are direct costs for gear owners and are expected to continue at or near current levels.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these locations, which may be known as FADs. Recreational and commercial fishing can occur near the FADs, although recreational fishing is more popular, because commercial mobile fishing gear is more likely to snag on FADs.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Habitat conversion	Structures, including foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented species thus benefit on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure and each other.	Vessel traffic, overall, is not expected to meaningfully increase over the next 35 years. The presence of navigation hazards is expected to continue at or near current levels.
Presence of structures: Space-use conflicts	Current structures do not result in space-use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Viewshed	No existing offshore structures are within the viewshed of the offshore wind lease area except buoys.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Transmission cable infrastructure	The existing offshore cable infrastructure supports the economy by transmitting electric power and communications between mainland and islands. Additional communication cables run between the U.S. East Coast and European countries along the eastern Atlantic.	No known proposed structures not associated with offshore wind development are reasonably foreseeable.
Traffic: Vessels	Ports and marine traffic related to shipping, fishing, and recreation are important to the region’s economy. No substantial changes are anticipated to existing vessel traffic volumes.	New vessel traffic near the geographic analysis area would be generated by proposed barge routes and dredging demolition sites over the next 35 years. Marine commerce and related industries would continue to be important to the geographic analysis area economy.
Traffic: Vessel collisions	The region’s substantial marine traffic may result in occasional vessel collisions, which would result in costs to the vessels involved. The likelihood of collisions is expected to continue at or near current rates.	No substantial changes anticipated.
Land disturbance: Onshore construction	Onshore development activities support local population growth, employment, and economies. Disturbances can cause temporary, localized traffic delays and restricted access to adjacent properties. The rate of onshore land disturbance is expected to continue at or near current rates.	Onshore development projects would be ongoing in accordance with local government land use plans and regulations.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change	Climate models predict climate change if current trends continue. Climate change has adverse implications for demographics and economic health of coastal communities, due in part to the costs of resultant damage to property and infrastructure, fisheries and other natural resources, increased disease frequency, and sedimentation, among other factors.	Onshore projects that reduce air emissions could contribute to the effort to limit climate change. Onshore solar and wind energy projects, although producing less energy than potential offshore wind developments, would also provide incremental reductions.
Regulated fishing effort	Commercial and recreational regulations for finfish and shellfish implemented and enforced by NMFS and coastal states affect how commercial and for-hire recreational fisheries operate. Commercial and recreational for-hire fisheries are managed by FMPs, which are established to manage fisheries to avoid overfishing through catch quotas, special management areas, and closed area regulations. These can reduce or increase the size of available landings to commercial and for-hire recreational fisheries.	Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the NARW by 60% (McCreary and Brooks 2019). This will likely have a significant impact on fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area for this resource.

Btu = British thermal unit; FAD = fish aggregating device

Table F1-9 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Environmental Justice

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Air emissions: Construction/ decommissioning	Ongoing population growth and new development within the analysis area is likely to increase traffic with resulting increase in emissions from motor vehicles. Some new industrial development may result in emissions-producing uses. At the same time, many industrial waterfront areas near environmental justice communities are losing industrial uses and converting to more commercial or residential uses.	New development may include emissions-producing industry and new development that would increase emissions from motor vehicles. Some historically industrial waterfront locations will continue to lose industrial uses, with no new industrial development to replace it.
Air emissions: O&M	Ongoing population growth and new development within the analysis area is likely to increase traffic with resulting increase in emissions from motor vehicles. Some new industrial development may result in emissions-producing uses. At the same time, many industrial waterfront areas near environmental justice communities are losing industrial uses and converting to more commercial or residential uses.	New development may include emissions-producing industry and new development that would increase emissions from motor vehicles. Some historically industrial waterfront locations will continue to lose industrial uses, with no new industrial development to replace it.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Light: Structures	Offshore buoys and towers emit low-intensity light, while onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors.	Future new cables would disturb the seafloor and cause temporary increases in suspended sediment, resulting in infrequent, localized, short-term impacts over the next 35 years.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the analysis area other than ongoing activities.
Noise: Trenching	Infrequent trenching for pipeline and cable laying activities emits noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Periodic trenching would be needed over the next 35 years for repair or new installation of underground infrastructure.
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels.	Vessel noise is anticipated to continue at or near current levels.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The New Jersey Wind Port is being developed and the Port of Paulsboro is being upgraded specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Presence of structures: Entanglement, gear loss/damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. Such loss and damage are direct costs for gear owners and are expected to continue at or near current levels.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure, and each other.	Vessel traffic is generally not expected to meaningfully increase over the next 35 years. The presence of navigation hazards is expected to continue at or near current levels.
Presence of structures: Space-use conflicts	Current structures do not result in space-use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Viewshed	There are no existing offshore structures within the viewshed of the offshore wind lease area except buoys.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: cable infrastructure	Existing submarine cables cross cumulative lease areas.	Existing cable O&M activities would continue within the analysis area.
Traffic: Vessels	Ports and marine traffic related to shipping, fishing and recreation are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes.	Vessel traffic is not expected to meaningfully increase over the next 35 years. Marine commerce and related industries would continue to be important to area employment.
Land disturbance: Erosion and sedimentation	Potential erosion and sedimentation from development and construction is controlled by local and state development regulations.	New development activities would be subject to erosion and sedimentation regulations.
Land disturbance: Onshore construction	Onshore development supports local population growth, employment, and economics.	Onshore development would continue in accordance with local government land use plans and regulations.
Land disturbance: Onshore, land use changes	Onshore development would result in changes in land use in accordance with local government land use plans and regulations.	Development of onshore solar and wind energy would provide diversified, small-scale energy generation.
Climate change	Climate models predict climate change if current trends continue. Climate change has adverse implications for demographics and the economic health of coastal communities, due in part to the costs of resultant damage to property and infrastructure, fisheries, and other natural resources; increased disease frequency; and sedimentation, among other factors.	Onshore projects that reduce air emissions could contribute to the effort to limit climate change. Onshore solar and wind energy projects, although producing less energy than potential offshore wind developments, would also provide incremental reductions.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Regulated fishing effort	Commercial and recreational regulations for finfish and shellfish implemented and enforced by NMFS and coastal states affect how commercial and for-hire recreational fisheries operate. Commercial and recreational for-hire fisheries are managed by FMPs, which are established to manage fisheries to avoid overfishing through catch quotas, special management areas, and closed area regulations. These can reduce or increase the size of available landings to commercial and for-hire recreational fisheries.	Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the NARW by 60% (McCreary and Brooks 2019). This will likely have a significant impact on the fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area for this resource. See No Action alternative for additional fishery management actions that will affect commercial fisheries and for-hire recreational fishing.

Table F1-10 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Finfish, Invertebrates, and Essential Fish Habitat

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-22 for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Impacts, including mortality, decreased fitness, and contamination of habitat, are localized and temporary, and rarely affect populations.	See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. Impacts are unlikely to affect populations.
Accidental releases: Invasive species	Invasive species are periodically released accidentally during ongoing activities, including the discharge of ballast water and bilge water from marine vessels. The impacts on finfish, invertebrates, and EFH depend on many factors, but can be widespread and permanent.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Anchoring	Vessel anchoring related to ongoing military use, and survey, commercial, and recreational activities continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Impacts on finfish, invertebrates, and EFH are greatest for sensitive EFH (e.g., eelgrass, hard bottom) and sessile or slow-moving species (e.g., corals, sponges, and sedentary shellfish).	Impacts from anchoring may occur on a semi-regular basis over the next 35 years due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. These impacts would include increased turbidity levels and potential for direct contact causing mortality of benthic species and, possibly, degradation of sensitive habitats. All impacts would be localized; turbidity would be temporary; impacts from direct contact would be recovered in the short term. Degradation of sensitive habitats such as certain types of hard bottom (e.g., boulder piles), if it occurs, could be long term.
EMF	EMF emanates continuously from installed telecommunication and electrical power transmission cables. Biologically significant impacts on finfish, invertebrates, and EFH have not been documented for AC cables (CSA Ocean Sciences, Inc. and Exponent 2019; Thomsen et al. 2015), but behavioral impacts have been documented for benthic species (skates and lobster) near operating DC cables (Hutchison et al. 2018). The impacts are localized and affect the animals only while they are within the EMF. There is no evidence to indicate that EMF from undersea AC power cables negatively affects commercially and recreationally important fish species (CSA Ocean Sciences, Inc. and Exponent 2019).	During operation, future new cables would produce EMF. Submarine power cables in the geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. Although the EMF would exist as long as a cable was in operation, impacts, on finfish, invertebrates, and EFH would likely be difficult to detect.
Light: Vessels	Marine vessels have an array of lights including navigational lights and deck lights. There is little downward-focused lighting, and therefore only a small fraction of the emitted light enters the water. Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light may also disrupt natural cycles, e.g., spawning, possibly leading to short-term impacts.	Vessels would continue to be a light source within the analysis area.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Light: Structures	Offshore buoys and towers emit light, and onshore structures, including buildings and ports, emit a great deal more on an ongoing basis. Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light may also disrupt natural cycles, e.g., spawning, possibly leading to short-term impacts. Light from structures is widespread and permanent near the coast, but minimal offshore.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances are local, limited to the cable corridor. New cables are infrequently added near shore. Cable emplacement/maintenance activities disturb, displace, and injure finfish and invertebrates and result in temporary to long-term habitat alterations. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur. (See also the IPF of Sediment deposition and burial.)	Future new cables would occasionally disturb the seafloor and cause temporary increases in suspended sediment, resulting in local short-term impacts. If the cable routes enter the geographic analysis area for this resource, short-term disturbance would be expected. The intensity of impacts would depend on the time (season) and place (habitat type) where the activities would occur.
Noise: Aircraft	Noise from aircraft reaches the sea surface on a regular basis. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH, as very little of the aircraft noise propagates through the water.	Aircraft noise is likely to continue to increase as commercial air traffic increases. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH.
Noise: Onshore/ offshore construction	Noise from construction occurs frequently in near shores of populated areas in New England and the mid-Atlantic but infrequently offshore. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary. See also sub-IPF for Noise: Pile driving.	Noise from construction near shores is expected to gradually increase in line with human population growth along the coast of the geographic analysis area for this resource.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: G&G	Ongoing site characterization surveys and scientific surveys produce noise around sites of investigation. These activities can disturb finfish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes. The extent depends on equipment used, noise levels, and local acoustic conditions.	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 35 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise to penetrate deep into the seabed, potentially resulting in injury or mortality to finfish and invertebrates in a small area around each sound source and short-term stress and behavioral changes to individuals over a greater area. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves more similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize but are likely local and temporary.
Noise: O&M	Some finfish and invertebrates may be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Farm, this low frequency noise barley exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (Thomsen et al. 2015), SPLs would be expected to be at or below ambient levels at relatively short distances (approximately 164 feet [50 meters]) from WTG foundations. These low levels of elevated noise likely have little to no impact. Noise is also created by O&M of marine minerals extraction and commercial fisheries, each of which has small local impacts.	New or expanded marine minerals extraction and commercial fisheries may intermittently increase noise during their O&M over the next 35 years. Impacts would likely be small and local.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to finfish and invertebrates in a small area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. Eggs, embryos, and larvae of finfish and invertebrates could also experience developmental abnormalities or mortality resulting from this noise, although thresholds of exposure are not known (Weilgart 2018; Hawkins and Popper 2017). Potentially injurious noise could also be considered as rendering EFH temporarily unavailable or unsuitable for the duration of the noise. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Noise: Cable laying/ trenching	Infrequent trenching activities for pipeline and cable laying, as well as other cable burial methods, emit noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines are likely to occur in the geographic analysis area for this resource. These disturbances would be infrequent over the next 35 years, temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.
Noise: Vessels	While ongoing vessel noise may have some effect on behavior, it is likely limited to brief startle and temporary stress responses. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels.	See cell to the left.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 35 years.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future. In addition, the general trend along the coast from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase may require port modifications, leading to local impacts. Future channel deepening activities will likely be undertaken. Existing ports have already affected finfish, invertebrates, and EFH, and future port projects would implement BMPs to minimize impacts. Although the degree of impacts on EFH would likely be undetectable outside the immediate vicinity of the ports, adverse impacts on EFH for certain species and/or life stages may lead to impacts on finfish and invertebrates beyond the vicinity of the port.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb habitats and potentially harm individuals, creating small, localized, short-term impacts.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Presence of structures: Hydrodynamic disturbance	Manmade structures, especially tall vertical structures such as foundations for towers of various purposes, continuously alter local water flow at a fine scale. Water flow typically returns to background levels within a relatively short distance from the structure. Therefore, impacts on finfish, invertebrates, and EFH are typically undetectable. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood. New structures are periodically added.	Tall vertical structures can increase seabed scour and sediment suspension. Impacts would likely be highly localized and difficult to detect. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. Structure-oriented fishes are attracted to these locations. These impacts are local and often permanent. Fish aggregation may be considered adverse, beneficial, or neutral.	New cables, installed incrementally in the geographic analysis area for this resource over the next 20 to 35 years, would likely require hard protection atop portions of the route (see the New cable emplacement/ maintenance IPF). Any new towers, buoys, or piers would also create uncommon relief in a mostly sandy seascape. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase. These impacts are local and may be permanent.
Presence of structures: Habitat conversion	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. A large portion is homogeneous sandy seascape but there is some other hard and/or complex habitat. Structure-oriented species thus benefit on a constant basis; however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Degraer et al. 2019 [Chapter 7]). Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat.	New cable, installed incrementally in the analysis area over the next 20 to 35 years, would likely require hard protection atop portions of the route (see New cable emplacement/maintenance). Any new towers, buoys, or piers would also create uncommon relief in a mostly sandy seascape. Structure-oriented species would benefit (Claisse et al. 2014; Smith et al. 2016); however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Degraer et al. 2019 [Chapter 7]). Soft bottom is the dominant habitat type from Cape Hatteras to the Gulf of Maine (over 60 million acres), and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010).
Presence of structures: Migration disturbances	Human structures in the marine environment, e.g., shipwrecks, artificial reefs, and oil platforms, can attract finfish and invertebrates that approach the structures during their migrations. This could slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure is (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). There is no evidence to suggest that structures pose a barrier to migratory animals.	The infrequent installation of future new structures in the marine environment over the next 35 years may attract finfish and invertebrates that approach the structures during their migrations. This could tend to slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded.
Presence of structures: Cable infrastructure	See other sub-IPFs within the Presence of structures IPF. See Table F1-6 on Coastal Habitats.	See other sub-IPFs within the Presence of structures IPF. See Table F1-6 on Coastal Habitats.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Regulated fishing effort	Regulated fishing effort results in the removal of a substantial amount of the annually produced biomass of commercially regulated finfish and invertebrates and can also influence bycatch of non-regulated species. Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by states, municipalities, and/or NOAA, depending on jurisdiction, affect finfish, invertebrates, and EFH by modifying the nature, distribution and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing).	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized short-term impacts (habitat alteration, change in complexity) on finfish, invertebrates, and EFH through this IPF. Dredging is most likely in sand wave areas where typical jet plowing is insufficient to meet target cable burial depth. Sand waves that are dredged would likely be redeposited in like-sediment areas. Any particular sand wave may not recover to the same height and width as pre-disturbance; however, the habitat function would largely recover post-disturbance. Therefore, seabed profile alterations, while locally intense, have little impact on finfish, invertebrates, and EFH on a regional (Cape Hatteras to Gulf of Maine) scale.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. Sediment deposition could have negative impacts on eggs and larvae, particularly demersal eggs such as longfin squid, which are known to have high rates of egg mortality if egg masses are exposed to abrasion or burial. Impacts may vary based on season/time of year.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Climate change: Ocean acidification	Continuous CO_2 emissions causing ocean acidification may contribute to reduced growth or the decline of invertebrates that have calcareous shells over the course of the next 35 years.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change: Warming and sea level rise, altered habitat, ecology, and migration patterns	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 35 years, influencing the distributions of finfish, invertebrates, and EFH. This sub-IPF has been shown to affect the distribution of fish in the northeast United States, with several species shifting their centers of biomass either northward or to deeper waters (Hare et al. 2016).	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 35 years, influencing the frequencies of various diseases of finfish and invertebrates.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

AC = alternating current; DC = direct current; hazmat = hazardous materials

Table F1-11 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Land Use and Coastal Infrastructure

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	Various ongoing onshore and coastal construction projects include the use of vehicles and equipment that contain fuel, fluids, and hazardous materials that could be released.	Ongoing onshore construction projects involve vehicles and equipment that use fuel, fluids, or hazardous materials could result in an accidental release. Intensity and extent would vary, depending on the size, location, and materials involved in the release.
Light: Structures	Various ongoing onshore and coastal construction projects have nighttime activities, as well as existing structures, facilities, and vehicles that would use nighttime lighting.	Ongoing onshore construction projects involving nighttime activity could generate nighttime lighting. Intensity and extent would vary, depending on the location, type, direction, and duration of nighttime lighting.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The New Jersey Wind Port is being developed and the Port of Paulsboro is being upgraded specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Viewshed	The only existing offshore structures within the offshore viewshed are minor features such as buoys.	Non-offshore wind structures that could be viewed in conjunction with the offshore components would be limited to met towers. Marine activity would also occur within the marine viewshed.
Presence of structures: Cable infrastructure	Onshore buried cables would only occur where permitted by local land use authorities, which would avoid long-term land use conflicts.	No known proposed structures are reasonably foreseeable and proposed to be located in the geographic analysis area for land use and coastal infrastructure.
Land disturbance: Onshore construction	Onshore construction supports local population growth, employment, and economics.	Onshore development would continue in accordance with local government land use plans and regulations.
Land disturbance: Onshore, land use changes	New development or redevelopment would result in changes in land use in accordance with local government land use plans and regulations.	Ongoing and future development and redevelopment is anticipated to reinforce existing land use patterns, based on local government planning documents.

hazmat = hazardous materials; met = meteorological

Table F1-12 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Marine Mammals

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-22 for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on the individual fitness, including adrenal effects, hematological effects, liver effects lung disease, poor body condition, skin lesions, and several other health affects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008; Smith et al. 2017; Sullivan et al. 2019; Takeshita et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to effects on prey species (Table F1-11).	See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on the individual fitness, including adrenal effects, hematological effects, liver effects lung disease, poor body condition, skin lesions, and several other health affects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008; Smith et al. 2017; Sullivan et al. 2019; Takeshita et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to effects on prey species (Table F1-11).

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying, and debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Worldwide 62 of 123 (50.4%) marine mammal species have been documented ingesting marine litter (Werner et al. 2016). Stranding data indicate potential debris induced mortality rates of 0 to 22%. Mortality has been documented in cases of debris interactions, as well as blockage of the digestive track, disease, injury, and malnutrition (Baulch and Perry 2014). However, it is difficult to link physiological effects to individuals to population level impacts (Browne et al. 2015).	As population and vessel traffic increase gradually over the next 35 years, accidental release of trash and debris may increase. Trash and debris may continue to be accidentally released through fisheries use and other offshore and onshore activities. There may also be a long-term risk from exposure to plastics and other debris in the ocean. Worldwide 62 of 123 (50.4%) of marine mammal species have been documented ingesting marine litter (Werner et al. 2016). Mortality has been documented in cases of debris interacts, as well as blockage of the digestive track, disease, injury, and malnutrition (Baulch and Perry 2014).
EMF	EMFs emanate constantly from installed telecommunication and electrical power transmission cables. Marine mammals appear to have a detection threshold for magnetic intensity gradients (i.e., changes in magnetic field levels with distance) of 0.1% of the earth's magnetic field or about 0.05 μT (Kirschvink 1990) and are thus likely to be very sensitive to minor changes in magnetic fields (Walker et al. 2003). There is a potential for animals to react to local variations of the geomagnetic field caused by power cable EMFs. Depending on the magnitude and persistence of the confounding magnetic field, such an effect could cause a trivial temporary change in swim direction or a longer detour during the animal's migration (Gill et al. 2005). Such an effect on marine mammals is more likely to occur with direct current cables than with AC cables (Normandeau et al. 2011). However, there are numerous transmission cables installed across the seafloor and no impacts on marine mammals have been demonstrated from this source of EMF.	During operation, future new cables would produce EMF. Submarine power cables in the marine mammal geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. EMF of any two sources would not overlap. Although the EMF would exist as long as a cable was in operation, impacts, if any, would likely be difficult to detect, if they occur at all. Marine mammals have the potential to react to submarine cable EMF; however, no effects from the numerous submarine cables have been observed. Furthermore, this IPF would be limited to extremely small portions of the areas used by migrating marine mammals. As such, exposure to this IPF would be low, and as a result impacts on marine mammals would not be expected.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Cable emplacement and maintenance	Cable maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be local and generally limited to the emplacement corridor. Data are not available regarding marine mammal avoidance of localized turbidity plumes; however, Todd et al. (Todd et al. 2015) suggest that since some marine mammals often live in turbid waters and some species of mysticetes and sirenians employ feeding methods that create sediment plumes, some species of marine mammals have a tolerance for increased turbidity. Similarly, McConnell et al. (McConnell et al. 1999) documented movements and foraging of grey seals in the North Sea. One tracked individual was blind in both eyes, but otherwise healthy. Despite being blind, observed movements were typical of the other study individuals, indicating that visual cues are not essential for grey seal foraging and movement (McConnell et al. 1999). If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any impacts would be temporary and short term. Turbidity associated with increased sedimentation may result in temporary, short-term impacts on marine mammal prey species (Table F1-11).	The impact on water quality from accidental sediment suspension during cable emplacement is temporary and short term. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any negative impacts would be temporary and short term. Turbidity associated with increased sedimentation may result in temporary, short-term impacts on some marine mammal prey species (Table F1-11).

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Aircraft	Aircraft routinely travel in the marine mammal geographic analysis area. With the possible exception of rescue operations, no ongoing aircraft flights would occur at altitudes that would elicit a response from marine mammals. If flights are at a sufficiently low altitude, marine mammals may respond with behavioral changes, including short surface durations, abrupt dives, and percussive behaviors (i.e., breaching and tail slapping) (Patenaude et al. 2002). These brief responses would be expected to dissipate once the aircraft has left the area. Similarly, aircraft have the potential to disturb hauled-out seals if aircraft overflights occur within 2,000 feet (610 meters) of a haul out area (Efroymson et al. 2000). However, this disturbance would be temporary, short-term, and result in minimal energy expenditure. These brief responses would be expected to dissipate once the aircraft has left the area.	Future low altitude aircraft activities such as survey activities and navy training operations could result short-term responses of marine mammals to aircraft noise. If flights are at a sufficiently low altitude, marine mammals may respond with a behavior changes, including short surface durations, abrupt dives, and percussive behaviors (i.e., breaching and tail slapping) (Patenaude et al. 2002). These brief responses would be expected to dissipate once the aircraft has left the area.
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities have the potential to result in high intensity, high consequence impacts, including auditory injuries, stress, disturbance, and behavioral responses, if present within the ensonified area (NOAA 2018). Survey protocols and underwater noise mitigation procedures are typically implemented to decrease the potential for any marine mammal to be within the area where sound levels are above relevant harassment thresholds associated with an operating sound source to reduce the potential for behavioral responses and injury (PTS/TTS) close to the sound source. The magnitude of effects, if any, is intrinsically related to many factors, including acoustic signal characteristics, behavioral state (e.g., migrating), biological condition, distance from the source, duration and level of the sound exposure, as well as environmental and physical conditions that affect acoustic propagation (NOAA 2018).	Same as ongoing activities, with the addition of possible future oil and gas exploration surveys. Exploratory oil and gas surveys are anticipated to occur infrequently over the next 35 years.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Turbines	Marine mammals would be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Facility, this low frequency noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (Thomsen et al. 2015) and Kraus et al. (Kraus et al. 2016), SPLs would be expected to be at or below ambient levels at relatively short distances from the WTG foundations.	This sub-IPF does not apply to future non-offshore wind development.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can result in high-intensity, low-exposure level, long-term, but localized intermittent risk to marine mammals. Impacts would be localized in nearshore waters. Pile driving activities may negatively affect marine mammals during foraging, orientation, migration, predator detection, social interactions, or other activities (Southall et al. 2007). Noise exposure associated with pile-driving activities can interfere with these functions and have the potential to cause a range of responses, including insignificant behavioral changes, avoidance of the ensonified area, PTS, harassment, and ear injury, depending on the intensity and duration of the exposure. BOEM assumes that all ongoing and potential future activities will be conducted in accordance with a project-specific IHA to minimize impacts on marine mammals.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.
Noise: Cable emplacement and maintenance	Noise from cable laying could periodically occur in the analysis area.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Vessels	Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, scientific and academic research vessels, as well as other construction vessels. The frequency range for vessel noise falls within marine mammals' known range of hearing and would be audible. Noise from vessels presents a long-term and widespread impact on marine mammals across in most oceanic regions. While vessel noise may have some effect on marine mammal behavior, it would be expected to be limited to brief startle and temporary stress response. Results from studies on acoustic impacts from vessel noise on odontocetes indicate that small vessels at a speed of 5 knots in shallow coastal water can reduce the communication range for bottlenose dolphins within 164 feet (50 meters) of the vessel by 26% (Jensen et al. 2009). Pilot whales in a quieter, deep-water habitat could experience a 50% reduction in communication range from a similar size boat and speed (Jensen et al. 2009). Since lower frequencies propagate farther away from the sound source compared to higher frequencies, LFCs are at a greater risk of experiencing Level B Harassment produced by vessel traffic.	Any offshore projects that require the use of ocean vessels could potentially result in long term but infrequent impacts on marine mammals, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes. However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of marine mammals and no stock or population level effects would be expected.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Port expansion activities are localized to nearshore habitats, and are expected to result in temporary, short-term impacts, if any, on marine mammals. Vessel noise may affect marine mammals, but response would be expected to be temporary and short-term (see Vessels: Noise sub-IPF above). The impacts on water quality from sediment suspension during port expansion activities is temporary, short-term, and would be similar to those described under the New cable emplacement/maintenance IPF above.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications. Future channel deepening activities are being undertaken to accommodate deeper-draft vessels for the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. Certain types of vessel traffic have increased recently (e.g. ferry use and cruise industry) and may continue to increase in the foreseeable future. Additional impacts associated with the increased risk of vessel strike could also occur (see the Traffic: Vessel collisions sub-IPF below).
Presence of structures: Entanglement or ingestion of lost fishing gear	There are more than 130 artificial reefs in the Mid-Atlantic region. This sub-IPF may result in long-term, high intensity impacts, but with low exposure due to localized and geographic spacing of artificial reefs, long-term. Currently bridge foundations and the Block Island Wind Facility may be considered artificial reefs and may have higher levels of recreational fishing, which increases the chances of marine mammals encountering lost fishing gear, resulting in possible ingestions, entanglement, injury, or death of individuals (Moore and van der Hoop 2012), if present nearshore where these structures are located. There are very few, if any, areas within the OCS geographic analysis area for marine mammals that would serve to concentrate recreational fishing and increase the likelihood that marine mammals would encounter lost fishing gear.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Habitat conversion and prey aggregation	There are more than 130 artificial reefs in the Mid-Atlantic region. Hard-bottom (scour control and rock mattresses) and vertical structures (bridge foundations and Block Inland Wind Facility WTGs) in a soft-bottom habitat can create artificial reefs, thus inducing the “reef” effect (Taormina et al. 2018; NMFS 2015). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for seals and small odontocetes compared to the surrounding soft-bottoms.	The presence of structures associated with non-offshore wind development in near shore coastal waters have the potential to provide habitat for seals and small odontocetes as well as preferred prey species. This “reef effect” has the potential to result in long term, low-intensity benefits. Bridge foundations will continue to provide foraging opportunities for seals and small odontocetes with measurable benefits to some individuals. Hard-bottom (scour control and rock mattresses used to bury the offshore export cables) and vertical structures (i.e., WTG and OSS foundations) in a soft-bottom habitat can create artificial reefs, thus inducing the “reef effect” (Taormina et al. 2018; Causon and Gill 2018). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for marine mammals compared to the surrounding soft-bottoms.
Presence of structures: Avoidance/ displacement	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF. There may be some impacts resulting from the existing Block Island Wind Facility, but given that there are only 5 WTGs, no measurable impacts are occurring.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Behavioral disruption - breeding and migration	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Displacement into higher risk areas (vessels and fishing)	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Traffic: Vessel collisions	Current activities that are contributing to this sub-IPF include port traffic levels, fairways, TSS, commercial vessel traffic, recreational and fishing activity, and scientific and academic vessel traffic. Vessel strike is relatively common with cetaceans (Kraus et al. 2005) and one of the primary causes of death to NARWs with as many as 75% of known anthropogenic mortalities of NARWs likely resulting from collisions with large ships along the U.S. and Canadian eastern seaboard (Kite-Powell et al. 2007). Marine mammals are more vulnerable to vessel strike when they are within the draft of the vessel and when they are beneath the surface and not detectable by visual observers. Some conditions that make marine mammals less detectable include weather conditions with poor visibility (e.g., fog, rain, and wave height) or nighttime operations. Vessels operating at speeds exceeding 10 knots have been associated with the highest risk for vessel strikes of NARWs (Vanderlaan and Taggart 2007). Reported vessel collisions with whales show that serious injury rarely occurs at speeds below 10 knots (Laist et al. 2001). Data show that the probability of a vessel strike increases with the velocity of a vessel (Pace and Silber 2005; Vanderlaan and Taggart 2007).	Vessel traffic associated with non-offshore wind development has the potential to result in an increased collision risk. While these impacts would be high consequence, the patchy distribution of marine mammals makes stock or population-level effects unlikely (Navy 2018).
Climate change: Warming and sea level rise, storm severity/frequency	Increased storm frequency could result in increased energetic costs for marine mammals and reduced fitness, particularly for juveniles, calves and pups.	No future activities were identified within the geographic analysis area for marine mammals other than ongoing activities.
Climate change: Ocean acidification	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine ecosystems by contributing to reduced growth or the decline of invertebrates that have calcareous shells.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat/ecology	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine mammals as a result of changes in distribution, reduced breeding, and/or foraging habitat availability, and disruptions in migration.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change: Warming and sea level rise, altered migration patterns	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine mammal habitat use and migratory patterns. For example, the NARW appears to be migrating differently and feeding in different areas in response to changes in prey densities related to climate change (Record et al. 2019; MacLeod 2009; Nunny and Simmonds 2019).	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, increased disease frequency	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of marine mammals, such as Phocine distemper. Climate change is clearly influencing infectious disease dynamics in the marine environment; however, no studies have shown a definitive causal relationship between any components of climate change and increases in infectious disease among marine mammals. This is due in large part to a lack of sufficient data and to the likely indirect nature of climate change's impact on these diseases. Climate change could potentially affect the incidence or prevalence of infection, the frequency or magnitude of epizootics, and/or the severity or presence of clinical disease in infected individuals. There are a number of potential proposed mechanisms by which this might occur (see summary in Burge et al. 2014 Climate Change Influences on Marine Infectious Diseases: Implications for Management and Society).	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, storm severity/frequency, sediment erosion, deposition	Increased storm frequency could result in increased energetic costs for marine mammals, reduced fitness, particularly for juveniles, calves and pups. Erosion could impact seal haul outs reducing their habitat availability, especially as things like sea walls are added, blocking seals access to shore.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.

μT = microtesla; AC = alternating current; hazmat = hazardous materials; IHA = Incidental Harassment Authorization

Table F1-13 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Navigation and Vessel Traffic

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Anchoring	Larger commercial vessels (specifically tankers) sometimes anchor outside of major ports to transfer their cargo to smaller vessels for transport into port, an operation known as lightering. These anchors have deeper ground penetration and are under higher stresses. Smaller vessels (commercial fishing or recreational vessels) would anchor for fishing and other recreational activities. These activities cause temporary to short-term impacts on navigation in the immediate anchorage area. All vessels may anchor in an emergency scenario (such as power loss) if they lose power to prevent them from drifting and creating navigational hazards for other vessels or drifting into structures.	Lightering and anchoring operations are expected to continue at or near current levels, with the expectation of moderate increase commensurate with any increase in tankers visiting ports. Deep-draft visits to major port visits are expected to increase as well, increasing the potential for an emergency need to anchor, creating navigational hazards for other vessels. Recreational activity and commercial fishing activity would likely stay largely the same related to this IPF.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Impacts from these activities would be short term and could include congestion in ports, delays, and changes in port usage by some fishing or recreational vessel operators.	Ports would need to perform maintenance and perform upgrades to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size. Impacts would be short term and could include congestion in ports, delays, and changes in port usage by some fishing or recreational vessel operators.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. There are two types of allisions that occur: drift and powered. A drift allision generally occurs when a vessel is powered down due to operator choice or power failure. A powered allision generally occurs when an operator fails to adequately control their vessel movements or is distracted.	Although there are some exceptions (ferry traffic and cruise ships), BOEM expects vessel traffic to remain relatively steady into the reasonably foreseeable future (BOEM 2019:57). Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Fish aggregation	Items in the water, such as ghost fishing gear, buoys, and energy platform foundations can create an artificial reef effect, aggregating fish. Recreational and commercial fishing can occur near the artificial reefs. Recreational fishing is more popular than commercial near artificial reefs as commercial mobile fishing gear can risk snagging on the artificial reef structure.	Fishing near artificial reefs is not expected to change meaningfully over the next 35 years.
Presence of structures: Habitat conversion	Equipment in the ocean can create a substrate for mollusks to attach to, and fish eggs to settle near. This can create a reef-like habitat and benefit structure-oriented species on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Migration disturbances	Noise-producing activities, such as pile driving and vessel traffic, may interfere and adversely affect marine mammals during foraging, orientation, migration, response to predators, social interactions, or other activities. Marine mammals may also be sensitive to changes in magnetic field levels. The presence of structures and operational noise could cause mammals to avoid areas.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions. When multiple vessels need to navigate around a structure, then navigation is made more complex, as the vessels need to avoid both the structure and each other.	Although there are some exceptions (ferry traffic and cruise ships), BOEM expects vessel traffic to remain relatively steady into the reasonably foreseeable future (BOEM 2019:57). Even with increased port visits by deep-draft vessels, this is still a relatively small effect when considering the whole of Atlantic Coast vessel traffic. The presence of navigation hazards is expected to continue at or near current levels.
Presence of structures: Space-use conflicts	Currently, the offshore area is occupied by marine trade, stationary and mobile fishing, and survey activities.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Cable infrastructure	See IPF for Anchoring.	See IPF for Anchoring.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
New cable emplacement/ maintenance	Within the geographic analysis area for navigation and vessel traffic, existing cables may require access for maintenance activities. Infrequent cable maintenance activities may cause temporary increases in vessel traffic and navigational complexity.	Future new cables would cause temporary increases in vessel traffic during installation or maintenance, resulting in infrequent, localized, short-term impacts over the next 35 years. Care would need to be taken by vessels that are crossing the cable routes during these activities.
Traffic: Aircraft	USCG SAR helicopters are the main aircraft that may be flying at low enough heights to risk interaction with WTGs. USCG SAR aircraft need to fly low enough that they can spot objects in the water.	SAR operations could be expected to increase with any increase in vessel traffic. However, as vessel traffic volume is not expected to increase appreciably, neither should SAR operations. Final EIS Section 3.16 provides a discussion of navigation impacts on fishing vessel traffic.
Traffic: Vessels	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.
Traffic: Vessels, collisions	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.

Table F1-14 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Military and National Security Uses

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Allisions	Existing stationary facilities that present allision risks include buoys that are used to mark inlet approaches, channels, and shoals (NOAA 2021), dock facilities, meteorological buoys associated with offshore wind lease areas, and other offshore or shoreline-based structures.	No additional non-offshore wind stationary structures were identified within the geographic analysis area. Stationary structures such as private or commercial docks may be added close to the shoreline.
Presence of structures: Fish aggregation	No existing stationary structures that would act as FADs were identified within the geographic analysis area.	No future non-offshore wind additional stationary structures that would act as FADs were identified within the geographic analysis area.
Presence of structures: Navigation hazard	Existing stationary facilities within the geographic analysis area that present navigational hazards include buoys that are used to mark inlet approaches, channels, and shoals (NOAA 2021), dock facilities, meteorological buoys associated with offshore wind lease areas, and other offshore or shoreline-based structures.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers and onshore commercial, industrial, and residential developments.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Space-use conflicts	Existing stationary facilities within the geographic analysis area that could present a space-use conflict include onshore wind turbines, communication towers, and other onshore commercial, industrial, and residential structures.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers and onshore commercial, industrial, and residential developments.
Presence of structures: Cable infrastructure	Existing submarine cables cross cumulative lease areas.	Submarine cables would remain in current locations with infrequent maintenance continuing along those cable routes for the foreseeable future.
Traffic: Vessels	Current vessel traffic in the region is described in Final EIS Section 3.16. Vessel activities associated with offshore wind in the cumulative lease areas is currently limited to site assessment surveys.	Continued vessel traffic in the region, as described in Final EIS Section 3.16.
Traffic: Vessels, collisions	Current vessel traffic in the region is described in Final EIS Section 3.16. Vessel activities associated with offshore wind in the cumulative lease areas is currently limited to site assessment surveys.	Continued vessel traffic in the region is described in Final EIS Section 3.16.

FAD = fish aggregating device

Table F1-15 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Aviation and Air Traffic

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Towers	Existing aboveground stationary facilities within the geographic analysis area that present aviation hazards include onshore wind turbines, communication towers, dock facilities, and other onshore structures exceeding 200 feet in height.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore development activities are anticipated to continue with additional proposed communications towers.
Presence of structures: Space-use conflicts	Existing aboveground stationary facilities within the geographic analysis area that could cause space-use conflicts for aircraft include onshore wind turbines, communication towers, and other onshore structures exceeding 200 feet in height.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers.

Table F1-16 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Cables and Pipelines

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Allisions and navigation hazards	Structures within and near the geographic analysis area that pose potential allision hazards include buoys that are used to mark inlet approaches, channels, and shoals, meteorological buoys associated with offshore wind lease areas, and shoreline developments such as docks, ports, and other commercial, industrial, and residential structures.	Reasonably foreseeable non-offshore wind structures that could affect submarine cables have not been identified in the geographic analysis area.
Presence of structures: Space-use conflicts	Existing submarine cables cross cumulative lease areas and create potential space-use conflicts with marine mineral and sand borrow areas.	Reasonably foreseeable non-offshore wind structures that could create space-use conflicts with submarine cables have not been identified in the geographic analysis area.
Presence of structures: Cable infrastructure	Existing submarine cables cross cumulative lease areas.	Reasonably foreseeable non-offshore wind structures have not been identified in the geographic analysis area.

Table F1-17 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Radar Systems

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Towers	Wind developments in the direct line-of-sight with, or extremely close to, radar systems can cause clutter and interference. Existing wind developments in the area include the Jersey-Atlantic Wind Farm in Atlantic City, New Jersey.	Reasonably foreseeable non-offshore wind structures proposed for construction in the lease areas that could affect radar systems have not been identified.

Table F1-18 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Scientific Research and Surveys

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Navigation hazards	Stationary structures are limited in the open ocean environment of the geographic analysis area, and include met buoys associated with site assessment activities, the five Block Island Wind Farm WTGs, and the two CVOW WTGs.	Reasonably foreseeable non-offshore wind activities would not implement stationary structures within the open ocean environment that would pose navigational hazards and raise the risk of allisions for survey vessels and collisions for survey aircraft.

CVOW = Coastal Virginia Offshore Wind; met = meteorological

Table F1-19 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Recreation and Tourism

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Anchoring	Anchoring occurs due to ongoing military, survey, commercial, and recreational activities.	Impacts from anchoring would continue, and may increase due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. Modest growth in vessel traffic could increase the temporary, localized impacts of navigational hazards, increased turbidity levels, and potential for direct contact causing mortality of benthic resources.
Light: Vessels	Ocean vessels have an array of lights including navigational lights and deck lights.	Anticipated modest growth in vessel traffic would result in some growth in the nighttime traffic of vessels with lighting.
Light: Structures	Offshore buoys and towers emit low-intensity light. Onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors.	Cable maintenance or replacement of existing cables in the geographic analysis area would occur infrequently and would generate short-term disturbances.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Cable laying/ trenching	Offshore trenching occurs periodically in connection with cable installation or sand and gravel mining.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels.	Planned new barge routes and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance.	Ports would need to perform maintenance and upgrade facilities over the next 35 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Port utilization: Maintenance/ dredging	Periodic maintenance is necessary for harbors within the analysis area.	Ongoing maintenance and dredging of harbors within the geographic analysis area will continue as needed. No specific projects are known.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. The likelihood of allisions is expected to continue at or near current levels.	Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these locations. Recreational and commercial fishing can occur near these aggregation locations, although recreational fishing is more popular, because commercial mobile fishing gear is more likely to snag on structures.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Habitat conversion	Structures, including foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented species thus benefit on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure and each other.	Vessel traffic, overall, is not expected to meaningfully increase over the next 35 years. The presence of navigation hazards is expected to continue at or near current levels.
Presence of structures: Space-use conflicts	Current structures do not result in space-use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Viewshed	The only existing offshore structures within the viewshed of the Project are minor features such as buoys.	Non-offshore wind structures that could be viewed in conjunction with the offshore components of the Project would be limited to meteorological towers. Marine activity would also occur within the marine viewshed.
Traffic: Vessels	Geographic analysis area ports and marine traffic related to shipping, fishing, and recreation are important to the region’s economy. No substantial changes are anticipated to existing vessel traffic volumes.	New vessel traffic near the geographic analysis area would be generated by proposed barge routes and dredging demolition sites over the next 35 years. Marine commerce and related industries would continue to be important to the geographic analysis area economy.
Traffic: Vessel collisions	The region’s substantial marine traffic may result in occasional vessel collisions, which would result in costs to the vessels involved. The likelihood of collisions is expected to continue at or near current rates.	An increased risk of collisions is not anticipated from future activities.

Table F1-20 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Sea Turtles

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-22 for a quantitative analysis of these risks. Ongoing releases are frequent and chronic. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka et al. 2010) or sublethal effects on individual fitness, including adrenal effects, dehydration, hematological effects, increased disease incidence, liver effects, poor body condition, skin effects, skeletomuscular effects, and several other health effects that can be attributed to oil exposure (Camacho et al. 2013; Bembenek-Bailey et al. 2019; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Additionally, accidental releases may result in impacts on sea turtles due to effects on prey species (Table F1-11).	See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka et al. 2010; Wallace et al. 2010) or sublethal effects on individual fitness, including adrenal effects, dehydration, hematological effects, increased disease incidence, liver effects, poor body condition, skin effects, skeletomuscular effects, and several other health effects that can be attributed to oil exposure (Camacho et al. 2013; Bembenek-Bailey et al. 2019; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Additionally, accidental releases may result in impacts on sea turtles due to effects on prey species (Table F1-11).

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities, cables, lines, and pipeline laying, as well as debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Direct ingestion of plastic fragments is well documented and has been observed in all species of sea turtles (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). In addition to plastic debris, ingestion of tar, paper, Styrofoam™, wood, reed, feathers, hooks, lines, and net fragments have also been documented (Thomás et al. 2002). Ingestion can also occur when individuals mistake debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Thomás et al. 2002). Potential ingestion of marine debris varies among species and life history stages due to differing feeding strategies (Nelms et al. 2016). Ingestion of plastics and other marine debris can result in both lethal and sublethal impacts on sea turtles, with sublethal effects more difficult to detect (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Long-term sublethal effects may include dietary dilution, chemical contamination, depressed immune system function, poor body condition, as well as reduced growth rates, fecundity, and reproductive success. However, these effects are cryptic and clear causal links are difficult to identify (Nelms et al. 2016).	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying, and debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Direct and indirect ingestion of plastic fragments and other marine debris is well documented and has been observed in all species of sea turtles (Bugoni et al. 2001; Gregory 2009; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014; Thomás et al. 2002). Ingestion can result in both lethal and sublethal impacts on sea turtles, with sublethal effects more difficult to detect (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). However, these effects are cryptic and clear causal links are difficult to identify (Nelms et al. 2016).

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
EMF	EMFs emanate constantly from installed telecommunication and electrical power transmission cables. Sea turtles appear to have a detection threshold of magnetosensitivity and behavioral responses to field intensities ranging from 0.0047 to 4000 µT for loggerhead turtles, and 29.3 to 200 µT for green turtles, with other species likely similar due to anatomical, behavioral, and life history similarities (Normandeau et al. 2011). Juvenile or adult sea turtles foraging on benthic organisms may be able to detect magnetic fields while they are foraging on the bottom near the cables and up to potentially 82 feet (25 meters) in the water column above the cable. Juvenile and adult sea turtles may detect the EMF over relatively small areas near cables (e.g., when resting on the bottom or foraging on benthic organisms near cables or concrete mattresses). There are no data on impacts on sea turtles from EMFs generated by underwater cables, although anthropogenic magnetic fields can influence migratory deviations (Luschi et al. 2007; Snoek et al. 2016). However, any potential impacts from AC cables on turtle navigation or orientation would likely be undetectable under natural conditions, and thus would be insignificant (Normandeau et al. 2011).	During operations, future new cables would produce EMF. Submarine power cables in the geographic analysis area for sea turtles are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. (Section 5.2.7 of BOEM's 2007 Final Programmatic EIS for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf.) EMF of any two sources would not overlap. Although the EMF would exist as long as a cable was in operation, impacts, if any, would likely be difficult to detect, if they occur at all. Furthermore, this IPF would be limited to extremely small portions of the areas used by resident or migrating sea turtles. As such, exposure to this IPF would be low, and as a result, impacts on sea turtles would not be expected.
Light: Vessels	Ocean vessels such as ongoing commercial vessel traffic, recreational and fishing activity, scientific and academic research traffic have an array of lights including navigational, deck lights, and interior lights. Such lights have some limited potential to attract sea turtles, although the impacts, if any, are expected to be localized and temporary.	Construction, operations, and decommissioning vessels associated with non-offshore wind activities produce temporary and localized light sources that could result in the attraction or avoidance behavior of sea turtles. These short-term impacts are expected to be of low intensity and occur infrequently.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Light: Structures	Artificial lighting on nesting beaches or in nearshore habitats has the potential to result in disorientation to nesting females and hatchling turtles. Artificial lighting on the OCS does not appear to have the same potential for effects. Decades of oil and gas platform operation in the Gulf of Mexico, that can have considerably more lighting than offshore WTGs, has not resulted in any known impacts on sea turtles (BOEM 2019).	Non-offshore wind activities would not be expected to appreciably contribute to this sub-IPF. As such, no impact on sea turtles would be expected.
New cable emplacement/ maintenance	Cable maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be local and generally limited to the emplacement corridor. Data are not available regarding effects of suspended sediments on adult and juvenile sea turtles, although elevated suspended sediments may cause individuals to alter normal movements and behaviors. However, these changes are expected to be too small to be detected (NOAA 2020). Sea turtles would be expected to swim away from the sediment plume. Elevated turbidity is most likely to affect sea turtles if a plume causes a barrier to normal behaviors, but no impacts would be expected due to swimming through the plume (NOAA 2020). Turbidity associated with increased sedimentation may result in short-term, temporary impacts on sea turtle prey species (Table F1-11).	The impact on water quality from accidental sediment suspension during cable emplacement is short-term and temporary. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any impacts would be short-term and temporary. Turbidity associated with increased sedimentation may result in short-term, temporary impacts on some sea turtle prey species (Table F1-11).
Noise: Aircraft	Aircraft routinely travel in the geographic analysis area for sea turtles. With the possible exception of rescue operations, no ongoing aircraft flights would occur at altitudes that would elicit a response from sea turtles. If flights are at a sufficiently low altitude, sea turtles may respond with a startle response (diving or swimming away), altered submergence patterns, and a temporary stress response (NSF and USGS 2011; Samuel et al. 2005). These brief responses would be expected to dissipate once the aircraft has left the area.	Future low-altitude aircraft activities such as survey activities and navy training operations could result in short-term responses of sea turtles to aircraft noise. If flights are at a sufficiently low altitude, sea turtles may respond with a startle response (diving or swimming away), altered submergence patterns, and a temporary stress response (NSF and USGS 2011; Samuel et al. 2005). These brief responses would be expected to dissipate once the aircraft has left the area.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities have the potential to result in some impacts including potential auditory injuries, short-term disturbance, behavioral responses, and short-term displacement of feeding or migrating sea turtles, if present within the ensonified area (NSF and USGS 2011). The potential for PTS and TTS is considered possible in proximity to G&G surveys utilizing air guns, but impacts are unlikely as turtles would be expected to avoid such exposure and survey vessels would pass quickly (NSF and USGS 2011). No significant impacts would be expected at the population level.	Same as ongoing activities, with the addition of possible future oil and gas exploration surveys.
Noise: Turbines	Available evidence suggests that typical underwater noise levels from operating WTGs would be below current cumulative injury and behavioral effect thresholds for sea turtles. Operating turbines were determined to produce underwater noise on the order of 110 to 125 dB_{RMS}, occasionally reaching as high as 128 dB_{RMS}, in the 10-Hz to 8-kilohertz range (Tougaard et al. 2020). As measured at the Block Island Wind Facility, low frequency operational noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base (Miller and Potty 2017). Operational noise impacts would be expected to be negligible.	This sub-IPF does not apply to future non-offshore wind development.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can result in high intensity, low exposure levels, and long-term, but localized intermittent risk to sea turtles. Impacts, potentially including behavioral responses, masking, TTS, and PTS, would be localized in nearshore waters. Data regarding threshold levels for impacts on sea turtles from sound exposure during pile driving are very limited, and no regulatory threshold criteria have been established for sea turtles. Based on current literature, the following thresholds are used to assess impacts on turtles: Potential mortal injury: 210 dB cumulative SPL or greater than 207 dB peak SPL (Popper et al. 2014) Potential mortal injury: 204 dB_{SEL}, 232 dB_{PEAK} (PTS), 189 dB_{SEL}, 226 dB_{PEAK} (TTS) (Navy 2017) Behavioral harassment: 175 dB referenced to 1 µPa RMS (Navy 2017)	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Noise: Vessels	The frequency range for vessel noise (10 to 1000 Hz; MMS 2007) overlaps with sea turtles' known hearing range (less than 1,000 Hz with maximum sensitivity between 200 to 700 Hz; Bartol 1994) and would therefore be audible. However, Hazel et al. (Hazel et al. 2007) suggests that sea turtles' ability to detect approaching vessels is primarily vision-dependent, not acoustic. Sea turtles may respond to vessel approach and/or noise with a startle response (diving or swimming away) and a temporary stress response (NSF and USGS 2011). Samuel et al. (Samuel et al. 2005) indicated that vessel noise could have an effect on sea turtle behavior, especially their submergence patterns.	Any offshore projects that require the use of ocean vessels could potentially result in long-term but infrequent impacts on sea turtles, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes, especially their submergence patterns (NSF and USGS 2011; Samuel et al. 2005). However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of sea turtles and no stock or population level effects would be expected.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Port expansion activities are localized to nearshore habitats, and are expected to result in short-term, temporary impacts, if any, on sea turtles. Vessel noise may affect sea turtles, but response would be expected to be short-term and temporary (see the Vessels: Noise sub-IPF above). The impact on water quality from sediment suspension during port expansion activities is short-term, temporary, and would be similar to those described under the New cable emplacement/maintenance IPF above.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications. Future channel deepening activities are being undertaken to accommodate deeper-draft vessels for the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future. Additional impacts associated with the increased risk of vessel strikes could also occur (see the Traffic: Vessel collisions sub-IPF below).
Presence of structures: Entanglement or ingestion of lost fishing gear	The Mid-Atlantic region has more than 130 artificial reefs. Currently bridge foundations and the Block Island Wind Facility may be considered artificial reefs and may have higher levels of recreational fishing, which increases the chances of sea turtles encountering lost fishing gear, resulting in possible ingestions, entanglement, injury, or death of individuals (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014) if present where these structures are located. At the scale of the OCS geographic analysis area for sea turtles, there are very few areas that would serve to concentrate recreational fishing and increase the likelihood that sea turtles would encounter lost fishing gear.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Habitat conversion and prey aggregation	The Mid-Atlantic region has more than 130 artificial reefs. Hard-bottom (scour control and rock mattresses) and vertical structures (bridge foundations, Block Island Wind Facility WTGs, and two WTGs with the CVOW pilot project) in a soft-bottom habitat can create artificial reefs, thus inducing the reef effect (Taormina et al. 2018; NMFS 2015). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for sea turtles compared to the surrounding soft-bottoms.	The presence of structures associated with non-offshore wind development in near-shore coastal waters has the potential to provide habitat for sea turtles as well as preferred prey species. This reef effect has the potential to result in long-term, low-intensity beneficial impacts. Bridge foundations will continue to provide foraging opportunities for sea turtles with measurable benefits to some individuals.
Presence of structures: Avoidance/ displacement	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF. There may be some impacts resulting from the existing Block Island Wind Facility (5 WTGs) and the CVOW pilot project (2 WTGs) but given the limited number of WTGs, no measurable impacts are occurring.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Behavioral disruption - breeding and migration	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Displacement into higher risk areas (vessels and fishing)	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Traffic: Vessel collisions	Current activities contributing to this sub-IPF include port traffic levels, fairways, TSS, commercial vessel traffic, recreational and fishing activity, and scientific and academic vessel traffic. Propeller and collision injuries from boats and ships are common in sea turtles. Vessel strike is an increasing concern for sea turtles, especially in the southeastern United States, where development along the coasts is likely to result in increased recreational boat traffic. In the United States, the percentage of strandings of loggerhead sea turtles that were attributed to vessel strikes increased from approximately 10% in the 1980s to a record high of 20.5% in 2004 (NMFS and USFWS 2007). Sea turtles are most susceptible to vessel collisions in coastal waters, where they forage from May through November. Vessel speed may exceed 10 knots in such waters, and evidence suggests that they cannot reliably avoid being struck by vessels exceeding 2 knots (Hazel et al. 2007).	Vessel traffic associated with non-offshore wind development has the potential to result in an increased collision risk. While these impacts would be high consequence, the patchy distribution of sea turtles makes stock or population-level effects unlikely (Navy 2018).
Climate change: Warming and sea level rise, storm severity/frequency	Increased storm frequency could lead to long-term, high-consequence impacts on sea turtle onshore beach nesting habitat, including changes to nesting periods, changes in sex ratios of nestlings, drowned nests, as well as loss or degradation of nesting beaches. Offshore impacts, including sedimentation of near-shore hard bottom habitats have the potential to result in long-term, high consequence changes to foraging habitat availability for green turtles.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Ocean acidification	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine ecosystems by contributing to reduced growth or the decline of invertebrates that have calcareous shells.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat/ecology	This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtles by influencing distributions of sea turtles and/or prey resources. This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtle breeding, foraging, and sheltering habitat use.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change: Warming and sea level rise, altered migration patterns	This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtle habitat use and migratory patterns.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of sea turtles such as fibropapillomatosis.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Warming and sea level rise, protective measures (barriers, sea walls)	The proliferation of coastline protections have the potential to result in long-term, high-consequence impacts on sea turtle nesting by eliminating or precluding access to potentially suitable nesting habitat or access to potentially suitable habitat.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Warming and sea level rise, storm severity, frequency, sediment erosion, deposition	Sediment erosion and/or deposition in coastal waters have the potential to result in long-term, high-consequence impacts on green sea turtle foraging habitat. Additionally, sediment erosion has the potential to result in the degradation or loss of potentially suitable nesting habitat.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.

μT = microtesla; AC = alternating current; CVOW = Coastal Virginia Offshore Wind; dB_{RMS} = root-mean-square decibels; hazmat = hazardous materials

Table F1-21 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Scenic and Visual Resources

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat, suspended sediments, trash and debris	Ongoing offshore and onshore construction projects involve the use of vehicles, vessels, and equipment that contain fuel, fluids, and hazmat that have the potential for accidental release. Offshore and onshore construction can also result in sedimentation from land and seabed disturbance and accidental releases of trash and debris with associated visual impacts.	Future offshore and onshore construction projects have the potential to result in accidental releases from vehicles, vessels, and equipment that contain fuel, fluids, and hazmat. Future offshore and onshore construction could also result in sedimentation from land and seabed disturbance and accidental releases of trash and debris with associated visual impacts.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Land disturbance: Erosion and sedimentation, onshore construction, onshore land use changes	Onshore human-caused and naturally occurring erosion and sedimentation results from construction, maintenance, and weather events.	Ongoing onshore construction projects could generate noticeable disturbance in the landscape. Intensity and extent would vary depending on the location, type, and duration of activities.
Light: Offshore structures and vessels, onshore vehicles, roads, laydown, parking, facilities, equipment, and structures	Offshore vessels have an array of lights including navigational lights, deck lights, and interior lights. Various ongoing onshore and coastal construction projects have nighttime activities, as well as existing structures, facilities, and vehicles that would require nighttime lighting.	Ongoing onshore construction projects involving nighttime activity could generate nighttime lighting. Intensity and extent would vary depending on the location, type, direction, and duration of nighttime lighting.
Structures: Viewshed	Buoys are the only existing stationary structures within the offshore viewshed of the Project. Typically, buoys are visible only in the immediate foreground (less than 1 mile). Stationary and moving barges, boats, and ships also are visible in the daytime and nighttime viewsheds.	Onshore wind-related structures that could be viewed in conjunction with the offshore project components would be limited to meteorological towers, substations, and electrical transmission towers and conductors.
Traffic: Helicopters, vessels, vehicles	Ongoing activities contribute air, marine, and onshore traffic and visible congestion.	Planned onshore and offshore construction projects involving vessel, vehicle, and helicopter traffic could generate noticeable changes in the characteristic seascape and landscape and viewer experience. Intensity and extent of the changes would vary depending on the location, type, direction, and duration of the traffic.

Table F1-22 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Water Quality

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	Accidental releases of fuels and fluids occur during vessel usage for dredge material ocean disposal, fisheries use, marine transportation, military use, survey activities, and submarine cable lines, and pipeline laying activities. According to the DOE, 31,000 barrels of petroleum are spilled into U.S. waters from vessels and pipelines in a typical year. Approximately 40.5 million barrels of oil were lost as a result of tanker incidents from 1970 to 2009, according to International Tanker Owners Pollution Federation Limited, which collects data on oil spills from tankers and other sources. From 1990 to 1999, the average annual input to the coastal Northeast was 220,000 barrels of petroleum and into the offshore was < 70,000 barrels. Impacts on water quality would be expected to brief and localized from accidental releases.	Future accidental releases from offshore vessel usage, spills, and consumption will likely continue on a similar trend. Impacts are unlikely to affect water quality.
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities, and cables, lines, and pipeline laying. Accidental releases of trash and debris are expected to be low probability events. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact.	As population and vessel traffic increase gradually over the next 35 years, accidental release of trash and debris may increase. However, there does not appear to be evidence that the volumes and extents anticipated would have any effect on water quality.
Anchoring	Impacts from anchoring occur due to ongoing military use and survey, commercial, and recreational activities.	Impacts from anchoring may occur semi-regularly over the next 35 years due to offshore military operations or survey activities. These impacts would include increased seabed disturbance resulting in increased turbidity levels. All impacts would be localized, short term, and temporary.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
New cable emplacement/ maintenance	Elevated suspended sediment concentrations can occur under natural tidal conditions and increase during storms, trawling, and vessel propulsion. Survey activities, and new cable and pipeline laying activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances would be short-term and either be limited to the emplacement corridor or localized.	Suspension of sediments may continue to occur infrequently over the next 35 years due to survey activities, and submarine cable, lines, and pipeline-laying activities. Future new cables would occasionally disturb the seafloor and cause short-term increases in turbidity and minor alterations in localized currents resulting in local short-term impacts. If the cable routes enter the water quality geographic analysis area, short-term disturbance in the form of increased suspended sediment and turbidity would be expected.
Port utilization: Expansion	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications, which, along with additional vessel traffic, could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future.	The general trend along the coastal region from Virginia to Maine is that port activity will increase modestly over the next 35 years. Port modifications and channel deepening activities are being undertaken to accommodate the increase in vessel traffic and deeper-draft vessels that transit the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future.
Presence of structures	The installation of onshore and offshore structures leads to alteration of local water currents. These disturbances would be local but, depending on the hydrologic conditions, have the potential to impact water quality through the formation of sediment plumes.	Impacts associated with the presence of structures includes temporary sediment disturbance during maintenance. This sediment suspension would lead to interim and localized impacts.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Discharges	Discharges impact water quality by introducing nutrients, chemicals, and sediments to the water. There are regulatory requirements related to prevention and control of discharges, the prevention and control of accidental spills, and the prevention and control of nonindigenous species.	Increased coastal development is causing increased nutrient pollution in communities. In addition, ocean disposal activity in the North and Mid-Atlantic is expected to gradually decrease or remain stable. Impacts of ocean disposal on water quality are minimized because USEPA has established dredge spoil criteria and regulate the disposal permits issued by USACE. The impact on water quality from sediment suspension during these future activities would be short-term and localized.
Land disturbance: Erosion and sedimentation	Ground disturbance activities may lead to un-vegetated 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.	Ground disturbance associated with construction and installation of onshore components could lead to un-vegetated or unstable soils. Precipitation events could mobilize these soils leading to erosion and sedimentation effects and turbidity. The impacts for future offshore wind through this IPF would be staggered in time and localized. The impacts would be short term and localized with an increased likelihood of impacts limited to onshore construction periods.
Land disturbance: Onshore construction	Onshore construction activities may lead to un-vegetated or otherwise unstable soils as well as soil contamination due to leaks or spills from construction equipment. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to increased turbidity and alteration of water quality.	The general trend along coastal regions is that port activity will increase modestly in the future. This increase in activity includes expansion needed to meet commercial, industrial, and recreational demand. Modifications to cargo handling equipment and conversion of some undeveloped land to meet port demand would be required to receive the increase in larger ships.

DOE = U.S. Department of Energy; hazmat = hazardous materials

Table F1-23 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Wetlands

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Land disturbance: Erosion and sedimentation	Ground disturbance activities may lead to unvegetated or otherwise unstable soils. Precipitation events could potentially mobilize the soils into nearby wetlands, leading to potential erosion and sedimentation effects and subsequent increased turbidity.	Ground disturbance associated with construction and installation of onshore components could lead to unvegetated or unstable soils. Precipitation events could mobilize these soils, leading to erosion and sedimentation effects and turbidity. Impacts from future offshore wind activities through this IPF would be staggered in time and localized. The impacts would be short term and localized, with an increased likelihood of impacts limited to onshore construction periods.
Land disturbance: Onshore construction	Onshore construction activities may lead to unvegetated or otherwise unstable soils as well as soil contamination due to leaks or spills from construction equipment. Precipitation events could potentially mobilize the soils into nearby wetlands, leading to increased turbidity and alteration of water quality.	The general trend along coastal regions is that port activity and land development will increase modestly in the future. This increase in activity includes expansion needed to meet commercial, industrial, and recreational demand. Modifications to cargo-handling equipment and conversion of some undeveloped land to meet port demand would be required to receive the increase in larger ships.

References Cited

Bartol, S. M. 1994. Auditory evoked potentials of the loggerhead sea turtle (*Caretta caretta*). Master's Thesis, College of William and Mary – Virginia Institute of Marine Science. 66 pp. Available: https://scholarworks.wm.edu/cgi/viewcontent.cgi?article=2805&context=etd.

Baulch, S., and C. Perry. 2014. Evaluating the Impacts of Marine Debris on Cetaceans. *Marine Pollution Bulletin* 80:210–221.

Bembenek-Bailey, S. A., J. N. Niemuth, P. D. McClellan-Green, M. H. Godfrey, C. A. Harms, H. Gracz, and M. K. Stoskopf. 2019. NMR Metabolomics Analysis of Skeletal Muscle, Heart, and Liver of Hatchling Loggerhead Sea Turtles (*Caretta caretta*) Experimentally Exposed to Crude Oil and/or Corexit. *Metabolites* 2019(9):21. doi:10.3390/metabo9020021.

Berreiros J. P., and V. S. Raykov. 2014. Lethal Lesions and Amputation Caused by Plastic Debris and Fishing Gear on the Loggerhead Turtle *Caretta caretta* (Linnaeus, 1758). Three case reports from Terceira Island, Azores (NE Atlantic). *Marine Pollution Bulletin* 86:518–522.

Briggs, K. T., M. E. Gershwin, and D. W. Anderson. 1997. Consequences of petrochemical ingestion and stress on the immune system of seabirds. *ICES Journal of Marine Science* 54:718–725.

Browne, M. A., A. J. Underwood, M. G. Chapman, R. Williams, R. C. Thompson, and J. A. van Franeker. 2015. Linking Effects of Anthropogenic Debris to Ecological Impacts. *Proceedings of the Royal Society B* 282:20142929. Available: http://dx.doi.org/10.1098/rspb.2014.2929.

Bugoni, L., L. Krause, and M. V. Petry. 2001. Marine Debris and Human Impacts on Sea Turtles in Southern Brazil. *Marine Pollution Bulletin* 42(12):1330–1334.

Bureau of Ocean Energy Management (BOEM). 2019. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf*. Available: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/IPFs-in-the-Offshore-Wind-Cumulative-Impacts-Scenario-on-the-N-OCS.pdf. Accessed: December 2020.

Burge. C. A., C. M. Eakin, C. S. Friedman, B. Froelich, P. K. Hershberger, E. E. Hofmann, L. E. Petes, K. C. Prager, E. Weil, B. L. Willis, S. E. Ford, and C. D. Harvell. 2014. Climate Change Influences on Marine Infectious Diseases: Implications for Management and Society. *Annual Review of Marine Science* 6:249–277.

Camacho, M., O. P. Luzardo, L. D. Boada, L. F. L. Jurado, M. Medina, M. Zumbado, and J. Orós. 2013. Potential Adverse Health Effects of Persistent Organic Pollutants on Sea Turtles: Evidence from a Cross-Sectional Study on Cape Verde Loggerhead Sea Turtles. *Science of the Total Environment*.

Causon, Paul D., and Andrew B. Gill. 2018. Linking Ecosystem Services with Epibenthic Biodiversity Change Following Installation of Offshore Wind Farms. *Environmental Science and Policy* 89:340–347.

Claisse, Jeremy T., Daniel J. Pondella II, Milton Love, Laurel A. Zahn, Chelsea M. Williams, Jonathan P. Williams, and Ann S. Bull. 2014. Oil Platforms off California are among the Most Productive Marine Fish Habitats Globally. *Proceedings of the National Academy of Sciences of the United States of America* 111(43):15462–15467. October 28, 2014. First published October 13, 2014. Available: https://doi.org/10.1073/pnas.1411477111. Accessed: March 2020.

Cook, A. S .C. P., and N. H. K. Burton. 2010. *A review of Potential Impacts of Marine Aggregate Extraction on Seabirds*. Marine Environment Protection Fund Project 09/P130. Available: https://www.bto.org/sites/default/files/shared_documents/publications/research-reports/2010/rr563.pdf. Accessed: February 25, 2020.

CSA Ocean Sciences, Inc. and Exponent. 2019. *Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019-049.

Degraer, S., R. Brabant, B. Rumes, and L. Vigin, eds. 2019. *Environmental Impacts of Offshore Wind Farms in the Belgian Part of the North Sea: Marking a Decade of Monitoring, Research and Innovation*. Brussels: Royal Belgian Institute of Natural Sciences, OD Natural Environment, Marine Ecology and Management, 134 pp.

Dolbeer, R. A., M. J. Begier, P. R. Miller, J. R. Weller, and A. L. Anderson. 2019. *Wildlife Strikes to civil aircraft in the United States, 1990 – 2018*. Federal Aviation Administration National Wildlife Strike Database Serial Report Number 25. 95 pp. + Appendices.

Efroymson, R. A., W. Hodge Rose, S. Nemth, and G. W. Suter II. 2000. *Ecological Risk Assessment Framework for Low Altitude Overflights by Fixed-Wing and Rotary-Wing Military Aircraft*. Research sponsored by Strategic Environmental Research and Development Program of the U.S. Department of Defense under Interagency Agreement 2107-N218-S1. Publication No. 5010, Environmental Sciences Division, ORNL.

Fabrizio, M. C., J. P. Manderson, and J. P. Pessutti. 2014. Home Range and Seasonal Movements of Black Sea Bass (*Centropristis striat*a) during their Inshore Residency at a Reef in the Mid-Atlantic Bight. *Fishery Bulletin* 112:82–97 (2014). doi: 10.7755/FB.112.1.5.

Gall, S. C., and R. C. Thompson. 2015. The Impact of Marine Debris on Marine Life. *Marine Pollution Bulletin* 92:170–179.

Gill, A. B., I. Gloyne-Phillips, K. J. Neal, and J. A. Kimber. 2005. *The Potential Effects of Electromagnetic Fields Generated by Sub-Sea Power Cables Associated with Offshore Wind Farm Developments on Electrically and Magnetically Sensitive Marine Organisms - A Review*. Collaborative Offshore Wind Research into the Environment (COWRIE), Ltd, UK.

Greene, J. K., M. G. Anderson, J. Odell, and N. Steinberg (editors). 2010. *The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems. Phase One*. The Nature Conservancy, Eastern U.S. Division, Boston, MA.

Gregory, M. R. 2009. Environmental Implications of Plastic Debris in Marine Settings – Entanglement, Ingestion, Smothering, Hangers-on, Hitch-Hiking, and Alien Invasion. *Philosophical Transactions of the Royal Society* B 364:2013–2025.

Guida, V., A. Drohan, H. Welch, J. McHenry, D. Johnson, V. Kentner, J. Brink, D. Timmons, and E. Estela-Gomez. 2017. *Habitat Mapping and Assessment of Northeast Wind Energy Areas*. U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-088.

Haney, J. C., P. G. R. Jodice, W. A. Montevecchi, and D. C. Evers. 2017. Challenges to oil spill assessments for seabirds in the deep ocean. *Archives of Environmental Contamination and Toxicology* 73:33–39.

Hann, Z. A., M. J. Hosler, and P. R. Mooseman, Jr. 2017. Roosting Habits of Two Lasiurus borealis (eastern red bat) in the Blue Ridge Mountains of Virginia. *Northeastern Naturalist* 24 (2):N15–N18.

Hare, J. A., W. E. Morrison, M. W. Nelson, M. M. Stachura, E. J. Teeters, and R. B. Griffis. 2016. A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast U.S. Continental Shelf. *PLOS ONE* 11(2):e0146756. DOI:10.1371/journal.pone.0146756.

Hawkins, A., and A. Popper. 2017. A Sound Approach to Assessing the Impact of Underwater Noise on Marine Fishes and Invertebrates. *ICES Journal of Marine Science* 74(3):635–651. DOI:10.1093/icesjms/fsw205.

Hazel, J., I. R. Lawler, H. Marsh, and S. Robson. 2007. Vessel Speed Increases Collision Risk for the Green Turtle *Chelonia mydas*. *Endangered Species Research* 3:105–113

Hoarau, L., L. Ainley, C. Jean, S. Ciccione. 2014. Ingestion and Defecation of Marine Debris by Loggerhead Sea Turtles, from By-catches in the South-West Indian Ocean. *Marine Pollution Bulletin* 84:90–96.

Hüppop, O., J. Dierschke, K. Exo, E. Frerich, and R. Hill. 2006. Bird Migration and Potential Collision Risk with Offshore Wind Turbines. *Ibis* 148:90–109.

Hutchison, Zoë, Peter Sigray, Haibo He, Andrew Gill, John King, and Carol Gibson. 2018. *Electromagnetic Field (EMF) Impacts on Elasmobranch (shark, rays, and skates) and American Lobster Movement and Migration from Direct Current Cables*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2018-003.

Jensen, J. H., L. Bejder, M. Wahlberg, N. Aguilar Solo, M. Johnson, and P. T. Madsen. 2009. Vessel Noise Effects on Delphinid Communication. *Marine Ecology Progress Series* 395:161–175.

Karp, M. A., J. O. Peterson, P. D. Lynch, R. B. Griffis, C. F. Adams, W. S. Arnold, L. A. Barnett, Y. deReynier, J. DiCosimo, and K. H. Fenske. 2019. Accounting for shifting distributions and changing productivity in the development of scientific advice for fishery management. *ICES Journal of Marine Science* 76 (5):1305–1315.

Kellar, N. M., T. R. Speakman, C. R. Smith, S. M. Lane, B. C. Balmer, M. L. Trego, K. N. Catelani, M. N. Robbins, C. D. Allen, R. S. Wells, E. S. Zolman, T. K. Rowles, and L. H. Schwacke. 2017. Low Reproductive Success Rates of Common Bottlenose Dolphins *Tursiops truncatus* in the Northern Gulf of Mexico Following the Deepwater Horizon Disaster (2010-2015). *Endangered Species Research* 33:1432–158.

Kirschvink, J. L. 1990. Geomagnetic Sensitivity in Cetaceans an Update with Live Strandings Recorded in the US. In *Sensory Abilities of Cetaceans*, edited by J. Thomas and R. Kastelein. Plenum Press, NY.

Kite-Powell, H. L., A. Knowlton, and M. Brown. 2007. *Modeling the Effect of Vessel Speed on Right Whale Ship Strike Risk*. Unpublished Report for NOAA/NMFS Project NA04NMF47202394. 8 pp.

Kraus, S. D., M. W. Brown, H. Caswell, C. W. Clark, M. Fujiwara, P. H. Hamilton, R. D. Kenney, A. R. Knowlton, S. Landry, C. A. Mayo, W. A. McLellan, M. J. Moore, D. P. Nowacek, D. A. Pabst, A. J. Read, and R. M. Rolland. 2005. North Atlantic Right Whales in Crisis. *Science* 309:561–562.

Kraus, S. D., S. Leiter, K. Stone, B. Wikgren, C. Mayo, P. Hughes, R. D. Kenney, C. W. Clark, A. N. Rice, B. Estabrook, and J. Tielens. 2016. *Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles. Final Report*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Sterling, Virginia. OCS Study BOEM 2016-054.

La Sorte, Frank, K. Horton, C. Nilsson, and A. Dokter. 2018. Projected changes in wind assistance under climate change for nocturnally migrating bird populations. Available: https://par.nsf.gov/servlets/purl/10092560. Accessed: February 10, 2021.

Laist, D. W., A. R. Knowlton, J. G. Mead, A. S. Collet, and M. Podesta. 2001. Collisions between Ships and Whales. *Marine Mammal Science* 17(1):35–75.

Law, K. L., S. Morét-Ferguson, N. A. Maximenko, G. Proskurowski, E. E. Peacock, J. Hafner, and C. M. Reddy. 2010. Plastic Accumulation in the North Atlantic Subtropical Gyre. *Science* 329:1185–1188.

Luschi, P., S. Benhamou, C. Girard, S. Ciccione, D. Roos, J. Sudre, and S. Benvenuti. 2007. Marine Turtles use Geomagnetic Cues during Open Sea Homing. *Current Biology* 17:126–133.

MacLeod, C. D. 2009. Global Climate Change, Range Changes, and Potential Implications for the Conservation of Marine Cetaceans: a Review and Synthesis. *Endangered Species Research* 7:125–136.

Maggini, I., L. V. Kennedy, A. Macmillan, K. H. Elliot, K. Dean, and C. G. Guglielmo. 2017. Light oiling of feathers increases flight energy expenditure in a migratory shorebird. *Journal of Experimental Biology* 220:2372–2379.

Mazet, J. A. K., I. A. Gardner, D. A. Jessup, and L. J. Lowenstine. 2001. Effects of Petroleum on Mink Applied as a Model for Reproductive Success in Sea Otters. *Journal of Wildlife Diseases* 37(4):686–692.

McConnell, B. J., M. A. Fedak, P. Lovell, and P. S. Hammond. 1999. Movements and Foraging Areas of Grey Seals in the North Sea. *Journal of Applied Ecology* 36:573–590.

McCreary, S., and B. Brooks. 2019. Atlantic Large Whale Take Reduction Team Meeting: Key Outcomes Meeting. April 23-26, 2019. Available: https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-mammal-protection/atlantic-large-whale-take-reduction-plan. Accessed: March 17, 2020.

Miller, J. H., and G. R. Potty. 2017. Overview of Underwater Acoustic and Seismic Measurements of the Construction and Operation of the Block Island Wind Farm. *Journal of the Acoustical Society of America* 141(5):3993–3993. doi:10.1121/1.4989144.

Minerals Management Service (MMS). 2007. *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf, Final Environmental Impact Statement*. October. OCS EIS/EA MMS 2007-046. Available: https://www.boem.gov/Guide-To-EIS/. Accessed: July 3, 2018.

Mitchelmore, C. L., C. A. Bishop, and T. K. Collier. 2017. Toxicological Estimation of Mortality of Oceanic Sea Turtles Oiled during the Deepwater Horizon Oil Spill. *Endangered Species Research* 33:39–50.

Mohr, F. C., B. Lasely, and S. Bursian. 2008. Chronic Oral Exposure to Bunker C Fuel Oil Causes Adrenal Insufficiency in Ranch Mink. *Archive of Environmental Contamination and Toxicology* 54:337–347.

Moore, M. J., and J. M. van der Hoop. 2012. The Painful Side of Trap and Fixed Net Fisheries: Chronic Entanglement of Large Whales. *Journal of Marine Biology* 2012:Article ID 230653, 4 pp.

Moser, J., and G. R. Shepherd. 2009. Seasonal Distribution and Movement of Black Sea Bass (*Centropristis striata*) in the Northwest Atlantic as Determined from a Mark-Recapture Experiment. *J. Northw. Atl. Fish. Sci.* 40:17–28. doi:10.2960/J.v40.m638.

National Marine Fisheries Service (NMFS). 2015. *Endangered Species Act (ESA) Section 7 Consultation Biological Opinion, Deepwater Wind: Block Island Wind Farm and Transmission System*. June 5.

National Marine Fisheries Service and U.S. Fish and Wildlife Service (NMFS and USFWS). 2007. *Loggerhead Sea Turtle (*Caretta caretta*) 5-Year Review: Summary and Evaluation*. National Marine Fisheries Service and U.S. Fish and Wildlife Service.

National Oceanic and Atmospheric Administration (NOAA). 2018. *Biological Opinion on the Bureau of Ocean Energy Management's Issuance of Five Oil and Gas Permits for Geological and Geophysical Seismic Surveys off the Atlantic Coast of the United States, and the National Marine Fisheries Services' Issuance of Associated Incidental Harassment Authorizations*. Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. 267 pp. + appendices.

National Oceanic and Atmospheric Administration (NOAA). 2020. *Section 7 Effect Analysis: Turbidity in the Greater Atlantic Region*. NOAA Greater Atlantic Regional Fisheries Office. Available: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effect-analysis-turbidity-greater-atlantic-region.

National Oceanic and Atmospheric Administration (NOAA). 2021. United States Coast Pilot 3. Chapter 4, New Jersey Coast. Available: https://nauticalcharts.noaa.gov/publications/coast-pilot/index.html. Accessed: September 27, 2021.

National Science Foundation (NSF) and U.S. Geological Survey (USGS). 2011. *Final Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for marine seismic research funded by the National Science Foundation or conducted by the U.S. Geological Survey*. 514 pp. Available: https://www.nsf.gov/geo/oce/envcomp/usgs-nsf-marine-seismic-research/nsf-usgs-final-eis-oeis_3june2011.pdf.

Nelms, S. E., E. M. Duncan, A. C. Broderick, T. S. Galloway, M. H. Godfrey, M. Hamann, P. K. Lindeque, and Bendan J. Godley. 2016. Plastic and Marine Turtles: a Review and Call for Research. *ICES Journal of Marine Science* 73(2):165–181.

Normandeau Associates, Inc., Exponent, Inc., T. Tricas, and A. Gill. 2011. *Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species*. Final Report. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09.

Nunny, L., and M. P. Simmonds. 2019. *Climate Change and Cetaceans: an update*. International Whaling Commission. May.

Pace, R. M., and G. K. Silber. 2005. Simple analysis of ship and large whale collisions: Does speed kill? Presentation at the Sixteenth Biennial Conference on the Biology of Marine Mammals, San Diego, CA, December 2005.

Paruk, J. D., E. M. Adams, H. Uher-Koch, K. A. Kovach, D. Long, IV, C. Perkins, N. Schoch, and D. C. Evers. 2016. Polycylic aromatic hydrocarbons in blood related to lower body mass in common loons. *Science of the Total Environment* 565:360–368.

Patenaude, N. J., W. J. Richardson, M. A. Smultea, W. R. Koski, and G. W. Miller. 2002. Aircraft Sound and Disturbance to Bowhead and Beluga Whales During Spring Migration in the Alaskan Beaufort Sea. *Marine Mammal Science* 18(2):309–335.

Popper, Arthur N., Anthony D. Hawkins, Richard R. Fay, David A. Mann, Soraya Bartol, Thomas J. Carlson, Sheryl Coombs, William T. Ellison, Roger L. Gentry, Michele B. Halvorsen, Svein Løkkeborg, Peter H. Rogers, Brandon L. Southall, David G. Zeddies, and William N. Tavolga. 2014. *Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report.* Prepared by ANSI - Accredited Standards Committee S3/SC1 and Registered with ANSI. ASAPress/Springer. ASA S3/SC1.4 TR-2014.

Record, N. R., J. A. Runge, D. E. Pendleton, W. M. Balch, K. T. A. Davies, A. J. Pershing, C. L. Johnson, K. Stamieszkin, Z. Feng, S. D. Kraus, R. D. Kenney, C. A. Hudak, C. A. Mayo, C. Chen, J. E. Salisbury, and C. R. S. Thompson. 2019. Rapid Climate-driven Circulation Changes Threaten Conservation of Endangered North Atlantic Right Whales. *Oceanography* 32(2):162–196.

Roman, L., B. D. Hardesty, M. A. Hindell, and C. Wilcox. 2019. A quantitative analysis linking seabird mortality and marine debris ingestion. *Scientific Reports* 9(1):1–7.

Samuel, Y., S. J. Morreale, C. W. Clark, C. H. Greene, and M. E. Richmond. 2005. Underwater, Low-frequency Noise in a Coastal Sea Turtle Habitat. *Journal of the Acoustical Society of America* 117(3):1465–1472.

Schaub, A., J. Ostwald, and B. M. Siemers. 2008. Foraging bats avoid noise. *Journal of Experimental Biology* 211:3147–3180.

Schuyler, Q. A., C. Wilcox, K. Townsend, B. D. Hardesty, and N. J. Marshall. 2014. Mistaken Identity? Visual Similarities of Marine Debris to Natural Prey Items of Sea Turtles. *BMC Ecology* 14(14). 7 pp.

Secor, D. H., F. Zhang, M. H. P. O'Brien, and M. Li. 2018. Ocean Destratification and Fish Evacuation Caused by a Mid-Atlantic Tropical Storm. *ICES Journal of Marine Science* 76(2):573–584. Available: https://doi.org/10.1093/icesjms/fsx241.

Shigenaka, G., S. Milton, P. Lutz, R. Hoff, R. Yender, and A. Mearns. 2010. *Oil and Sea Turtles: Biology, Planning, and Response*. NOAA Office of Restoration and Response Publication. 116 pp.

Sigourney, D. B. C. D. Orphanides, J. M. Hatch. 2019. *Estimates of Seabird Bycatch in Commercial Fisheries off the East Coast of the United States from 2015-2016*. NOAA Technical Memorandum NMFS-NE-252. Woods Hole, Massachusetts. 27 pp.

Simmons, A. M., K. N. Horn, M. Warnecke, and J. A. Simmons. 2016. Broadband Noise Exposure Does Not Affect Hearing Sensitivity in Big Brown Bats (Eptesicus fuscus). *Journal of Experimental Biology* 219:1031–1040.

Smith, C. R., T. K. Rowles, L. B. Hart, F. I. Townsend, R. S. Wells, E. S. Zolman, B. C. Balmer, B. Quigley, M. Ivnacic, W. McKercher, M. C. Tumlin, K. D. Mullin, J. D. Adams, Q. Wu, W. McFee, T. K. Collier, and L. H. Schwacke. 2017. Slow Recovery of Barataria Bay Dolphin Health Following the Deepwater Horizon Oil Spill (2013-2014) with Evidence of Persistent Lung Disease and Impaired Stress Response. *Endangered Species Research* 33:127–142.

Smith, James, Michael Lowry, Curtis Champion, and Iain Suthers. 2016. A Designed Artificial Reef is among the Most Productive Marine Fish Habitats: New Metrics to Address Production Versus Attraction. *Marine Biology* 163:188.

Snoek, R., R. de Swart, K. Didderen, W. Lengkeek, and M. Teunis. 2016. *Potential Effects of Electromagnetic Fields in the Dutch North Sea.* Final Report submitted to Rijkswaterstaat Water, Verkeer en Leefmgeving.

Southall, B., A. Bowles, W. Ellison, J. Finneran, R. Gentry, C. Greene Jr., D. Kastak, D. Ketten, J. Miller, P. Nachtigall, W. Richardson, J. Thomas, and P. Tyack. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. *Aquatic Mammals* 33(4):411–509.

Sullivan, L., T. Brosnan, T. K. Rowles, L. Schwacke, C. Simeone, and T. K. Collier. 2019. *Guidelines for Assessing Exposure and Impacts of Oil Spills on Marine Mammals*. NOAA Tech. Memo. NMFS-OPR-62, 82 pp.

Takeshita, R., L. Sullivan, C. Smith, T. Collier, A. Hall, T. Brosnan, T. Rowles, and L. Schwacke. 2017. The Deepwater Horizon Oil Spill Marine Mammal Injury Assessment. *Endangered Species Research* 33:96–106.

Taormina, B, J. Bald, A. Want, G. D. Thouzeau, M. Lejart, N. Desroy, and A. Carlier. 2018. A Review of Potential Impacts of Submarine Power Cables on the Marine Environment: Knowledge Gaps, Recommendations and Future Directions. *Renewable and Sustainable Energy Reviews* 96(2018):380–391.

Thomás, J., R. Guitart, R. Mateo, and J. A. Raga. 2002. Marine Debris Ingestion in Loggerhead Turtles, *Caretta caretta*, from the Western Mediterranean. *Marine Pollution Bulletin* 44:211–216.

Thomsen, Frank, A. B. Gill, Monika Kosecka, Mathias Andersson, Michel André, Seven Degraer, Thomas Folegot, Joachim Gabriel, Adrian Judd, Thomas Neumann, Alain Norro, Denise Risch, Peter Sigray, Daniel Wood, and Ben Wilson. 2015. *MaRVEN – Environmental Impacts of Noise, Vibrations and Electromagnetic Emissions from Marine Renewable Energy*. 10.2777/272281.

Todd, V. L. G., I. B. Todd, J. C. Gardiner, E. C. N. Morrin, N. A. MacPherson, N. A. DiMarzio, and F. Thomsen. 2015. A Review of Impacts on Marine Dredging on Marine Mammals. *ICES Journal of Marine Science* 72(2):328–340.

Tougaard, J., L. Hermannsen, and P. T. Madsen. 2020. How loud is the underwater noise from operating offshore wind turbines? *Journal of the Acoustical Society of America* 148(5):2885–2893.

Tournadre, J. 2014. Anthropogenic Pressure on the Open Ocean: The Growth of Ship Traffic Revealed by Altimeter Data Analysis. *Geophysical Research Letters* 41:7924–7932. doi:10.1002/2014GL061786.

U.S. Department of the Navy (Navy). 2017. C*riteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)*. Technical report. Available: https://nwtteis.com/portals/nwtteis/files/technical_reports/Criteria_and_Thresholds_for_U.S._Navy_Acoustic_and_Explosive_Effects_Analysis_June2017.pdf.

U.S. Department of the Navy (Navy). 2018. *Hawaii-Southern California Training and Testing EIS/OEIS*. Available: https://www.hstteis.com/Documents/2018-Hawaii-Southern-California-Training-and-Testing-Final-EIS-OEIS/Final-EIS-OEIS.

U.S. Energy Information Administration. 2020. New Jersey State Energy Profile. Last Updated: September 17, 2020. Available: https://www.eia.gov/state/print.php?sid=NJ.

Vanderlaan, A. S. M., and C. T. Taggart. 2007. Vessel Collisions with Whales: The Probability of Lethal Injury Based on Vessel Speed. *Marine Mammal Science* 23(1):144–156.

Vargo, S., P. Lutz, D. Odell, E. Van Vleet, and G. Bossart. 1986. *Effects of Oil on Marine Turtles. Final Report prepared for the Minerals Management Service (MMS).* 12 pp. Available: http://www.seaturtle.org/PDF/VargoS_1986a_MMSTechReport.pdf.

Vegter, A. C., M. Barletta, C. Beck, J. Borrero, H. Burton, M. L. Campbell, M. F. Costa, M. Eriksen, C. Eriksson, A. Estrades, K. V. K. Gilardi, B. D. Hardesty, J. A. Ivar do Sul, J. L. Lavers, B. Lazar, L. Lebreton, W. J. Nichols, C. A. Ribic, P. G. Ryan, Q. A. Schuyler, S. D. A. Smith, H. Takada, K. A. Townsend, C. C. C. Wabnitz, C. Wilcox, L. C. Young, and M. Hamann. 2014. Global Research Priorities to Mitigate Plastic Pollution Impacts on Marine Wildlife. *Endangered Species Research* 25:225–247.

Walker, M. M., C. E. Diebel, and J. L. Kirschvink. 2003. Detection and Use of the Earth's Magnetic Field by Aquatic Vertebrates. In *Sensory Processing in Aquatic Environments*, edited by S. P. Collin and N. J. Marshall, pp. 53–74. Spriner-Verlag, New York.

Wallace, B. P., B. A. Stacey, E. Cuevas, C. Holyake, P. H. Lara, A. C. J. Marcondes, J. D. Miller, H. Nijkamp, N. J. Pilcher, I. Robinson, N. Rutherford, and G. Shigenaka. 2010. Oil Spills and Sea Turtles: Documented Effects and Considerations for Response and Assessment Efforts. *Endangered Species Research* 41:17–37.

Weilgart, Lindy. 2018. The Impact of Ocean Noise Pollution on Fish and Invertebrates. Report for OceanCare. Switzerland. Available: https://www.oceancare.org/wp-content/uploads/2017/10/OceanNoise_FishInvertebrates_May2018.pdf. Accessed: April 21, 2020.

Werner, S., A. Budziak, J. van Franeker, F. Galgani, G. Hanke, T. Maes, M. Matiddi, P. Nilsson, L. Oosterbaan, E. Priestland, R. Thompson, J. Veiga, and T. Vlachogianni. 2016. *Harm Caused by Marine Litter*. *MSFD GES TG Marine Litter - Thematic Report*. JRC Technical report; EUR 28317 EN; doi:10.2788/690366.

Whitaker, J. O., Jr. 1998. Life History and Roost Switching in Six Summer Colonies of Eastern Pipistrelles in Buildings. *Journal of Mammalogy* 79(2):651–659.

ATTACHMENT 2
MAXIMUM-CASE SCENARIO ESTIMATES FOR OFFSHORE WIND PROJECTS

This page intentionally left blank.

LIST OF TABLES

This page intentionally left blank.

The following tables provide maximum-case scenario estimates of potential offshore wind project impacts assuming maximum buildout within the Ocean Wind 1 EIS geographic analysis areas. BOEM developed these estimates based on offshore wind demand, as discussed in its 2019 study *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf* (BOEM 2019). Estimates disclosed in this EIS's Chapter 3, No Action analyses were developed by summing acreage or number calculations across all lease areas noted as occurring within, or overlapping, a given geographic analysis area. This likely overestimates some impacts in cases where lease areas only partially overlap analysis areas. However, this approach was used to provide the most conservative estimate of future offshore wind development.

This page intentionally left blank

Table F2-1 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 1, Turbine and Cable Design Parameters)

Region	Lease, Project, Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps geographic analysis area)[3]						Estimated Construction Schedule[4]	Turbine Number[5]	Generating Capacity (MW)	Offshore Export Cable Length (statute miles)[6]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Inter-Array Cable Length (statute miles)[7]	Hub Height (feet)[8]	Rotor Diameter (feet)[8]	Height of Turbine (feet)[8]
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism									
NE	*Aqua ventus (state waters)*	*State Project*					*X*		*2023*	*2*	*11*					*450*	*520*
	Total State Waters Projects									**2**	11					450	520
Existing and Ongoing Projects																	
MA/RI	*Block Island (state waters)*	*Built*					*X*		*Built*	*5*	*30*	*28*	*5*	*2*	*328*	*541*	*659*
MA/RI	*Vineyard Wind 1 part of OCS-A 0501*	*COP Approved (ROD issued 2021), PPA, SAP*					*X*		*2023*	*62*	*800*	*98*	*6.5*	*171*	*451*	*721*	*812*
MA/RI	*South Fork, OCS-A 0517*	*COP Approved (ROD issued 2021), PPA, SAP*					*X*		*2023*	*12*	*130*	*139*	*6.5*	*24*	*472*	*735*	*840*
VA/NC	*CVOW, OCS-A 0497*	*RAP, FDR/FIR*					*X*		*Built*	*2*	*12*	*27*	*3*	*9*	*364*	*506*	*620*
	Total Existing and Ongoing Projects									81	972	292		206			
Planned Projects																	
Massachusetts/Rhode Island Region																	
MA/RI	Sunrise, OCS-A 0487	COP, PPA, SAP					X		2024	94	1,034	105	6.5	180	459	656	787
MA/RI	Revolution, part of OCS-A 0486	COP, PPA, SAP					X		2023–2024	100	880	100	131	155	512	722	873
MA/RI	New England Wind, OCS-A 0534 and portion of OCS-A 0501 (Phase 1 [i.e., Park City Wind])	COP, PPA, SAP					X		2024–2026	62	804	125	10	139	630	837	1,047
MA/RI	New England Wind, OCS-A 0534 and portion of OCS-A 0501 (Phase 2 [i.e., Commonwealth Wind])	COP, PPA, SAP							2024–2026	79	1,500	225	10	201	702	935	1,171
MA/RI	Mayflower OCS-A 0521	COP, PPA, SAP					X		2024–2028	147	804	744	6.5	497	605	919	1,066
MA/RI	Beacon Wind 1, part of OCS-A 0520	PPA, SAP							2024–2025	78	1,230	233	6.5	186	591	984	853
MA/RI	Beacon Wind 2, part of OCS-A 0520	SAP					X		2025–2026	77	1,200	233	6.5	186	591	984	853
MA/RI	Bay State Wind, part of OCS-A 0500	SAP, COP (unpublished); the MW is included in the description below in the 5,148 MW.					X		By 2030, spread over 2025–2030	110	4,200	120	6.5	172	492	722	853
MA/RI	Liberty Wind, part of OCS-A 0522	This group is exposed to 5,800 MW of demand—for MA (4,000 MW remaining), CT (900 MW remaining), and RI (900 MW expected). Collectively the remaining technical capacity is 5,148 MW.					X			227		480	6.5	398	492	722	853
MA/RI	OCS-A 0500 remainder						X					120			492	722	853
MA/RI	OCS-A 0487 remainder						X					120			492	722	853
MA/RI	Remaining MA/RI Lease Area Total[2]	73%								337	4,400	480	6.5	540	492	722	853

Region	Lease, Project, Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps geographic analysis area)[3]						Estimated Construction Schedule[4]	Turbine Number[5]	Generating Capacity (MW)	Offshore Export Cable Length (statute miles)[6]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Inter-Array Cable Length (statute miles)[7]	Hub Height (feet)[8]	Rotor Diameter (feet)[8]	Height of Turbine (feet)[8]
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Inverterbrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism									
	Total MA/RI Leases[2]									**974**	**13,248**	**2,852**		**2,654**			
New York/New Jersey Region																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA, SAP	X	X	X	X	X	X	2023–2025	98	1,100	194[11]	98	190	512	788	906
NY/NJ	Atlantic Shores South (OCS-A 0499)	COP, PPA, SAP	X	X	X		X	X	2024–2027	200	1,510	441	58	584	576	919	1,049
NY/NJ	Ocean Wind 2, OCS-A 0532	PPA	X	X	X	X	X	X	By 2030, spread over 2026–2030	111	1,554	120	5	173	512	788	906
NY/NJ	Empire Wind 1, part of OCS-A 0512	COP, PPA, SAP					X		2023–2026	57	816	46	5	133	525	853	951
NY/NJ	Empire Wind 2, part of OCS-A 0512	COP, PPA, SAP					X		2023–2027	90	1,260	30	5	166	525	853	951
NY/NJ	Atlantic Shores North, OCS-A 0549	SAP	X		X		X	X	By 2030, spread over 2026–2030	157	2,198	99	58	249	576	919	1,049
NY/NJ	OW Ocean Winds East LLC, OCS-A 0537[12]						X		By 2030, spread over 2026–2030	100	1,200	120	5	157	492	722	853
NY/NJ	Attentive Energy LLC, OCS-A 0538[12]						X		By 2030, spread over 2026–2030	102	1,224	120	5	130	492	722	853
NY/NJ	Bight Wind Holdings LLC, OCS-A 0539[12]						X		By 2030, spread over 2026–2030	145	1,740	120	5	205	492	722	853
NY/NJ	Atlantic Shores Offshore Wind Bight LLC, OCS-A 0541[12]						X	X	By 2030, spread over 2026–2030	93	1,116	120	5	133	492	722	853
NY/NJ	Invenergy Wind Offshore LLC, OCS-A 0542[12]						X	X	By 2030, spread over 2026–2030	97	1,164	120	5	147	492	722	853
NY/NJ	Vineyard Mid-Atlantic LLC, OCS-A 0544[12]						X		By 2030, spread over 2026–2030	102	1,224	120	5	95	492	722	853
	Total NY/NJ Leases									**1,352**	**16,106**	**1,650**		**2,362**			
Maryland/Delaware Region																	
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA, SAP					X	X	2024	16	120	40	10	30	492	722	853
DE/MD	US Wind, part of OCS-A 0490	COP, PPA, SAP					X		2024–2027	125	1,500	190	6.5	151	440	722	801
DE/MD	GSOE I, OCS-A 0482	Collectively the technical capacity of this is group is 1,080 MW (90 turbines). The remaining capacity may be utilized by demand from NJ or MD.					X	X	By 2030, spread over 2023–2030	90	1,080	-	-	-	492	722	853
DE/MD	OCS-A 0519 remainder						X	X				-	-	-			
DE/MD	Remaining DE/MD Lease Area Total									90	1,080	240	5	139			
	Total DE/MD Leases									**231**	**2,700**	**470**		**320**			
Virginia/North Carolina Region																	
VA/NC	CVOW-C, OCS-A 0483	COP, SAP					X		2025–2027	205	3,000	417	5	301	489	761	869

Region	Lease, Project, Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps geographic analysis area)[3]						Estimated Construction Schedule[4]	Turbine Number[5]	Generating Capacity (MW)	Offshore Export Cable Length (statute miles)[6]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Inter-Array Cable Length (statute miles)[7]	Hub Height (feet)[8]	Rotor Diameter (feet)[8]	Height of Turbine (feet)[8]
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism									
VA/NC	Kitty Hawk North, OCS-A 0508	COP, SAP					X		2024–2030	69	1,242	200	29.5	149	574	935	1,042
VA/NC	Kitty Hawk South, OCS-A 0508	COP					X		2024–2027	121	1,242	353	29.5	149	472	728	837
	Total VA/NC Leases									**395**	**5,484**	**970**		**599**			
	OCS Total (Planned)[9,10]									**2,952**	**38,038**	**5,942**		**5,395**			

Projects in *italics* are projects that have already been constructed or that are ongoing projects. Completed and ongoing projects are not included in project totals.

[1] The spacing/layout for projects are as follows: NE State water projects include a single strand of WTGs and no OSS. For projects in the RI, MA, NY, NJ, DE, MD lease areas, a 1×1–nm grid spacing is assumed. For the CVOW Project, the spacing is 0.7 nm; and the Dominion commercial lease area off the coast of Virginia would utilize 0.5 nm average spacing, which is less than the 1×1–nm spacing due to the need to attain the state's goals.

[2] Because development could occur anywhere within the RI and MA lease areas and assumes a continuous 1x1–nm grid, the actual development for these projects is expected to be approximately 73% of the collective technical capacity. Under the scenario described in this appendix, the total area in the RI and MA lease areas is greater than the area needed to meet state demand. Therefore, if a project is not constructed, BOEM assumes that another future project would be constructed to fulfill the unmet demand.

[3] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas.

[4] The estimated construction schedule is based on information known at the time of this analysis and could be different when an applicant submits a COP.

[5] The number of turbines for those lease areas without an announced number of turbines has been calculated based on lease size, a 1×1-nm grid spacing, and/or the generating capacity.

[6] BOEM assumes that each offshore wind development would have its own cable (both onshore and offshore) and that future projects would not utilize a regional transmission line. The length of offshore export cable for those lease areas without a known project size is assumed to include two offshore cables totaling 120 miles (193 kilometers). The offshore export cable would be buried a minimum of 4 feet (1.8 meters) but not more than 10 feet (3.1 meters).

[7] If information for a future project could not be obtained from a COP, the length of inter-array cabling is assumed to be the average amount per foundation based on the COPs submitted to date, which is 1.48 miles (2.4 kilometers). In addition, for those lease areas that require more than one OSS, it is assumed that an additional 6.2 miles (9.9 kilometers) of inter-link cable would be required to link the two OSSs. Inter-array cable is assumed to be buried between 4 and 6 feet.

[8] The hub height, rotor diameter, and turbine height for lease areas is based on worst-case scenario for the resource area. Presentation of heights vary by COP and may be presented relative to MLLW, mean sea level, or height above highest astronomical tide.

[9] BOEM recognizes that the estimates presented within this analysis are likely high, conservative estimates; however, BOEM believes that this analysis is appropriately capturing the potential cumulative impacts and errs on the side of maximum impacts. Totals by lease area and by OCS may not fully sum due to rounding errors.

[10] New York's demand is not double-counted, this total comes from looking at New York's state demand, not adding up the potential of the areas because that would double-count New York.

CT = Connecticut; CVOW = Coastal Virginia Offshore Wind; DE = Delaware; FDR = Facility Design Report; FIR = Fabrication and Installation Report; MA = Massachusetts; MD = Maryland; NE = New England; NJ = New Jersey; NY = New York; PPA = Power Purchase Agreement; RAP = research activities plan; RI = Rhode Island

[11] Includes cable length from offshore export cables and substation interconnector cables.

[12] Parameters for the New York Bight leases represent a build-out based on current technology and expectations for each lease prior to receiving plans, and may differ from what is analyzed in total in the upcoming New York Bight Draft Programmatic EIS.

Table F2-2 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 2, Seabed/Anchoring Disturbance and Scour Protection)

Region	Lease/Project/Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps analysis area)[3]						Estimated Foundation Number[2]	Foundation Footprint[3] (acres)	WTG Seabed Disturbance (Foundation + Scour Protection) (acres)[4]	Offshore Export Cable Seabed Disturbance (acres)[5]	Offshore Export Cable Operating Seabed Footprint (acres)[6]	Offshore Export Cable Hard Protection (acres)[7]	Anchoring Disturbance (acres)[8]	Inter-Array Construction Footprint/Seabed Disturbance (acres)[9]	Inter-Array Operating Footprint/ Seabed Disturbance (acres)[10]	Inter-Array Cable Hard Protection (acres)[11]
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism										
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA, SAP	X	X	X	X	X	X	101	4	84	1,935[12]	+78	94	19	1,850[13]	144	77
NY/NJ	Atlantic Shores South, OCS-A 0499	COP, PPA, SAP	X	X	X		X	X	211	9	135	1,606	137	12	262	2,035	317	307
NY/NJ	Ocean Wind 2, OCS-A 0532, and remainder	PPA	X	X	X	X	X	X	113	5	96	727	48	43	12	271	162	0
NY/NJ	Empire Wind 1, part of OCS-A 0512	COP, PPA, SAP					X		58	1	52	368	37	33	9	534	82	26
NY/NJ	Empire Wind 2, part of OCS-A 0512	COP, PPA, SAP					X		91	2	82	360	24	32	9	633	129	32
NY/NJ	Atlantic Shores North, OCS-A 0549	SAP, COP (unpublished)	X		X		X	X	160	7	135	600	40	35	10	382	239	0
NY/NJ	OW Ocean Winds East LLC, OCS-A 0537[14]						X		102	4	87	727	48	43	12	952	146	0
NY/NJ	Attentive Energy LLC, OCS-A 0538[14]						X		104	4	88	727	48	43	12	970	149	0
NY/NJ	Bight Wind Holdings LLC, OCS-A 0539[14]						X		148	6	126	727	48	43	12	1,403	212	0
NY/NJ	Atlantic Shores Offshore Wind Bight LLC[14]						X	X	95	4	81	727	48	43	12	890	136	0
NY/NJ	Invenergy Wind Offshore LLC, OCS-A 0542[14]						X	X	99	4	84	727	48	43	12	925	142	0
NY/NJ	Vineyard Mid-Atlantic LLC, OCS-A 0544[14]						X		104	4	88	727	48	43	12	970	149	0
	Total NY/NJ Leases								**1,386**	**54**	**1,138**	**9,959**	**652**	**506**	**393**	**11,815**	**2,006**	**442**
	MA, RI, DE, MD, NC, VA Leases								**1,630**	**206**	**3,466**	**140,321**	**1,814**	**1,017**	**2,009**	**22,484**	**2,529**	**697**
	OCS Total								**3,016**	**260**	**4,604**	**150,280**	**2,465**	**1,523**	**2,402**	**34,299**	**4,534**	**1,139**

[1] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas.
[2] The estimated number of foundations is the total number of turbines plus OSS. If information for a future project could not be obtained from a publicly available COP, it is assumed that for every 50 turbines there would be one OSS installed.
[3] If information for a future project could not be obtained from a publicly available COP, the foundation footprint is assumed to be 0.04 acre, which is based on the largest monopile reported (12 MW) for all lease areas.
[4] The seabed disturbance with the addition of scour protection was calculated based on scour protection expected in submitted COPs. If information for a future project could not be obtained from a publicly available COP, it is assumed that for all lease areas that a 12-MW foundation with addition of scour protection would be 0.85 acre per foundation.
[5] Offshore export cable seabed bottom disturbance is assumed to be due to installation of the export cable, the use of jack-up vessels, and the need to perform dredging. If information for a future project could not be obtained from a publicly available COP, export cable seabed disturbance assumed to be 6.06 acres per mile.
[6] If information for a future project could not be obtained from a publicly available COP, the offshore export cable operating seabed footprint assumed to be 0.4 acre per mile.
[7] If information for a future project could not be obtained from a publicly available COP, the offshore export cable hard protection is assumed to be similar to Vineyard Wind 1 Project, which is 0.357 acre per mile of offshore export cable.
[8] If information for a future project could not be obtained from a publicly available COP, anchoring disturbance for other lease areas is assumed to be a rate equal to 0.10 acre per mile of offshore export cable.
[9] If information for a future project could not be obtained from a publicly available COP, inter-array construction seabed disturbance is assumed to be 6.06 acres per mile.
[10] If information for a future project could not be obtained from a publicly available COP, the inter-array operating footprint is assumed to be a rate equal to the average amount per foundation of 1.43 acres per foundation.
[11] If information for a future project could not be obtained from a publicly available COP, the inter-array cable hard protection is assumed to be zero.
[12] Includes disturbance from offshore export cables and substation interconnector cables. Assumes an 82-foot-wide corridor would be disturbed per cable, based on the Ocean Wind 1 COP.
[13] Assumes an 82-foot-wide corridor would be disturbed, based on the Ocean Wind 1 COP.
[14] Parameters for the New York Bight leases represent a build-out based on current technology and expectations for each lease prior to receiving plans, and may differ from what is analyzed in total in the upcoming New York Bight Draft Programmatic EIS.
nd = not defined; NJ = New Jersey; NY = New York; PPA = Power Purchase Agreement

Table F2-3 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 3, Gallons of Coolant, Oils, Lubricants, and Diesel Fuel)

Region	Lease/Project/Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps analysis area)[1]						Total Coolant Fluids in WTGs (gallons)	Total Coolant Fluids in OSS or ESP (gallons)	Total Oils and Lubricants in WTGs (gallons)	Total Oils and Lubricants in OSS or ESP (gallons)	Total Diesel Fuel in WTGs (gallons)	Total Diesel Fuel in OSS or ESP (gallons)
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism						
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA, SAP	X	X	X	X	X	X	39,690	-	187,964	238,707	77,714	158,502
NY/NJ	Atlantic Shores South, OCS-A 0499	COP, PPA, SAP	X	X	X		X	X	820,000	10,300	606,200	370,050	80,000	75,000
NY/NJ	Ocean Wind 2, part of OCS-A 0532[2], and remainder	PPA	X	X	X	X	X	X	44,953	-	212,888	160,732	88,019	105,673
NY/NJ	Empire Wind 1, part of OCS-A 0512	COP, PPA, SAP					X		49,704		285,684	158,503	-	7,925
NY/NJ	Empire Wind 2, part of OCS-A 0512	COP, PPA, SAP					X		78,480		451,080	158,503	-	7,925
NY/NJ	Atlantic Shores North, OCS-A 0549[3]	SAP, COP (unpublished)	X		X		X	X	643,700	8,240	475,867	296,040	62,800	60,000
NY/NJ	OW Ocean Winds East LLC, OCS-A 0537[2,4]						X		40,500	-	191,800	243,579	79,300	161,737
NY/NJ	Attentive Energy LLC, OCS-A 0538[2,4]						X		41,310	-	195,636	248,450	80,886	164,971
NY/NJ	Bight Wind Holdings LLC, OCS-A 0539[2,4]						X		58,725	-	278,110	353,189	114,985	234,518
NY/NJ	Atlantic Shores Offshore Wind Bight LLC ,OCS-A 0541[2,4]						X	X	37,665	-	178,374	226,528	73,749	150,415
NY/NJ	Invenergy Wind Offshore LLC, OCS-A 0542[2,4]						X	X	39,285		186,046	236,271	76,921	156,885
NY/NJ	Vineyard Mid-Atlantic LLC, OCS-A 0544[2,4]						X		41,310	-	195,636	248,450	80,886	164,971
	Total NY/NJ Leases								**1,935,322**	**18,540**	**3,445,285**	**2,939,003**	**815,260**	**1,448,523**
	MA, RI, DE, MD, NC, VA Leases								**2,156,654**	**21,063**	**5,430,591**	**5,688,507**	**1,397,165**	**1,048,288**
	OCS Total								**4,091,976**	**39,603**	**8,875,876**	**8,627,510**	**2,212,425**	**2,496,811**

[1] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas.
[2] Quantities of coolant, oil and lubricants, and diesel fuel are scaled to Ocean Wind 1 based on number turbines and OSS.
[3] Quantities of coolant, oil and lubricants, and diesel fuel are scaled to Atlantic Shores South based on number turbines and OSS.
[4] Parameters for the New York Bight leases represent a build-out based on current technology and expectations for each lease prior to receiving plans, and may differ from what is analyzed in total in the upcoming New York Bight Draft Programmatic EIS.
ESP = electrical service platform; NJ = New Jersey; NY = New York; PPA = Power Purchase Agreement

Table F2-4 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 4, OCS Construction and Operation Emissions)

Region	Lease/Project/Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps analysis area)[1]						2023	2024	2025	2026	2027	2028	2029	2030	Beyond 2030
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism									
Nitrogen oxides (tons)																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	5	11,168	159	159	159	159	159	159	159
NY/NY	Atlantic Shores South, OCS-A 0499	COP, PPA, SAP	X	X	X		X	X	--	2,089	2,089	2,089	2,089	519	519	519	519
NY/NJ	Ocean Wind 2, OCS-A 0532, and remainder	PPA	X	X	X	X	X	X	--	--	--	2,531	2,531	2,531	2,531	2,531	180
NY/NJ	Atlantic Shores North, OCS-A 0549	SAP, COP (unpublished)	X		X		X	X	--	--	--	1,312	1,312	1,312	1,312	1,312	407
Total Air Quality Analysis Area									5	13,257	2,248	6,091	6,091	4,521	4,521	4,521	1,265
Volatile organic compounds (tons)																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	<1	293	4	4	4	4	4	4	4
NY/NY	Atlantic Shores South, OCS-A 0499	COP, PPA, SAP	X	X	X		X	X	--	40	40	40	40	9	9	9	9
NY/NJ	Ocean Wind 2, OCS-A 0532, and remainder	PPA	X	X	X	X	X	X	--	--	--	66	66	66	66	66	4
NY/NJ	Atlantic Shores North, OCS-A 0549	SAP, COP (unpublished)	X		X		X	X	--	--	--	25	25	25	25	25	7
Total Air Quality Analysis Area									<1	333	44	136	136	104	104	104	24
Carbon monoxide (tons)																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	3	2,154	40	40	40	40	40	40	40
NY/NY	Atlantic Shores South, OCS-A 0499	COP, PPA, SAP	X	X	X		X	X	--	503	503	503	503	121	121	121	121
NY/NJ	Ocean Wind 2, OCS-A 0532, and remainder	PPA	X	X	X	X	X	X	--	--	--	489	489	489	489	489	45
NY/NJ	Atlantic Shores North, OCS-A 0549	SAP, COP (unpublished)	X		X		X	X	--	--	--	316	316	316	316	316	95
Total Air Quality Analysis Area									3	2,657	543	1,348	1,348	966	966	966	302
Particulate matter, 10 microns or less (tons)																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	<1	365	6	6	6	6	6	6	6
NY/NY	Atlantic Shores South, OCS-A 0499	COP, PPA, SAP	X	X	X		X	X	--	70	70	70	70	17	17	17	17
NY/NJ	Ocean Wind 2, OCS-A 0532, and remainder	PPA	X	X	X	X	X	X	--	--	--	83	83	83	83	83	6

Region	Lease/Project/Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps analysis area)[1]						2023	2024	2025	2026	2027	2028	2029	2030	Beyond 2030
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism									
NY/NJ	Atlantic Shores North, OCS-A 0549	SAP, COP (unpublished)	X		X		X	X	--	--	--	44	44	44	44	44	13
	Total Air Quality Analysis Area								<1	435	76	202	202	149	149	149	42
Particulate matter, 2.5 microns or less (tons)																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	<1	349	5	5	5	5	5	5	5
NY/NY	Atlantic Shores South, OCS-A 0499	COP, PPA, SAP	X	X	X		X	X	--	68	68	68	68	16	16	16	16
NY/NJ	Ocean Wind 2, OCS-A 0532, and remainder	PPA	X	X	X	X	X	X	--	--	--	79	79	79	79	79	6
NY/NJ	Atlantic Shores North, OCS-A 0549	SAP, COP (unpublished)	X		X		X	X	--	--	--	43	43	43	43	43	13
	Total Air Quality Analysis Area								<1	417	73	195	195	143	143	143	40
Sulfur dioxide (tons)																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	<1	115	1	1	1	1	1	1	1
NY/NY	Atlantic Shores South, OCS-A 0499	COP, PPA, SAP	X	X	X		X	X	--	7	7	7	7	1	1	1	1
NY/NJ	Ocean Wind 2, OCS-A 0532, and remainder	PPA	X	X	X	X	X	X	--	--	--	26	26	26	26	26	1
NY/NJ	Atlantic Shores North, OCS-A 0549	SAP, COP (unpublished)	X		X		X	X	--	--	--	4	4	4	4	4	1
	Total Air Quality Analysis Area								<1	122	8	39	39	33	33	33	4
Carbon dioxide (tons)																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	3,539	652,774	11,752	11,752	11,752	11,752	11,752	11,752	11,752
NY/NY	Atlantic Shores South, OCS-A 0499	COP, PPA, SAP	X	X	X		X	X	--	139,357	139,357	139,357	139,357	33,566	33,566	33,566	33,566
NY/NJ	Ocean Wind 2, OCS-A 0532, and remainder	PPA	X	X	X	X	X	X	--	--	--	148,675	148,675	148,675	148,675	148,675	13,311
NY/NJ	Atlantic Shores North, OCS-A 0549	SAP, COP (unpublished)	X		X		X	X	--	--	--	87,516	87,516	87,516	87,516	87,516	26,349
	Total Air Quality Analysis Area								3,539	792,131	151,109	387,301	387,301	281,510	281,510	281,510	84,978

[1] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas.
Note: Emissions for Ocean Wind 2 and Atlantic Shores North are scaled from Ocean Wind 1 and Atlantic Shores South, respectively, based on number of turbines and estimated construction schedule.
NJ = New Jersey; NY = New York; PPA = Power Purchase Agreement

This page intentionally left blank.

References Cited

Bureau of Ocean Energy Management (BOEM). 2019. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf*. Available: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/IPFs-in-the-Offshore-Wind-Cumulative-Impacts-Scenario-on-the-N-OCS.pdf. Accessed: December 2020.

This page intentionally left blank.

Appendix G. Assessment of Resources with Minor (or Lower) Adverse Impacts in the Draft Environmental Impact Statement

This page intentionally left blank.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

G.1. Introduction

To focus on the impacts of most concern in the main body of the EIS, BOEM included the analysis of resources with no greater than **minor** adverse impacts in Appendix G in the Draft EIS. This included air quality; bats; birds; coastal habitat and fauna; demographics, employment, and economics; land use and coastal infrastructure, sea turtles; and water quality. After further review, and with consideration of public comments on the Draft EIS, impact levels for air quality, coastal habitat and fauna, and water quality were increased to up to **moderate** in the Final EIS. For easier comparison, the Draft EIS structure is retained in the Final EIS and the resource sections for air quality, coastal habitat and fauna, and water quality are still included in Appendix G of the Final EIS even though the impacts for these resources have been reassessed as up to **moderate**.

This page intentionally left blank.

3.4. 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, includes the airshed within 25 miles (40 kilometers) of the Wind Farm Area (corresponding to the OCS permit area) and the airshed within 15.5 miles (25 kilometers) of onshore construction areas and ports that may be used for the Project. The geographic analysis area encompasses the geographic region subject to USEPA review as part of an OCS permit for the Project under the CAA. The geographic analysis area also considers potential air quality impacts associated with the onshore construction areas and the mustering port(s) outside of the OCS permit area. The dispersion characteristics of emissions from marine vessels, equipment, and similar emission sources that would be used during proposed construction and O&M activities would likely have maximum potential air quality impacts occurring within a few miles of the source, as would decommissioning activities if emissions are similar to those during construction. BOEM selected the 15.5-mile (25-kilometer) distance to ensure that the locations of maximum potential air quality impact would be considered.

3.4.1 Description of the Affected Environment for Air Quality

The overall geographic analysis area for air quality covers much of southern New Jersey and the adjacent portions of Delaware Bay and the Atlantic Ocean. This includes the air above the Wind Farm Area and adjacent OCS area, the offshore and onshore export cable routes, the onshore substations, the construction staging areas, the onshore construction and proposed Project-related sites, and the ports used to support proposed Project activities. COP Volume II, Section 2.1.3 (Ocean Wind 2023), provides further description of the air quality geographic analysis area. Appendix I provides information on climate and meteorological conditions in the Project region.

Air quality within a region is measured in comparison to the National Ambient Air Quality Standards (NAAQS), which are standards established by USEPA) pursuant to the CAA (42 USC 7409) for several common pollutants, known as criteria pollutants, to protect human health and welfare. The criteria pollutants are CO, lead, nitrogen dioxide (NO_2), ozone, PM_{10}, $PM_{2.5}$, and SO_2. New Jersey has established ambient air quality standards (AAQS) that are similar to the NAAQS. Table 2.1.3-1 in COP Volume II (Ocean Wind 2023) 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 EIS. Ozone is not emitted directly but is formed in the atmosphere from precursor chemicals, primarily NO_X and VOCs, in the presence of sunlight. Potential impacts of a project on ozone levels are evaluated in terms of NO_X and VOC emissions.

USEPA designates all areas of the country as attainment, nonattainment, or unclassified for each criteria pollutant. An attainment area is an area where all criteria pollutant concentrations are within all NAAQS. A nonattainment area does not meet the NAAQS for one or more pollutants. Unclassified areas are those where attainment status cannot be determined based on available information and are regulated as attainment areas. An area can be in attainment for some pollutants and nonattainment for others. If an area was nonattainment at any point in the last 20 years but is currently attainment or is unclassified, then the area is designated a maintenance area. Nonattainment and maintenance areas are required to prepare a State Implementation Plan, which 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 81 and in the USEPA Green Book, which the agency revises from time to time (USEPA 2021). Attainment status is determined through evaluation of air quality data from a network of monitors.

The nearest onshore designated areas to the proposed Wind Farm Area are Ocean, Atlantic, and Cape May Counties in New Jersey. Parts of these counties are in a designated nonattainment area for ozone (Philadelphia-Wilmington-Atlantic City Pennsylvania-New Jersey-Maryland-Delaware), which also includes Cumberland, Gloucester, and Salem Counties. Also, Gloucester County is in the maintenance area for the 2006 $PM_{2.5}$ NAAQS. The nonattainment areas include facilities that the Project could use in Atlantic City, BL England, Oyster Creek, Hope Creek, Port Elizabeth, and Repauno/Paulsboro. More distant ports that may be used include Norfolk, Virginia, which is in an ozone maintenance area, and Charleston, South Carolina, which is in an area designated in attainment for all pollutants. Figure 3.4-2 displays the nonattainment and maintenance areas[1] that intersect the geographic analysis area.

The CAA prohibits federal agencies from approving any activity that does not conform to a State Implementation Plan. 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 State Implementation Plan means conformity to a State Implementation Plan's purpose of reducing the severity and number of violations of the NAAQS to achieve attainment of such standards. The activities for which BOEM has authority are outside of any nonattainment or maintenance area and therefore not subject to the requirement to show conformity.

The CAA defines Class I areas as certain national parks and wilderness areas where very little degradation of air quality is allowed. Class I areas consist of national parks larger than 6,000 acres and wilderness areas larger than 5,000 acres that were in existence before August 1977. In order to begin an analysis of whether projects will have an adverse impact on Class I areas, projects subject to federal permits are required to notify the federal land manager responsible for designated Class I areas within 62 miles (100 kilometers) of the Project.[2] The federal land manager identifies appropriate air quality–related values for the Class I area and evaluates the impact of the Project on air quality–related values. The Brigantine Wilderness Area, within the geographic analysis area approximately 25 miles north-northwest of the geographic center of the Project, is the only Class I area within 62 miles (100 kilometers) of the Project. Air quality–related values identified by USFWS for Brigantine Wilderness include aquatic resources, fauna/wildlife, soils, vegetation, and visibility.

The CAA amendments 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 off Florida, east of 87° 30′ west longitude. The OCS Air Regulations (40 CFR 55) establish the applicable air pollution control requirements, including provisions related to permitting, monitoring, reporting, fees, compliance, and enforcement for facilities subject to the CAA. These regulations apply to OCS sources that are beyond state seaward boundaries. Projects within 25 nm of a state seaward boundary are required to comply with the air quality requirements of the nearest or corresponding onshore area, including applicable permitting requirements.

In addition to the CAA, the National Wildlife Refuge Administration Act directs USFWS to manage Refuge System lands to "ensure that the biological integrity, diversity, and environmental health of the System are maintained for the benefit of present and future generations of Americans." Furthermore, the Wilderness Act directs USFWS to manage and preserve a Wilderness Area's "natural conditions and retain its primeval character and influence." Maintaining air quality as a natural condition is necessary for a wilderness area to retain these characteristics.

[1] Figure 3.4-2 also indicates the nonattainment area for the 1979 1-hour ozone NAAQS, which USEPA has revoked; however, this area still must meet the provisions of the former State Implementation Plan for the 1-hour ozone standard.
[2] The 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 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).

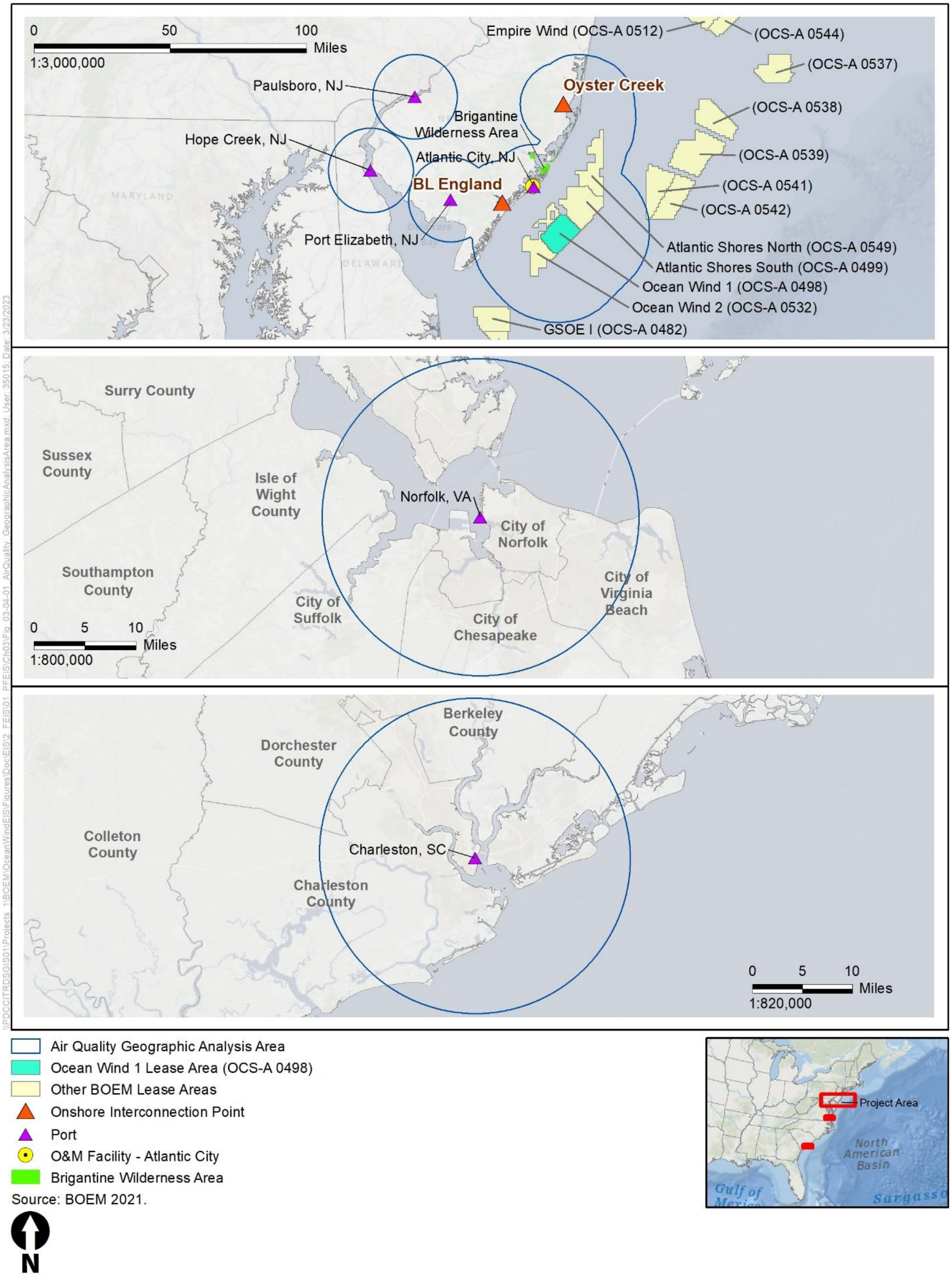


Figure 3.4-1 Air Quality Geographic Analysis Area

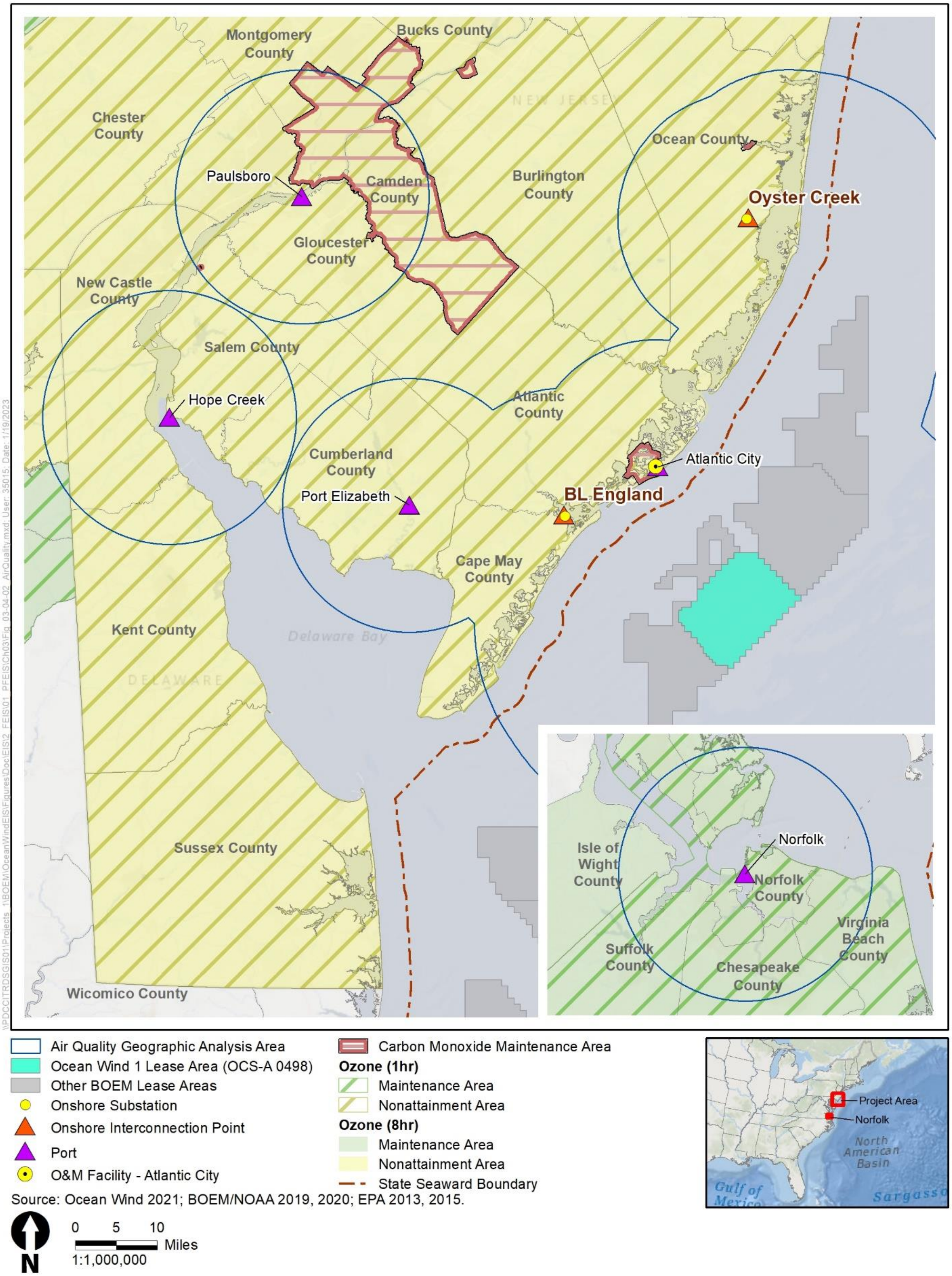


Figure 3.4-2 Air Quality Nonattainment and Maintenance Areas in the Geographic Analysis Area

3.4.2 Environmental Consequences

3.4.2.1. Impact Level Definitions for Air Quality

Definitions of impact levels are provided in Table 3.4-1. Impact levels are intended to serve NEPA purposes only, and are not intended to establish thresholds or other requirements with respect to permitting under the CAA.

Table 3.4-1 Impact Level Definitions for Air Quality

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

3.4.3 Impacts of the No Action Alternative on Air Quality

Section 3.1 of the Final EIS explains the approach to predicting impacts related to the No Action Alternative. When analyzing the impacts of the No Action Alternative on air quality, 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 air quality. 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 F, *Planned Activities Scenario*. Separate impact conclusions are presented for both scenarios.

3.4.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for air quality described in Section 3.4.1, *Description of the Affected Environment for Air Quality*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-shore 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. See Appendix F, Table F1-1 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for air quality. There are no ongoing offshore wind activities within the geographic analysis area for air quality.

NJDEP has projected that under a scenario of continuation of current regulations and policies, emissions from electricity generation would decline slowly through 2050 due to improvements in efficiency and switching to cleaner fuels (NJDEP 2019). Under the No Action Alternative, without implementation of other offshore wind projects, the electricity that would have been generated by offshore wind would likely be provided by fossil fuel-fired facilities.[3] As a result, a continuation of ongoing 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 Executive Order 92 (November 19, 2019) sets a goal of developing 7,500 MW of offshore wind energy off the coast of New Jersey by 2035. The New Jersey Energy Master Plan (BPU 2019) sets a goal of transitioning New Jersey to 100 percent renewable electricity by 2050. In addition to electricity generation, emissions from other ongoing activities including vessel and vehicle emissions and accidental releases of fuel or other hazardous material would continue to contribute to ongoing regional air quality impacts.

3.4.3.2. Cumulative Impacts of the No Action Alternative

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

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 F). 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.

Other planned offshore wind activities within the geographic analysis area that could contribute to impacts on air quality include:

- Construction of the Atlantic Shores South project (200 WTGs), expected 2024–2027
- Construction of the Ocean Wind 2 project (111 WTGs), expected 2026–2030
- Construction of the Atlantic Shores North project (157 WTCs), expected 2026–2030

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

Air emissions: Most air pollutant emissions and air quality impacts from planned offshore wind projects would occur during construction, potentially from multiple projects occurring simultaneously. All projects would be required to comply with the CAA and NAAQS. Primary emission sources would include increased public and commercial vehicular traffic, air traffic, combustion emissions from construction equipment, and fugitive emissions from construction-generated dust. As wind energy projects come online, power generation emissions overall could decrease and the region as a whole could realize a net benefit to air quality.

[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).

The planned offshore wind projects other than the Proposed Action that may result in air pollutant emissions and air quality impacts within the air quality geographic analysis area include projects within all or portions of the following lease areas: OCS-A-0499, OCS-A-0532, and OCS A-0549 (Table F2-4). Projects currently proposed in these lease areas include Atlantic Shores South, Ocean Wind 2, and Atlantic Shores North, respectively. These projects would produce 5,262 MW of renewable power from the installation of 468 WTGs (Table F2-1). Based on the assumed offshore construction schedule in Table F2-1, those projects within the geographic analysis area would have overlapping construction periods beginning in 2024 and continuing through 2030.

During the construction phase, the total emissions of criteria pollutants and ozone precursors from offshore wind projects other than Ocean Wind 1 proposed within the air quality geographic analysis area, summed over all construction years, are estimated to be 6,034 tons of CO, 27,571 tons of NO_X, 913 tons of PM_{10}, 880 tons of $PM_{2.5}$, 181 tons of SO_2, 618 tons of VOCs, and 1,738,387 tons of CO_2 (Table F2-4). Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases. Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. As a result, air quality impacts would be minor, shifting spatially and temporally across the air quality geographic analysis area during the proposed construction period (2024–2030).

During operations, emissions from planned offshore wind projects within the air quality geographic analysis area would overlap temporally, but operations would contribute few criteria pollutant emissions compared to construction and decommissioning. Operational emissions would come largely from commercial vessel traffic and emergency diesel generators. The aggregate operational emissions for all projects within the air quality analysis area would vary by year as successive projects begin operation. Estimated operational emissions would be 121–261 tons per year of CO, 519–1,106 tons per year of NO_X, 17–36 tons per year of PM_{10}, 16–35 tons per year of $PM_{2.5}$, 1–3 tons per year of SO_2, 9–20 tons per year of VOCs, and 33,566–73,226 tons per year of CO_2 (Table F2-4). Cumulatively, operational emissions would result in negligible air quality impacts because emissions would be intermittent, localized, and dispersed throughout the 342,733-acre combined lease areas and vessel routes from the onshore O&M facility and be indistinguishable from background concentrations.

Offshore wind energy development could help offset emissions from fossil fuels, potentially improving regional air quality and reducing GHGs. An analysis by Katzenstein and Apt (2009), for example, estimates that CO_2 emissions can be reduced by up to 80 percent and NO_X emissions can be reduced up to 50 percent by implementing wind energy projects.[4] An analysis by Barthelmie and Pryor (2021) calculated that, depending on global trends in GHG emissions and the amount of wind energy expansion, development of wind energy could reduce predicted increases in global surface temperature by 0.3–0.8 °C (0.5–1.4 °F) by 2100.

Estimations and evaluations of potential health and climate benefits from offshore wind activities for specific regions and project sizes rely on information about the air pollutant emission contributions of the existing and projected mixes of power generation sources, and generally estimate the annual health

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

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).

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 2020a). 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 development of 36 GW of reasonably foreseeable wind power on the OCS (Appendix F, Table F2-1). Table 3.4-2 presents the estimated monetized health benefits and avoided mortality for this example scenario.

Table 3.4-2 COBRA Estimate of Annual Avoided Health Effects with 36 GW Reasonably Foreseeable Offshore Wind Power

Discount Rate[1] (2023)	Monetized Total Health Benefits (Million U.S. dollars/year)		Avoided Mortality (cases/year)	
	Low Estimate[2]	High Estimate[2]	Low Estimate[2]	High Estimate[2]
3%	7,765	17,516	698	1,580
7%	6,929	15,619	698	1,580

[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 2020b).
[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 2020b).

BOEM anticipates that the air quality impacts associated with planned offshore wind activities other than the Proposed Action in the geographic analysis area would result in minor adverse impacts due to emissions of criteria pollutants, VOCs, hazardous air pollutants (HAP), and GHGs, mostly released during construction and decommissioning. Impacts would be minor because these 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.

Construction and operation of 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 source location. Increasing energy production from offshore wind projects could reduce regional GHG emissions by displacing energy from fossil fuels. This reduction could more than offset the relatively small GHG emissions from offshore wind projects. This reduction in regional GHG emissions would be noticeable in the regional context, would contribute incrementally to reducing climate change, and would represent a moderate beneficial impact in the regional context but a negligible beneficial impact in the global context.

Accidental releases: Planned offshore wind activities could release air toxics or HAPs because of accidental chemical spills within the air quality geographic analysis area. Section 3.21, *Water Quality*, includes a discussion of the nature of releases anticipated. Based on Table F2-3, up to about 1,527,193 gallons (5.8 million liters) of coolants, 2,121,777 gallons (8.0 million liters) of oils and lubricants, and 471,492 gallons (1.8 million liters) of diesel fuel would be contained in the 482 wind turbine and substation structures for the wind energy projects within the air quality geographic analysis area. If accidental releases occur, they would be most likely during construction but could occur during operations and decommissioning of offshore wind facilities. These may lead to short-term periods (hours to days)[5] 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). BOEM expects air quality impacts from accidental releases would be negligible because impacts would be short term and limited to the area near the accidental release location. Accidental spills would occur infrequently over a 30-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.

3.4.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, air quality would continue to be affected by existing environmental trends and ongoing activities. Additional, higher-emitting, fossil-fuel energy facilities would be kept in service to meet future 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 would continue to have regional air quality impacts primarily through air pollutant emissions, accidental releases, and climate change.

BOEM anticipates that ongoing non-offshore wind activities would result in **moderate** impacts on air quality because of air pollutant and GHG emissions resulting from the No Action Alternative. Although there are no such energy generation facilities planned within the air quality geographic analysis area, continuation of current regional trends in energy development could include new power plants that could contribute to air quality and GHG impacts in New Jersey and the Mid-Atlantic states. BOEM anticipates that the impacts of planned non-offshore wind activities would be moderate. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in moderate impacts on air quality, primarily driven by recent market and permitting trends indicating future electric generating units would most likely include natural-gas-fired facilities.

Offshore wind activities in the geographic analysis area would contribute to the emissions of criteria pollutants, VOCs, HAPs, and GHGs, mostly released during construction and decommissioning. Impacts would be minor because these emissions would incrementally increase ambient pollutant concentrations, though not by enough to cause a violation of the NAAQS or New Jersey AAQS. Pollutant emissions during operations would be generally lower and more transient. Most air pollutant emissions and air quality impacts would occur during multiple overlapping project construction phases from 2024 through 2030 (Table F2-4). Overall, adverse air quality impacts from offshore wind projects are expected to be relatively small and transient. Offshore wind projects likely would lead to reduced emissions from fossil-fueled power generating facilities and consequently minor to moderate beneficial impacts on regional air quality after offshore wind projects are operational.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and activities would continue, and air quality would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **moderate** impacts on air quality. BOEM anticipates that the No Action Alternative combined with all other planned activities (including other offshore wind activities) would result in **moderate** adverse impacts due to emissions of criteria pollutants, VOCs, HAPs, and GHGs, mostly released during construction and decommissioning,

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

and **minor** to **moderate beneficial** impacts on regional air quality after offshore wind projects are operational.

3.4.4 Relevant Design Parameters & Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; BOEM expects any potential variances in the proposed Project build-out within range of the PDE to result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix E) would influence the magnitude of the impacts on air quality:

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

Changes to the design capacity of the WTGs would not alter the maximum potential air quality impacts for the Proposed Action and other action alternatives because the maximum-case scenario involved the maximum number of WTGs (98) allowed in the PDE.

Ocean Wind has committed to the following measures to reduce impacts on air quality. Low-sulfur fuels would be used to the extent practicable (AQ-01) and specific engines designed to reduce air pollution would be used when practicable (AQ-02), in addition to limiting engine idling times (AQ-03), complying with international air emission standards for marine vessels (AQ-04), and implementing a dust control plan (AQ-05) (COP Volume II, Table 1.1-2; Ocean Wind 2023). Ocean Wind has committed to measures to minimize fugitive emissions of sulfur hexafluoride contained in WTGs and OSS switchgear, because the use of sulfur hexafluoride-free switchgear for WTGs and OSS is not feasible. Ocean Wind would follow manufacturer recommendations for service and repair of the affected breakers and switches; conduct visual inspections of the switchgear and monitoring equipment according to manufacturer recommendations; create alarms based on the pressure readings in the breakers/switches, so leaks can be detected when substantial sulfur hexafluoride leakage occurs; upon a detectable pressure drop that is greater than 10 percent of the original pressure (accounting for ambient air conditions), perform maintenance to fix seals as soon as feasible; if an event requires removal of sulfur hexafluoride, the affected major component(s) will be replaced with new component(s); keep a log of all detected leaks and maintenance procedures potentially affecting sulfur hexafluoride emissions from circuit breakers/ switches; and capture and recycle sulfur hexafluoride removed from breakers and switches during maintenance (AQ-06) (COP Volume II, Table 1.1-2; Ocean Wind 2023).

3.4.5 Impacts of the Proposed Action on Air Quality

3.4.5.1. Impacts of the Proposed Action

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park, which is described in Section 3.4.6, *Impacts of Alternatives B, C, D, and E on Air Quality*.

The Project may generate emissions and affect air quality in the New Jersey region and nearby coastal waters during construction, O&M, and decommissioning activities. Onshore emissions would occur in the onshore export cable corridors and at points of interconnection, potentially including BL England and Oyster Creek, in Ocean, Atlantic, and Cape May Counties in New Jersey. Offshore emissions would be within the OCS, including state offshore waters. Offshore emissions would occur in the Lease Area and the offshore export cable corridors. COP Volume I, Section 4 (Ocean Wind 2023), provides additional information on land use and proposed ports.

As discussed elsewhere in this section, Ocean Wind is required to obtain a permit from USEPA for air emissions resulting from the construction and operation of a new OCS source, as defined in USEPA's regulations (40 CFR 55.6). USEPA's regulations set forth the federal and state requirements that an OCS source must satisfy in order to obtain a permit (40 CFR 55.13 and 55.14). Generally, these requirements include demonstrating, as applicable, that emissions from construction and operation of the OCS source will not cause or contribute to violations of any NAAQS or exceed the allowable consumption of any ambient air increment. In addition, the OCS air permit may contain requirements for offsetting certain emissions, as well as complying with any additional applicable requirements specific to New Jersey, which is the corresponding onshore area under 40 CFR 55.14. Ocean Wind is in the process of applying to USEPA for a permit under 40 CFR 55.

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

The proposed Project's WTGs, substations, and offshore and onshore cable corridors would not themselves generate air pollutant emissions during normal operations. However, air pollutant emissions from equipment used in the construction, O&M, and decommissioning phases could affect air quality in the geographic analysis area and nearby coastal waters and shore areas. Most emissions would occur temporarily during construction, offshore in the Wind Farm Area, onshore at the landfall sites, along the offshore and onshore export cable routes, at the onshore substations, and at the construction staging areas. Additional emissions related to the Project could also occur at nearby ports used to transport material and personnel to and from the Project site.

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

The 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.

Air emissions – construction: Fuel combustion and solvent use would cause construction-related emissions. The air pollutants would include criteria pollutants, VOCs, and HAPs, as well as GHGs. During the construction phase, the activities of additional workers, increased traffic congestion, additional commuting miles for construction personnel, and increased air-polluting activities of supporting businesses also could have impacts on air quality. Construction equipment would comply with all applicable emissions and fuel-efficiency standards to minimize combustion emissions and associated air quality impacts. The total estimated construction emissions of each pollutant are summarized in Table 3.4-3.

Table 3.4-3 Ocean Wind 1 Total Construction Emissions (U.S. tons)

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2	CH_4	N_2O	CO_2e
Year 1	2.5	5.1	0.3	0.3	0.02	0.4	3,539	0.0	0.0	3,539
Year 2	2,154	11,168	365.3	349.3	115.3	292.6	652,774	4.1	32	662,421
Total	2,156	11,173	365.6	349.5	115.3	293.0	656,313	4.1	32	665,960

Source: COP Volume II, Table 2.1.3-3 (Ocean Wind 2023)
Sum of individual values may not equal total due to rounding.
CH_4 = methane; CO_2e = carbon dioxide equivalent; N_2O = nitrous oxide

Offshore Construction

Emissions from potential sources or 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 substation installation. Offshore construction-related emissions also would come from diesel-fueled generators used to temporarily supply power to the WTGs and substations so that workers could operate lights, controls, and other equipment before cabling is in place. There also would be emissions from engines used to power pile-driving hammers and air compressors used to supply compressed air to noise-mitigation devices during pile driving (if used). Emissions from vessels used to transport workers, supplies, and equipment to and from the construction areas would result in additional air quality impacts. The Project may need emergency generators at times, potentially resulting in increased emissions for limited periods. Ocean Wind's APMs include compliance with applicable fuel-efficiency and emissions standards (AQ-02, AQ-04; see COP Volume II, Table 1.1-2; Ocean Wind 2023).

Table 3.4-4 presents an initial summary of the Project's estimated offshore construction emissions in the OCS permit area and a comparison of the total OCS permit area emissions in relation to the total emission inventories of the potentially affected counties. The OCS permit area, measured as 25 nm from the center of the Wind Farm Area, extends into Atlantic County, Cape May County, and Ocean County, New Jersey. This summary is a conservative analysis because it assumes all emissions would directly affect the nearest county's air; however, depending on the wind conditions at the time of emissions, it is likely that not all emissions generated offshore would reach land.

Table 3.4-4 Estimated Ocean Wind 1 Construction Emissions (U.S. tons) in OCS Permit Area

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2	CH_4	N_2O	CO_2e
OCS Permit Area Year 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OCS Permit Area Year 2	1,342	7,486	244	233	95	217	417,894	2.7	21	424,114
Total	1,342	7,486	244	233	95	217	417,894	2.7	21	424,114

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2	CH_4	N_2O	CO_2e
Atlantic County, New Jersey 2017 Inventory	29,820	4,493	1,828	839	267	15,084	NA	NA	NA	1,598,849
Project percentage of Atlantic County, New Jersey 2017 Inventory	4.5	166.6	13.4	27.7	35.4	1.4	NA	NA	NA	26.5
Cape May County, New Jersey 2017 Inventory	18,831	2,883	959	475	64	9,015	NA	NA	NA	833,592
Project percentage of Cape May County, New Jersey 2017 Inventory	7.1	259.6	25.5	49.0	148.8	2.4	NA	NA	NA	50.9
Ocean County, New Jersey 2017 Inventory	63,398	7,738	3,238	2,064	187	20,866	NA	NA	NA	3,702,977
Project percentage of Ocean County, New Jersey 2017 Inventory	2.1	96.7	7.5	11.3	50.5	1.0	NA	NA	NA	11.5

Source: COP Volume III, Appendix N, Table 3-1 and COP Volume II, Table 2.1.3-4 (Ocean Wind 2023); USEPA 2022
Sum of individual values may not equal total due to rounding.
Global Warming Potentials (GWP) used for conversion to CO_2e as defined in 40 CFR 98, Table A-1: CH_4 GWP = 25, N_2O GWP = 298
CH_4 = methane; CO_2e = carbon dioxide equivalent; N_2O = nitrous oxide; NA = not available

The largest air quality impacts are anticipated during construction, with smaller and more infrequent impacts anticipated during decommissioning. During the construction phase, the total emissions of criteria pollutants and ozone precursors from all offshore wind projects, including the Proposed Action, proposed within the air quality geographic analysis area, summed over all construction years, are estimated to be 8,190 tons of CO, 38,744 tons of NO_X, 1,279 tons of PM_{10}, 1,229 tons of $PM_{2.5}$, 297 tons of SO_2, 911 tons of VOCs, and 2,394,700 tons of CO_2 (Table F2-4). Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases.

BOEM anticipates that air quality impacts from construction and decommissioning of the Proposed Action would be minor (i.e., less than the NAAQS as discussed below). The Proposed Action would contribute an average of approximately 34 percent of the total offshore wind project emissions that may generate impacts, depending on the pollutant, due to construction and decommissioning activities within the air quality geographic analysis area. This suggests that about two-thirds of the air quality impacts resulting from offshore wind development, depending on the pollutant, would be due to other offshore wind projects in total and the addition of the Proposed Action would yield a noticeable contribution 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 shift 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 Proposed Action is anticipated to overlap with Atlantic Shores South for 2 years of construction in 2024 and 2025. Construction of other wind projects within the air quality geographic analysis area would overlap with the proposed Project’s operations

(Table F2-4). The highest emissions would occur in the offshore region and the westerly prevailing winds would result in most emission plumes remaining offshore. Although OCS sources in the Atlantic are subject to CAA requirements including requirements not to violate any NAAQS both onshore and offshore, 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 majority of air pollutant and GHG emissions from the Proposed Action alone would come from the main engines, auxiliary engines, and auxiliary equipment on marine vessels used during offshore construction activities. Fugitive dust emissions would occur as a result of excavation and hauling of soil during onshore construction activities. Emissions from the OCS source, as defined in the CAA, would be permitted as part of the OCS permit for which Ocean Wind is currently in the application process. The Project must demonstrate compliance with the NAAQS. The OCS air permitting process includes air dispersion modeling of emissions to demonstrate compliance with the NAAQS. The CAA also provides protection of air quality in Class I wilderness areas by means of the NAAQS and the Prevention of Significant Deterioration program and gives federal land managers a responsibility to protect the air quality–related values of Class I areas from the adverse impacts of air pollution. If emissions from the Project would cause or contribute to adverse impacts on the air quality–related values of a Class I area, the permitting authority (i.e., USEPA) can deny the permit. As part of the air quality–related values analysis, the Project must demonstrate that significant visibility degradation would not occur as a result of increased haze or plumes.

As part of its OCS air permit application (Ocean Wind 2022), Ocean Wind conducted dispersion modeling to estimate pollutant concentrations and air quality–related values. The regulatory definition of an OCS emission source for air permitting purposes does not include all emissions associated with the Project. However, the modeling analysis included all Project-associated emissions to ensure that impacts would not be underestimated.

The USEPA Offshore and Coastal Dispersion model (USEPA 1997) was used to estimate criteria pollutant concentrations for comparison to the NAAQS and Prevention of Significant Deterioration increments. Prevention of Significant Deterioration increments represent allowable concentration increases in attainment areas. Impacts of secondary pollutants (particulate matter and ozone formed in the atmosphere from reactions of precursor chemicals) were estimated using USEPA guidance for Modeled Emissions Rates for Precursors (USEPA 2019). Table 3.4-5 and Table 3.4-6 present the estimated concentrations for construction of the Proposed Action compared to the Prevention of Significant Deterioration increments and the NAAQS, respectively. Table 3.4-5 and Table 3.4-6 show that all predicted concentrations during construction of the Project would be within the respective Prevention of Significant Deterioration increments and NAAQS. Concentrations during O&M would be much lower than shown in Table 3.4-5 and Table 3.4-6 because emissions during O&M would be much lower than during construction. Consequently, concentrations during O&M would also be within the respective Prevention of Significant Deterioration increments and NAAQS.

Table 3.4-5 Estimated Pollutant Concentrations During Construction Compared to Prevention of Significant Deterioration Increments

Pollutant	Period	Increment Consumption (μg/m^3)			
		Modeled	MERP	Modeled + MERP	Allowable Increment Consumption
Class I Area Increments					
NO_2	Annual	0.68	NA	NA	2.5
$PM_{2.5}$	24-hour	0.69	0.52	1.21	2

Pollutant	Period	Increment Consumption (μg/m³)			
		Modeled	MERP	Modeled + MERP	Allowable Increment Consumption
$PM_{2.5}$	Annual	0.02	0.04	0.06	1
PM_{10}	24-hour	0.71	0.52	1.23	8
PM_{10}	Annual	0.02	0.04	0.06	4
Class II Area Increments					
NO_2	Annual	16.18	NA	16.18	25
$PM_{2.5}$	24-hour	8.22	0.53	8.75	9
$PM_{2.5}$	Annual	1.35	0.04	1.39	4
PM_{10}	24-hour	10.24	0.53	10.77	30

Source: Ocean Wind 2022
μg/m³ = microgram per cubic meter; MERP = Modeled Emissions Rates for Precursors; NA = not applicable

Table 3.4-6 Estimated Pollutant Concentrations During Construction Compared to NAAQS

Pollutant	Period	Modeled	Concentration (μg/m³)			
			MERP	Background	Modeled + MERP	NAAQS
NO_2	1-hour	Hourly[1]	NA	Hourly[1]	179.37	188
NO_2	Annual	Hourly[1]	NA	Hourly[1]	49.46	100
$PM_{2.5}$	24-hour	5.16	0.53	16.7	22.39	35
$PM_{2.5}$	Annual	1.35	0.04	6.6	7.99	12
PM_{10}	24-hour	10.24	0.53	44.7	55.47	150

Source: Ocean Wind 2022
[1] Background values were varied by hour of the day and season of the year and added to the modeled values hour-by-hour of each year at each receptor location to generate the estimates of total NO_2 impact for the 1-hour and annual periods (based on 3-year averages).
μg/m³ = microgram per cubic meter; MERP = Modeled Emissions Rates for Precursors; NA = not applicable

The OCS air permit is subject to Prevention of Significant Deterioration requirements for analysis of impacts on soils, vegetation, and economic growth and associated emissions. Based on the modeled concentrations the permit application (Ocean Wind 2022), it was determined that impacts on soils and vegetation would be lower than applicable thresholds. The permit application (Ocean Wind 2022) also determined and that the Project would lead to only limited growth and emissions. For further discussion of economic impacts see Section 3.11, *Demographics, Employment, and Economics*.

The air quality–related values analysis assessed visibility and acidic deposition impacts at the Brigantine Wilderness Area. Projects that affect Class I areas should apply the Federal Land Managers' Air Quality–Related Values Work Group guidance from 2010, as referenced in USEPA Regulations at 40 CFR 51, Appendix W. The Applicant is currently revising air quality modeling to assess impacts on air quality–related values per the Federal Land Managers' Air Quality–Related Values Work Group guidance. Initial modeling has shown potential visibility impacts from visible plumes ("plume blight") using the USEPA VISCREEN screening model. The VISCREEN model is a pass/fail test that showed plume blight would occur for some duration during the construction period.

Acidic deposition impacts were assessed using the USEPA CALPUFF model. The CALPUFF deposition results for total sulfur (as elemental sulfur) and total nitrogen (as elemental nitrogen) were 0.00025 kilogram per hectare per year and 0.00694 kilogram per hectare per year, respectively. These values are lower than the applicable screening levels of 0.005 kilogram per hectare per year for sulfur and 0.010 kilogram per hectare per year for nitrogen (FLAG 2010). Based on these results, the Project is not expected to have adverse effects on soils, vegetation, or biota in the Brigantine Class I area due to deposition of sulfur and nitrogen compounds.

Potential visibility impacts from regional haze were assessed using the USEPA CALPUFF model (Exponent 2000). The metric used to assess the potential for discernible visibility reduction is the deciview. 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. While USEPA Regional Haze rules (40 CFR 51, Appendix Y) do not apply to the impact analysis for air quality–related values for Class I areas, they do provide a screening level of 0.5 deciview that may be used as a screening benchmark for whether the proposed Project would potentially cause or contribute to visibility impairment at the Brigantine Class I area. The modeled visibility impacts exceeded the screening level. Given these circumstances, Ocean Wind has requested that USFWS discuss the potential for impacts in accordance with applicable FLAG guidance, and provide appropriate feedback to USEPA.

Analysis conducted by USFWS, summarized in USFWS's April 4, 2023, comment letter to USEPA on the Ocean Wind 1 OCS Air Permit application, concludes that Ocean Wind's construction as outlined in the application would result in 40 days of visibility impacts for the evaluation year of 2018, which exceeds the Federal Land Managers' Air Quality Related Values Workgroup threshold. The Federal Land Managers' Air Quality Related Values Workgroup guidance targets no more than 7 days over the threshold per year. In the current OCS Air Permit application, the eighth highest impact day was estimated at 18.4 percent change, which exceeds the threshold of a 5 percent change in visibility when compared to an annual estimate of natural visibility conditions. According to USEPA definitions and scientific research, this would be a noticeable change in visibility to visitors and would affect USFWS management goals within the refuge.

Onshore Construction

Onshore activities of the Proposed Action would consist primarily of HDD, duct bank construction, cable-pulling operations, and substation construction. Emissions would primarily be from operation of diesel-powered equipment and vehicle activity such as bulldozers, excavators, and diesel trucks, and fugitive particulate emissions from excavation and hauling of soil. Ocean Wind's APMs include complying with applicable fuel-efficiency and emissions standards, implementing anti-idling practices, and developing and implementing a fugitive dust control plan (AQ-01, AQ-02, AQ-03, AQ-04, AQ-05; see COP Volume II, Table 1.1-2; Ocean Wind 2023).

These emissions would be highly variable and limited in spatial extent at any given period and would result in minor impacts (less than the NAAQS as shown in Table 3.4-6), as they would be temporary in nature. Fugitive particulate emissions would vary depending on the spatial extent of the excavated areas, soil type, soil moisture content, and magnitude and direction of ground-level winds.

Air emissions – O&M: During O&M, air quality impacts are anticipated to be smaller in magnitude compared to construction and decommissioning. Offshore O&M activities would consist of WTG operations, planned maintenance, and unplanned emergency maintenance and repairs. The WTGs operating under the Proposed Action would have no pollutant emissions. The WTGs would not include permanently installed emergency generators; however, a temporary backup diesel generator may be installed at the turbine during the commissioning phase until the grid connection is made. Emergency generators on 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 for maintenance activities. Crew transfer vessels would transport crews to the Wind Farm Area for inspections, routine maintenance, and repairs. Jack-up vessels, multipurpose offshore support vessels, and rock-dumping vessels would travel infrequently to the Wind Farm Area for significant maintenance and repairs. The proposed Project's contribution would be additive with the impact(s) of any and all other operational activities, including offshore wind activities, that occur within the air quality geographic analysis area. COP Volume I, Sections 6.1.3 and 6.2.3 (Ocean Wind 2023), provide a more detailed description of offshore and onshore O&M activities, and COP Volume II, Table 2.1.3-4, summarizes emissions during O&M. The annual estimated emissions for O&M are summarized in Table 3.4-7.

Table 3.4-7 Ocean Wind 1 Operations and Maintenance Emissions (U.S. tons)

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2	CH_4	N_2O	CO_2e
Annual	40	159	5.6	5.4	0.9	4.1	11,753	0.09	0.5	11,912
Lifetime (35 years)	1,411	5,576	196	191	31	144	411,347	3.3	18.4	416,907

Source: COP Volume II, Table 2.1.3-5 (Ocean Wind 2023)
CH_4 = methane; CO_2e = carbon dioxide equivalent; N_2O = nitrous oxide

Table 3.4-8 presents a summary of the Project's estimated offshore O&M emissions in the OCS permit area and a comparison of the total OCS permit area emissions in relation to the total emission inventories of the potentially affected counties. This summary is a conservative analysis because it assumes all emissions would directly affect the nearest county's air; however, depending on the wind conditions at the time of emissions, it is likely that not all emissions generated offshore would reach land.

Table 3.4-8 Estimated Ocean Wind 1 O&M Emissions (U.S. tons) in OCS Permit Area

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2	CH_4	N_2O	CO_2e
OCS Permit Area Annual	**40**	**159**	**5.6**	**5.4**	**0.8**	**3.9**	**11,587**	**0.1**	**0.5**	**11,744**
Atlantic County, New Jersey 2017 Inventory	29,820	4,493	1,828	839	267	15,084	NA	NA	NA	1,598,849
Project percentage of Atlantic County, New Jersey 2017 Inventory	0.1	3.5	0.3	0.6	0.3	0.0	NA	NA	NA	0.7
Cape May County, New Jersey 2017 Inventory	18,831	2,883	959	475	64	9,015	NA	NA	NA	833,591
Project percentage of Cape May County, New Jersey 2017 Inventory	0.2	5.5	0.6	1.1	1.3	0.0	NA	NA	NA	1.4
Ocean County, New Jersey 2017 Inventory	63,398	7,738	3,238	2,064	187	20,866	NA	NA	NA	3,702,978
Project percentage of Ocean County, New Jersey 2017 Inventory	0.1	2.1	0.2	0.3	0.4	0.0	NA	NA	NA	0.3

Source: COP Volume III, Appendix N, Table 3-2 and COP Volume II, Table 2.1.3-6 (Ocean Wind 2023); USEPA 2022 Global Warming Potentials (GWP) used for conversion to CO_2e as defined in 40 CFR 98 Table A-1: CH_4 GWP = 25, N_2O GWP = 298
CH_4 = methane; CO_2e = carbon dioxide equivalent; N_2O = nitrous oxide; NA = not available

BOEM anticipates that air quality impacts from O&M of the Proposed Action would be minor (less than the NAAQS), occurring for short periods of time several times per year during the proposed 35 years.

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

Increases in renewable energy could lead to reductions in emissions from fossil-fueled power plants. BOEM used its Wind Tool (BOEM 2017) to estimate the emissions avoided as a result of the Proposed Action. Once operational, the Proposed Action would result in annual avoided emissions of 2,362 tons of NO_X, 114 tons of $PM_{2.5}$, and 5,705 tons of SO_2 (COP Volume II, Table 2.1.3-5). It is important to note that the estimated annual avoided emissions are relative to today's energy grid. Accounting for construction emissions and assuming decommissioning emissions would be the same, and including emissions from future operations, operation of the Proposed Action would offset emissions related to its construction and eventual decommissioning within different time periods of operation depending on the pollutant: NO_X would be offset in approximately 10 years of operation, $PM_{2.5}$ in 6 years, and SO_2 in 1 month. If emissions from future operations and decommissioning were not included, the times required for emissions to "break even" would be shorter. From that point, the Project would be offsetting emissions that would otherwise be generated from another source. The potential health benefits of avoided emissions can be evaluated using USEPA's COBRA health impacts screening and mapping tool as discussed in Section 3.4.3.2. COBRA was used to analyze the avoided emissions that were calculated for the Proposed Action (COP Volume II, Table 2.1.3-5; Ocean Wind 2023). Table 3.4-9 presents the results.

Table 3.4-9 COBRA Estimate of Annual Avoided Health Effects with Proposed Action

Discount Rate[2] (2023)	Monetized Total Health Benefits[1] (U.S. dollars/year)		Avoided Mortality[1] (cases/year)	
	Low Estimate[3]	High Estimate[3]	Low Estimate[3]	High Estimate[3]
3%	239,354,740	539,958,646	21.511	48.694
7%	213,599,259	481,487,641	21.511	48.694

[1] Estimates are gross benefits, i.e., they do not account for emissions from Project O&M.
[2] 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 2020b).
[3] 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 2020b).

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

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

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

Table 3.4-10 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, methane, and nitrous oxide emissions. In accordance with IWG's recommendation, four estimates were calculated based on IWG estimates of social cost per metric ton of emissions for a given emissions year and Ocean Wind's estimates of emissions in each year. In Table 3.4-10, negative values represent social benefits of avoided GHG emissions. The negative values for net SC-GHG indicate that the impact of the Proposed Action on GHG emissions and climate would be a net benefit in terms of SC-GHG.

Table 3.4-10 Estimated Social Cost of GHGs associated with the Proposed Action

Description	Social Cost of GHGs (2020$)[1]			
	Average Value, 5% discount rate	Average Value, 3% discount rate	Average Value, 2.5% discount rate	95th Percentile Value, 3% discount rate
Social Cost of CO_2				
Construction, Operation, and Decommissioning	$16,640,000	$67,296,000	$103,780,000	$203,870,000
Avoided	-$962,528,000	-$3,967,307,000	-$6,120,384,000	-$12,108,979,000

Description	Social Cost of GHGs (2020$)[1]			
	Average Value, 5% discount rate	Average Value, 3% discount rate	Average Value, 2.5% discount rate	95th Percentile Value, 3% discount rate
Emissions[2]				
Net SC-CO_2	-$945,888,000	-$3,900,011,000	-$6,016,604,000	-$11,905,109,000
Social Cost of CH_4				
Construction, Operation, and Decommissioning	$5,000	$14,000	$20,000	$38,000
Avoided Emissions	-$3,946,000	-$11,017,000	-$15,164,000	-$29,357,000
Net SC-CH_4	-$3,941,000	-$11,003,000	-$15,144,000	-$29,319,000
Social Cost of N_2O				
Construction, Operation, and Decommissioning	$314,000	$1,169,000	$1,791,000	$3,103,000
Avoided Emissions	-$4,638,000	-$17,748,000	-$27,245,000	-$47,262,000
Net SC-N_2O	-$4,324,000	-$16,579,000	-$25,454,000	-$44,159,000
Social Cost of GHG				
Construction, Operation, and Decommissioning	$39,956,000	$156,121,000	$239,719,000	$445,688,000
Avoided Emissions	-$3,580,863,000	-$14,268,309,000	-$21,953,268,000	-$40,889,501,000
Net SC-GHG	-$3,540,907,000	-$14,112,189,000	-$21,713,548,000	-$40,443,813,000

Estimates are the sum of the social costs for CO_2, CH_4, and N_2O over the Project lifetime.
Estimates are rounded to the nearest $1,000.
[1] The following calendar years were used in calculating SC-GHG: construction 2023–2024, operation (35 years) 2025–2059, and decommissioning 2060–2061.
[2] Negative cost values indicate benefits.
CH_4 = methane; N_2O = nitrous oxide; SC = social cost

The Proposed Action would produce GHG emissions that contribute to climate change; however, its contribution would be less than the emissions reductions from fossil-fueled sources during operation of the Project. Because GHG emissions disperse and mix within the troposphere, the climatic impact of GHG emissions does not depend upon the source location. Therefore, regional climate impacts are largely a function of global emissions. Nevertheless, the Proposed Action per se would have negligible impacts on climate change during these activities and an overall net beneficial impact on criteria pollutant and ozone precursor emissions as well as GHGs, compared to a similarly sized fossil-fueled power plant or to the generation of the same amount of energy by the existing grid.

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 3.4-5 and Table 3.4-6) 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.

Overall, it is anticipated that there would be a net reduction in GHG emissions, and no collective adverse impact on climate change as a result of offshore wind projects. Additional offshore wind projects would likely contribute a relatively small emissions increase of CO_2. Development of offshore wind projects including the Proposed Action and construction, O&M, and eventual decommissioning activities would cause some GHG emissions to increase, primarily through emissions of CO_2. The additional GHG emissions anticipated from the planned activities including the Proposed Action over the next 35-year period would have a negligible incremental contribution to existing GHG emissions.

Air emissions – decommissioning: At the end of the operational lifetime of the Project, Ocean Wind would decommission the Project. Ocean Wind anticipates that all structures above the seabed level or aboveground would be completely removed. The decommissioning sequence would generally be the reverse of the construction sequence, involve similar types and numbers of vessels, and use similar equipment.

The dismantling and removal of the turbine components (blades, nacelle, and tower) and other offshore components would largely be a “reverse installation” process subject to the same constraints as the original construction phase. Onshore decommissioning activities would include removal of facilities and equipment and restoration of the sites to pre-Project conditions where warranted. Emissions from Project decommissioning were not quantified but are expected to be less than for construction. The Project anticipates pursuing a separate OCS Air Permit for those activities because it is assumed that marine vessels, equipment, and construction technology will change substantially in the next 35 years and in the future will have lower emissions than current vessels and equipment. Ocean Wind anticipates minor and temporary air quality impacts from the Proposed Action due to decommissioning.

Accidental releases: The proposed Project could release VOCs or HAPs because of accidental chemical spills. Based on Table F2-3, the Proposed Action would have up to about 39,690 gallons (150,243 liters) of coolants, 426,671 gallons (1.6 million liters) of oils and lubricants, and 236,216 gallons (894,174 liters) of diesel fuel in its 101 wind turbine and substation structures. Accidental releases including spills from vessel collisions and allisions may lead to short-term periods of VOC and HAP emissions through evaporation. VOC emissions also would be a precursor to ozone formation. Air quality impacts would be short term and limited to the local area at and around the accidental release location. BOEM anticipates that a major spill is very unlikely due to vessel and offshore wind energy industry safety measures, as discussed in Section 3.21.3.2, as well as the distributed nature of the material. BOEM anticipates that these activities would have a negligible air quality impact as a result of the Proposed Action alone.

Collectively, based on Table F2-3, there would be up to about 1,566,883 gallons (5.9 million liters) of coolants, 2,548,448 gallons (9.6 million liters) of oils and lubricants, and 707,708 gallons (2.7 million liters) of diesel fuel contained in the 583 structures among the Proposed Action and planned activities in the air quality geographic analysis area.

3.4.5.2. Cumulative Impacts of the Proposed Action

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

Air emissions – construction: The cumulative impacts of the Proposed Action would be moderate during construction. The Proposed Action would contribute a noticeable increment to the cumulative impacts on air quality associated with offshore construction. Impacts would be greatest during overlapping construction activities, but these effects would be short term in nature, as the overlap in the air quality geographic analysis area would be limited in time. The Proposed Action would contribute a noticeable increment to cumulative air quality impacts associated with onshore construction, which would be minor. Emissions from ongoing and planned activities, including the Proposed Action, would be highly variable and limited in spatial extent at any given period. Fugitive particulate emissions would vary depending on the spatial extent of the excavated areas, soil type, soil moisture content, and magnitude and direction of ground-level winds.

Air emissions – O&M: The Proposed Action would contribute a noticeable increment to cumulative impacts, which would be moderate. O&M emissions from ongoing and planned activities, including the Proposed Action, could begin in 2024. Emissions would largely be due to the same source types as for the Proposed Action, including commercial vessel traffic, air traffic, and operation of emergency diesel generators. Planned activities, including the Proposed Action, are estimated to emit 302 tons per year of CO, 1,265 tons per year of NO_X, 42 tons per year of PM_{10}, 40 tons per year of $PM_{2.5}$, 4 tons per year of SO_2, 24 tons per year of VOCs, and 84,978 tons per year of CO_2 when all projects are operating (Table F2-4). Cumulative O&M activity across the air quality geographic analysis area would result in short-term, intermittent, and widely dispersed emissions. 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 emissions from all offshore wind projects as noted above to the emissions contributions from the Proposed Action alone shown in Table 3.4-3 and Table 3.4-4 shows that the increases in air quality impacts from the Proposed Action could be greater or lesser than the impacts of any other single project depending on project size, but would be small relative to those of the combined total of the other planned offshore wind projects. In summary, the largest magnitude air quality impacts and largest spatial extent would result from the overlapping operations activities from the multiple offshore wind projects within the air quality geographic analysis area. A net improvement in air quality is expected on a regional scale as wind projects begin operation and offset emissions from fossil-fueled sources. The Proposed Action would also contribute a noticeable increment to the cumulative GHG impacts on air quality, which 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.

Air emissions – decommissioning: The Proposed Action would contribute a noticeable increment to the cumulative air quality impacts, which would represent a moderate impact. The decommissioning process for all offshore wind projects is expected to be similar to that for Ocean Wind 1, and impacts would be similar to those of Ocean Wind 1 decommissioning. Because the emissions related to onshore activities would be widely dispersed and transient, BOEM expects all air quality impacts to occur close to the emitting sources. If decommissioning activities for projects overlap in time, then impacts could be greater for the duration of the overlap.

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 35-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.

3.4.5.3. Conclusions

Impacts of the Proposed Action. The Proposed Action would result in a net decrease in overall emissions over the region compared to the installation of a traditional fossil-fueled power plant. Although there would be some short-term air quality impacts due to various activities associated with construction, maintenance, and eventual decommissioning, these emissions would be relatively small and limited in duration. The Proposed Action would result in air quality–related health effects avoided in the region due to the reduction in emissions associated with fossil-fueled energy generation (Table 3.4-2). As described above, the impact from air pollutant emissions is anticipated to be minor to moderate, and the impact from accidental releases would be negligible. Considering all IPFs together, **minor** to **moderate** air quality impacts would be anticipated for a limited time during construction, maintenance, and decommissioning, but there would be a **minor beneficial** impact on air quality near the Wind Farm Area and the surrounding region overall to the extent that energy produced by the Project would displace energy produced by fossil-fueled power plants. Ocean Wind has committed to APMs that would reduce potential impacts through complying with applicable emissions and fuel standards (AQ-01, AQ-02, and AQ-04), limiting engine idling time (AQ-03), and requiring dust control plans for onshore construction areas (AQ-05). Because of the amounts of emissions, the fact that emissions would be spread out in time (2 years for construction and then lesser emissions annually during operation), and the large geographic area over which they would be dispersed (throughout the 75,525-acre Lease Area and the vessel routes from the onshore facilities), air pollutant concentrations associated with the Proposed Action are not expected to exceed the NAAQS and New Jersey AAQS.

Cumulative Impacts of the Proposed Action. The incremental impacts contributed by the Proposed Action to the cumulative impacts on air quality would range from undetectable to noticeable, with noticeable beneficial impacts. BOEM anticipates that the cumulative impacts associated with the Proposed Action would result in **moderate** adverse impacts and **moderate beneficial** impacts. The main driver for this impact rating is emissions related to construction activities increasing commercial vessel traffic, air traffic, and truck and worker vehicle traffic. Combustion emissions from construction equipment, and fugitive emissions, would be higher during overlapping construction activities but short term in nature, as the overlap would be limited in time. Therefore, the adverse impact on air quality would likely be **moderate** because while emissions would incrementally increase ambient pollutant concentrations, they 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. While the benefit is regional, BOEM anticipates a **moderate beneficial** impact because the magnitude of the potential reduction in emissions from displacing fossil-fueled generated power would be small relative to total energy generation emissions in the area.

3.4.6 Impacts of Alternatives B, C, D, and E on Air Quality

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park.

Impacts of Alternatives B, C, D, and E. Air quality and climate impacts associated with all action alternatives would be similar to those of the Proposed Action. Alternatives B-1, B-2, and D could have slightly lower emissions from offshore construction and operation compared to the Proposed Action, to the extent that these alternatives would reduce the number of WTGs. To the extent that total annual MW-hours generated were diminished due to differing wind cut-in speeds of higher-capacity turbine generators, benefits would be diminished. Alternatives C-1 and C-2 would have the same number of WTGs as the Proposed Action and, therefore, the same anticipated emissions. Although under Alternative E, the offshore and onshore cable lengths would be slightly (2,000 feet) longer, the anticipated emissions from offshore and onshore cable construction and installation would not be discernably different from those of the Proposed Action. Overall, the differences in emissions among the action alternatives and the Proposed Action would be small, and the air quality and climate impacts from all action alternatives would be substantively the same as described for the Proposed Action. Similarly, the quantities of coolants, oils and lubricants, and diesel fuel under the other action alternatives would be similar to those of the Proposed Action and therefore the impacts on air quality from accidental releases are expected to be about the same as those of the Proposed Action.

BOEM used the USEPA AVERT v4.0 model to calculate the avoided CO_2 emissions for the operational lifespan[6] of the Project with a capacity factor of 45 percent (Ocean Wind 2023) and with a generation capacity of 1,100 MW for each alternative. Table 3.4-11 presents the associated annual emissions and avoided emissions of CO_2 for each alternative. The Proposed Action would result in an annual reduction of 3,177,897 U.S. tons of CO_2, which is the equivalent of the removal of 621,185 gasoline-powered passenger vehicles driven per year (USEPA 2020c) with a lifetime reduction of 111,226,395 tons of CO_2.

Alternative B-1 would exclude up to nine WTGs, resulting in a 14.0-percent reduction in expected annual energy production and a 9-percent reduction in annual construction and O&M emissions. By reducing the number of WTGs constructed, the emissions related to construction and O&M would be lower; however, by reducing the energy produced, the avoided emissions would be reduced, equivalent to 534,104 vehicles removed annually. Alternative B-2 would exclude up to 19 WTGs, resulting in a 29.6-percent[7] reduction in expected annual energy production and a 19-percent reduction in annual construction and O&M emissions, equivalent to the removal of 440,811 vehicles per year.

Alternative C-1 would exclude or relocate up to eight WTGs, resulting in a 12.5-percent reduction in expected annual energy production and an 8-percent reduction in annual construction and O&M emissions, equivalent to the removal of 543,433 vehicles per year. Alternative D would exclude up to 15 WTGs, resulting in a 19.0-percent reduction in expected annual energy production and a 15-percent reduction in annual construction and O&M emissions, equivalent to the removal of 503,068 vehicles per year.

The No Action Alternative would result in no emissions during construction and O&M, as the Project would not be built, but would also offer no avoided emissions, resulting in higher GHG emissions over the Project duration by not displacing fossil-fueled power generation via offshore wind and resulting in emissions equivalent to 687,271 additional vehicles per year. These figures are relative to the existing grid configuration, 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.

Table 3.4-11 Net Emissions of CO_2 for Each Alternative

Alternative	CO_2 Emissions (U.S. tons)					
	Construction		Operation			Operational Lifetime Net Emissions
	Year 1	Year 2	Years 3–37	Years 3–37 Avoided Emissions	Years 3–37 Net Emissions	
A (Proposed Action)	3,539	656,313	11,753	-3,189,650	-3,177,897	-111,226,395
B-1	3,220	597,245	10,695	-2,743,099	-2,732,404	-95,634,132
B-2	2,867	531,614	9,520	-2,264,652	-2,255,132	-78,929,605
C-1	3,256	603,808	10,813	-2,790,944	-2,780,131	-97,304,585
D	3,008	557,866	9,990	-2,583,617	-2,573,626	-90,076,926

[6] The assumed operational lifetime of the Project is 35 years, while Lease OCS-A 0498 has an operation term of 25 years. Ocean Wind would need to request and be granted an extension of its operations terms from BOEM.
[7] Calculation for Alternative B-2 assumed a linear reduction of 1.56 percent in energy produced per turbine removed based on the ratio in Alternative B-1 that the removal of eight WTGs results in a reduction in expected annual energy production of 12.5 percent.

Alternative	CO_2 Emissions (U.S. tons)					
	Construction		Operation			Operational Lifetime Net Emissions
	Year 1	Year 2	Years 3–37	Years 3–37 Avoided Emissions	Years 3–37 Net Emissions	
No Action	0	0	0	0	+3,189,650	+111,637,750

Cumulative Impacts of Alternatives B, C, D, and E. The incremental impacts contributed by the action alternatives to the overall impacts on air quality would be similar to those of the Proposed Action.

3.4.6.1. Conclusions

Impacts of Alternatives B, C, D, and E. Expected **minor** to **moderate** impacts associated with the Proposed Action would not change under the other action alternatives. The same construction, O&M, and decommissioning activities would still occur, albeit at slightly differing scales as identified. Alternatives B-1, B-2, and D could have slightly less, but not materially different, impacts on air quality compared to the Proposed Action due to a reduced number of WTGs. Alternatives C-1 and C-2 would have the same number of WTGs and therefore the same impacts on air quality as the Proposed Action. Alternative E would have similar impacts on air quality compared to the Proposed Action. As under the Proposed Action, the action alternatives would result in **minor beneficial** impacts on air quality and climate overall due to reduced emissions from fossil-fueled power plants.

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

3.4.7 Proposed Mitigation Measures

Measures are proposed to minimize impacts on air quality (Appendix H, Table H-3). If the measures analyzed below is adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced. Furthermore, BOEM anticipates that some necessary authorizations for the proposed Project, including the OCS Air Permit, may be issued after BOEM issues a ROD or reaches a decision on the COP. Measures or offsets to mitigate potential impacts on the Brigantine Wilderness Area may be included as conditions of the OCS Air Permit. Ocean Wind would be required to adhere to all conditions of the consultations, authorizations, and permits regardless of whether they are issued prior to or after BOEM's decision on the COP.

Table 3.4-12 Additional Proposed Measures (Also Identified in Appendix H, Table H-3): Air Quality

Measure	Description	Effect
Brigantine Wilderness Area air quality related values	BOEM, BSEE, USFWS, and Ocean Wind would develop a framework for the mitigation of AQRV impacts at Brigantine Wilderness Area. The framework would include a description of existing conditions and	Development of a mitigation framework and the subsequent implementation of preventative and compensatory mitigation measures would offset incremental increases in

Measure	Description	Effect
(AQRV) mitigation framework	monitoring objectives; description of preventative 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 Ocean Wind to USFWS; and, reporting to demonstrate completion of implementation.	nitrogen deposition and visibility reducing particles (e.g., plume blight) in the Brigantine Wilderness Area.
SF_6 leak rate monitoring and detection	Leak detection and monitoring requirements of less than 1% would be required in line with IEC and USEPA guidance.	Monitoring leaks at a higher detection threshold would allow for the maintenance to fix seals as soon as possible at an earlier stage.

IEC = International Electrotechnical Commission; SF_6 = sulfur hexafluoride

3.4.7.1. Measures Incorporated in the Preferred Alternative

BOEM has identified the additional measures in Table 3.4-12, Brigantine Wilderness Area air-quality related values mitigation framework, to be incorporated in the Preferred Alternative. This measure, if adopted, would result in the coordinated development and implementation of preventative and compensatory mitigation measures intended to offset air quality impacts. Adoption of this measure would not reduce the minor to moderate impacts of the Preferred Alternative or other action alternatives because increases in ambient pollutant concentrations due to Project emissions would still be detectable.

3.5. Bats

This section discusses potential impacts on bat populations 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, includes the United States coastline from Maine to Florida, and extends 100 miles (161 kilometers) offshore and 5 miles (8 kilometers) inland to capture the movement range for species in this group. The geographic analysis area 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 Description of the Affected Environment for Bats

The number of bat species in the geographic analysis area varies by state, ranging from eight species (Rhode Island, New Hampshire, and Maine) to 17 (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).

There are nine species of bats present in the state of New Jersey, eight of which may be present in the Project area and six that are year-round residents (Table 3.5-1).

Table 3.5-1 Bats Present in New Jersey and their Conservation Status

Common Name	Scientific Name	State Status	Federal Status
Cave-Hibernating Bats			
Eastern small-footed bat[1]	*Myotis leibii*	-	-
Little brown bat[1]	*Myotis lucifugus*	-	Under Review[2]
Northern long-eared bat[1,3]	*Myotis septentrionalis*	-	Endangered
Indiana bat[4]	*Myotis sodalist*	Endangered	Endangered
Tri-colored bat[1]	*Perimyotis subflavus*	-	Proposed
Big brown bat[5]	*Eptesicus fuscus*	-	-
Migratory Tree Bats			
Eastern red bat[5]	*Lasiurus borealis*	-	-
Hoary bat[5]	*Lasiurus cinereus*	-	-
Silver-haired bat[5]	*Lasionycteris noctivagans*	-	-

Source: Ocean Wind 2023; USFWS 2021a, 2021b.
[1] Currently a candidate for state listing as endangered pending rule promulgation (NJDEP 2013).
[2] Currently under a USFWS discretionary status review. Results of the review may be to propose listing, make a species a candidate for listing, provide notice of a not warranted candidate assessment, or other action as appropriate. USFWS anticipates a decision in Fiscal Year 2022.
[3] USFWS reclassified the northern long-eared bat as endangered on January 30, 2023 (87 *Federal Register* 73488).
[4] Range does not indicate species presence in Project area.
[5] Currently a candidate for state listing as special concern pending rule promulgation (NJDEP 2013).

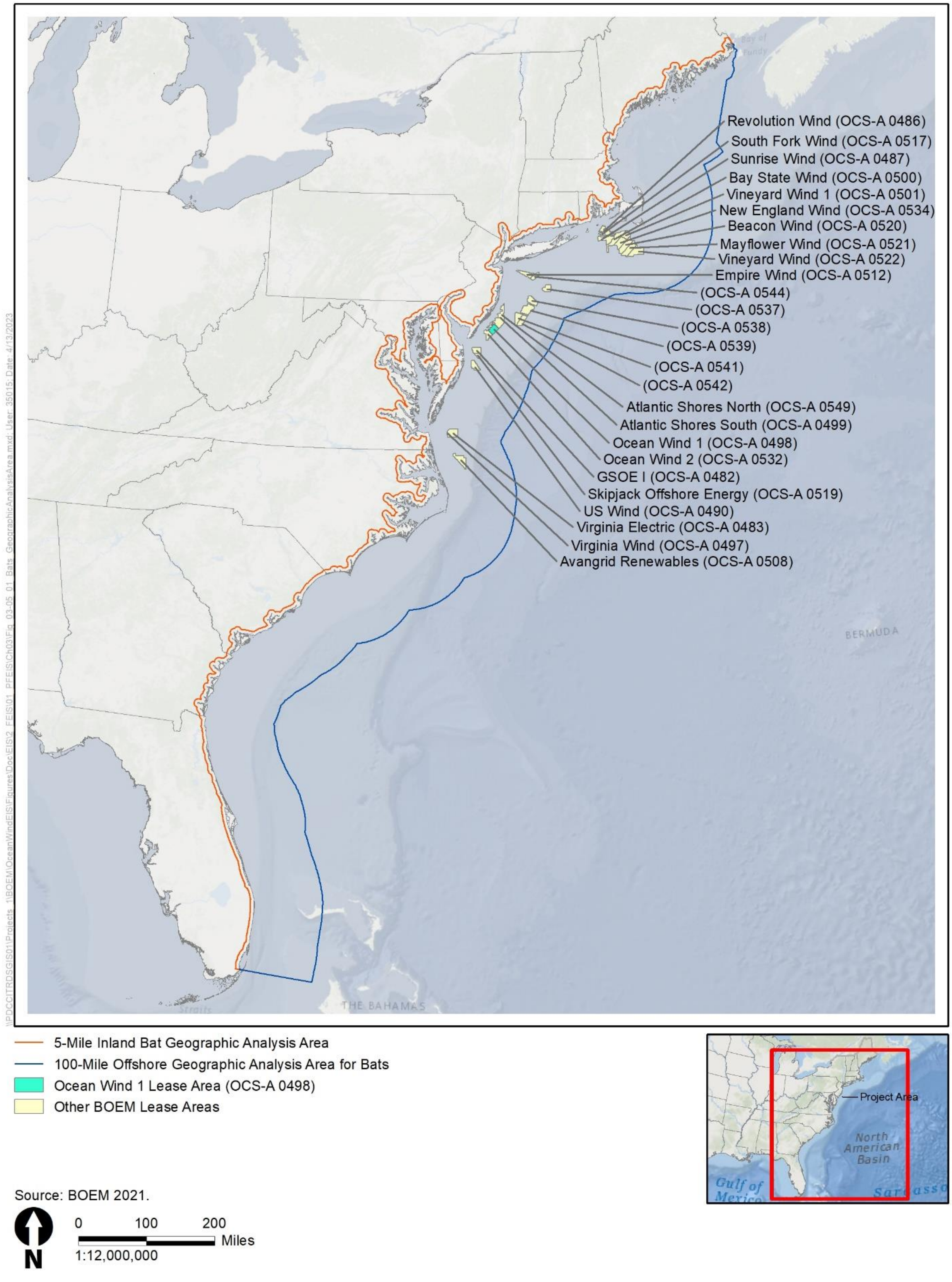


Figure 3.5-1 Bats Geographic Analysis Area

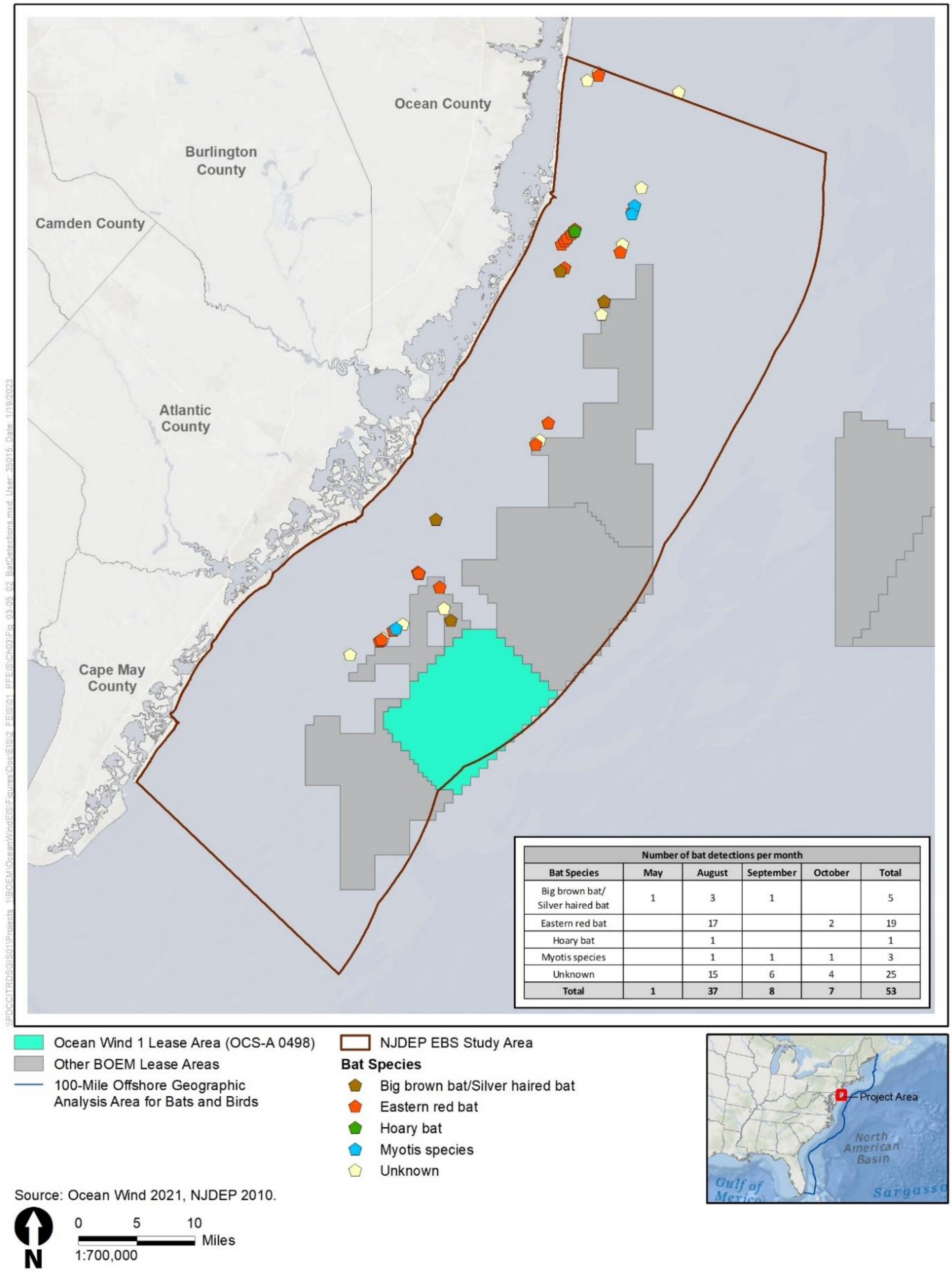
These species can be broken down into cave-hibernating bats and migratory tree bats based on their wintering strategy. Bats are terrestrial species that spend almost their entire lives on or over land. On occasion, tree bats may potentially occur offshore during spring and fall migration and under very specific conditions like low wind and high temperatures. Recent studies, combined with historical anecdotal accounts, indicate that migratory tree bats sporadically travel offshore during spring and fall migration, with 80 percent of acoustic detections occurring in August and September (Dowling et al. 2017; Hatch et al. 2013; Pelletier et al. 2013; Stantec 2016). However, unlike tree bats, the likelihood of detecting a Myotis species or other cave bat is substantially less in offshore areas (Pelletier et al. 2013).

The presence of bats has been documented 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; Ocean Wind 2023). Bats have been documented temporarily roosting on structures (i.e., lighthouses) on nearshore islands and there is evidence of eastern red bats migrating offshore in the Atlantic. In a mid-Atlantic bat acoustic study conducted during the spring and fall of 2009 and 2010, the maximum distance that bats were detected from shore was 13.6 miles (21.9 kilometers) and the mean distance was 5.2 miles (8.4 kilometers). In Maine, bats were detected on islands up to 25.8 miles (41.6 kilometers) from the mainland. In the mid-Atlantic acoustic study, eastern red bat represented 78 percent of all bat detections offshore and bat activity decreased as wind increased. In addition, eastern red bats were detected in the mid-Atlantic up to 27.3 miles (44 kilometers) offshore by high-definition video aerial surveys (Ocean Wind 2023). At this time, there is some uncertainty regarding the level of bat use of the OCS. However, available data indicates that bat activity levels are generally lower offshore compared to onshore (Hein et al. 2021). A bat migration study in the North Sea off Belgium found that the number of bat detections was up to 24 times higher at onshore locations compared to the offshore locations (Brabant et al. 2021).

Cave-hibernating bats hibernate regionally in caves, mines, and other structures (e.g., buildings) and feed primarily on insects in terrestrial and fresh-water habitats. These species generally exhibit lower activity in the offshore environment than the migratory tree bats (Ocean Wind 2023), with movements primarily during the fall. In the mid-Atlantic, the maximum distance *Myotis* bats were detected offshore was 7.2 miles (11.5 kilometers). A recent nano-tracking study on Martha's Vineyard recorded little brown bat movements off the island in late August and early September, with one individual flying from Martha's Vineyard to Cape Cod. Big brown bats were also detected migrating from the island later in the year (October–November). These findings are supported by an acoustic study conducted on islands and buoys off the Gulf of Maine that indicated the greatest percentage of activity in July–October. Given that the use of the coastline as a migratory pathway by cave-hibernating bats is likely limited to their fall migration period, that acoustic studies indicate lower use of the offshore environment by cave-hibernating bats, and that cave-hibernating bats do not regularly feed on insects over the ocean, exposure to the Wind Farm Area is unlikely for this group (Ocean Wind 2023).

Tree bats migrate south to overwinter and have been documented in the offshore environment (Ocean Wind 2023). Eastern red bats have been detected migrating from Martha's Vineyard late in the fall, with one bat tracked as far south as Maryland. These results are supported by historical observations of eastern red bats offshore and recent acoustic and survey results (Ocean Wind 2023). While little local data are available for the Project area, the NJDEP EBS surveys recorded several observations of bats flying over the ocean, with observations of migratory tree bats in the near-shore portion of the Wind Farm Area. Given that tree-bats were detected in the offshore environment, they may pass through the Project area during the migration period (Figure 3.5-2). Offshore acoustic bat surveys were conducted in Lease Area OCS-A 0499 in 2020 and 2021, which is directly adjacent to and north of the Wind Farm Area (Atlantic Shores 2021); species detected in this area during the 2020/2021 survey period may presumably occur in the Wind Farm Area given Lease Area OCS-A 0499's proximity to the Wind Farm Area. Eastern red bat represented the most detections (495) followed by big brown/silver-haired bat group (478), silver-haired bat (80), hoary bat (37), big brown bat (26), tri-colored bat (5), and *Myotis* spp. (3). Detections occurred from July to October, with peak activity in August and September, and the latest detection occurring on November 1. Overall, there were 1,124 total bat detections identified to species or species group across the 180 survey nights in Lease Area OCS-A 0499. 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 Lease Area OCS-A 0499 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 bats undoubtedly take offshore routes during migration and can be present offshore, they appear to represent a very small percentage of their species' total population onshore.

Onshore coastal areas throughout the geographic analysis area provide a variety of habitats that support a diversity of bat species. The onshore export cable route corridors to BL England and Oyster Creek contain a diverse set of habitats including coastal wetlands, forested wetlands, forested uplands, forested lowlands, barrier beaches, and bay island habitats that support a diversity of bat species. Forested habitats, such as the area adjacent to the proposed onshore export cables at BL England and Oyster Creek, can provide roosting areas for both migratory and non-migratory species. All bat species present in New Jersey (migratory and non-migratory) are known to utilize forested areas (of varying types) during summer for roosting and foraging. Some of these species roost solely in the foliage of trees, while others select dead and dying trees where they roost in peeling bark or inside crevices. Some species may select forest interior sites, while others prefer edge habitats (Ocean Wind 2023). Ocean Wind conducted acoustic bat surveys in eight locations of potential suitable bat habitat in the Onshore Project area, including two locations at the Oyster Creek Substation, three locations along a segment of the Oyster Creek onshore export cable route, and three locations around the BL England substation (Johnson and Ostroski 2022). Over the course of the survey, which took place on various nights between July 13 and August 15, 2022, 3,874 total bat calls were recorded (note that number of bat calls does not equal number of bat individuals). The quantitative analysis of the recorded data indicates the presence of big brown bat, eastern red bat, and little brown bat. A manual review of each call file indicated the presence of big brown bat (3), eastern red bat (388), hoary bat (8), evening bat (1), and tricolored bat (2). Biodiversity Research Institute completed field work in 2011 in the area at Edwin B. Forsythe National Wildlife Refuge (6 miles [10 kilometers] south of Oyster Creek and 30 miles [48 kilometers] north of BL England) where northern long-eared bat, eastern red bat, big brown bat, and little brown bat were captured. No telemetry was conducted, so it is unknown if they used the refuge or surrounding areas for roosting. Caves and mines provide key habitat for non-migratory bats. These locations serve as winter hibernacula, fall swarm locations (areas where mating takes place in the fall months), and summer roosting locations for some individuals. Hibernacula are documented in New Jersey, but the numbers of individuals at the sites have declined dramatically because of the fungal disease white-nose syndrome (WNS) (Ocean Wind 2023). Overall, while both cave-hibernating and migratory tree bats may occur in the area around BL England and Oyster Creek, the onshore export cable route corridors are not likely to provide suitable habitat because they are anticipated to be mostly co-located with existing disturbed areas (e.g., roads, transmission lines). In addition, there are generally fewer bats along the coast of New Jersey (see Figure 2-4 in COP Volume III, Appendix H, Ocean Wind 2023).



Number of bat detections per month					
Bat Species	May	August	September	October	Total
Big brown bat/ Silver haired bat	1	3	1		5
Eastern red bat		17		2	19
Hoary bat		1			1
Myotis species		1	1	1	3
Unknown		15	6	4	25
Total	**1**	**37**	**8**	**7**	**53**

Figure 3.5-2 Bat Occurrences in the New Jersey Department of Environmental Protection Ecological Baseline Studies

One bat species protected under the ESA may occur in the Project area: the northern long-eared bat (USFWS 2021a; Ocean Wind 2023). However, the 2022 acoustic bat surveys did not detect any northern long-eared bats (Johnson and Ostroski 2022). The 2022 acoustic survey did detect two calls from tricolored bat, which was recently proposed for listing under the federal ESA. The two calls occurred on one night at one survey location along the Oyster Creek onshore cable route. It is not expected that northern long-eared bats will be exposed to the offshore Wind Farm Area. A recent tracking study on Martha's Vineyard (July–October 2016) did not record any offshore movements (Ocean Wind 2023). If northern long-eared bat were to migrate over water, movements would likely be in close proximity to the mainland. The related little brown bat has been documented to migrate from Martha's Vineyard to Cape Cod, and northern long-eared bat may likewise migrate to mainland hibernacula from these islands in August–September (Ocean Wind 2023). Given that there is little evidence of use of the offshore environment by northern long-eared bat, exposure to the proposed Wind Farm Area, if it occurs, is anticipated to be minimal. The Ocean Wind BA provides a detailed discussion of ESA-listed species and potential impacts on these species as a result of the Project (BOEM 2022).

Cave bat species, including the northern long-eared bat, are experiencing drastic declines due to WNS. WNS has been confirmed present in every state in the geographic analysis area, except Florida (Whitenosesyndrome.org 2021). WNS was confirmed present in New Jersey in 2009 and has killed large numbers of cave bats during hibernation—more than 90 percent at many sites (Whitenosesyndrome.org 2021; New Jersey Division of Fish and Wildlife 2019). However, New Jersey's bat population appears to be stabilizing (New Jersey Division of Fish and Wildlife 2019). Proposed Project-related impacts 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 proposed Project area (USFWS 2015). However, given the drastic reduction in cave bat populations in the region, the biological significance of mortality resulting from the proposed Project, if any, may be increased.

3.5.2 Environmental Consequences

3.5.2.1. Impact Level Definitions for Bats

Definitions of impact levels are provided in Table 3.5-2. There are no beneficial impacts on bats.

Table 3.5-2 Impact Level Definitions for Bats

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

3.5.3 Impacts of the No Action Alternative on Bats

Section 3.1 of the Final EIS 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 F, *Planned Activities Scenario*. Separate impact conclusions are presented for both scenarios.

3.5.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for bats described in Section 3.5.1, *Description of the Affected Environment for Bats,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on bats are generally associated with onshore construction and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect bat species through temporary and permanent habitat removal and temporary noise impacts, which could cause avoidance behavior and displacement. Mortality of individual bats could occur, but population-level effects would not be anticipated. Impacts associated with climate change have the potential to reduce reproductive output and increase individual mortality and disease occurrence.

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

- Continued O&M of the Block Island project (five WTGs) installed in state waters;
- Continued O&M of the Coastal Virginia Offshore Wind project (two WTGs) installed in OCS-A 0497; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

The effects of approved projects have been evaluated through previous NEPA review and are incorporated by reference. Ongoing O&M of the Block Island and Coastal Virginia Offshore Wind projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect bats through the primary IPFs of noise, presence of structures, and land disturbance. Ongoing offshore wind activities would have the same type of impacts from noise, presence of structures, and land disturbance that are described in detail in Section 3.5.3.2 for planned offshore wind activities but the impacts would be of lower intensity.

3.5.3.2. Cumulative Impacts of the No Action Alternative

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

Other planned non-offshore wind activities that may affect bats include 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 F.2 in Appendix F for a complete description of planned activities). These activities may result in temporary and permanent onshore habitat impacts and temporary or permanent displacement and injury of or mortality to individual bats, but population-level effects would not be expected. See Table F1-2 for a summary of potential impacts associated with planned non-offshore wind activities by IPF for bats.

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.

Offshore wind activities may affect bats through the following primary IPFs.

Noise: Anthropogenic noise 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. BOEM anticipates that these impacts would be temporary and highly localized.

In the planned activities scenario (Appendix F, *Planned Activities Scenario*), the construction of 3,000 offshore structures (other than the Proposed Action) 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 4 to 6 hours at a time 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 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.

Potential for temporary and localized habitat impacts arising from onshore construction noise exists; however, no auditory impacts on bats would be expected to occur. 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 significant. 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 common among bats (Hann et al. 2017; Whitaker 1998).

Non-routine activities associated with the offshore wind facilities would generally 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 temporary and last only as long as repair or remediation activities were necessary to address these non-routine events.

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

Presence of structures: Offshore wind-related activities would add up to 3,000 WTGs and OSS on the OCS that could result in potential impacts on bats. Cave bats (including the federally listed as threatened northern long-eared bat) do not tend to fly offshore (even during fall migration) and, therefore, exposure to construction vessels during construction or maintenance activities, or the rotor-swept zone (RSZ) of operating WTGs in the wind lease areas (e.g., collisions, barotrauma), is expected to be negligible to minor, if exposure occurs at all (BOEM 2015; Pelletier et al. 2013).

Tree bats, however, may pass through the offshore wind lease areas during the fall migration, with limited potential for migrating bats to encounter vessels during construction and decommissioning of WTGs, OSS, and offshore export cable corridors, although structure and vessel lights may attract bats due to increased prey abundance. As discussed above, while bats have been documented on offshore islands, relatively little bat activity has been documented over open water habitat similar to the conditions in the Project Wind Farm Area. Several authors, such as Cryan and Barclay (Barclay 2009), Cryan et al. (Cryan et al. 2014), and Kunz et al. (Kunz et al. 2007), discuss several hypotheses as to why bats may be attracted to WTGs. Many of these, including the creation of linear corridors, altered habitat conditions, or thermal inversions, would not apply to WTGs on the Atlantic OCS (Cryan and Barclay 2009; Cryan et al. 2014; Kunz et al. 2007). Other hypotheses associated with the Atlantic OCS 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, OSS and non-operational WTG towers to opportunistically roost or forage. However, bats' echolocation abilities and agility make it unlikely that these stationary objects (OSS and non-operational WTGs) or moving vessels would pose a collision risk to migrating individuals; this assumption is supported by the evidence that bat carcasses are rarely found at the bases of onshore turbine towers (Choi et al. 2020).

Tree bat species that may encounter the operating WTGs in the offshore wind lease areas include the eastern red bat, hoary bat, and silver-haired bat. Offshore O&M would present a seasonal risk factor to migratory tree bats that may utilize the offshore habitats during fall migration. While some potential exists for migrating tree bats to encounter operating WTGs during fall migration, the overall occurrence of bats on the OCS is relatively very low (Stantec 2016). 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 offshore wind development. With the proposed up to 1-nm (1.9-kilometer) spacing between structures associated with offshore wind development and the distribution of anticipated projects, individual bats migrating over the OCS within the RSZ of project WTGs would likely pass through projects 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). Additionally, the potential collision risk to migrating tree bats varies with climatic conditions; for example, bat activity is associated with relatively low wind speeds and warm temperatures (Arnett et al. 2008; Cryan and Brown 2007; Fiedler 2004; Kerns et al. 2005). Given the relatively low numbers of tree bats in the offshore environment, the WTGs being widely spaced, and the patchiness of projects, the likelihood of collisions is expected to be low, so impacts on bats would be negligible to minor. Additionally, the likelihood of a migrating individual encountering one or more operating WTGs during adverse weather conditions is extremely low, as bats have been shown to suppress activity during periods of strong winds, low temperatures, and rain in the onshore environment (Arnett et al. 2008; Erickson et al. 2002), as well as the offshore environment where strong winds, low temperatures, and inclement weather correlate with lower bat activity in the offshore environment (Sjollema et al. 2014; Ahlen et al. 2007; Stantec 2016; True et al. 2021). In addition, bats avoid flying in rain due to the increased energy expenditure (Voigt et al. 2011).

Land disturbance: A small amount of infrequent construction impacts associated with onshore power infrastructure would be required over the next 8 years to tie offshore wind energy projects to the electrical grid. Typically, this would require only small amounts of habitat removal, if any, and would occur in previously disturbed areas. Short-term, negligible to minor impacts associated with habitat loss or avoidance during construction may occur, and injury or mortality of individuals would be unlikely. As such, onshore construction activities associated with offshore wind development would not be expected to appreciably contribute to 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 general trend along the coastal region from Virginia to Maine is that port activity will increase modestly and require some conversion of undeveloped land to meet port demand. This conversion will result in permanent habitat loss for local bat populations. However, the incremental increase from offshore wind development would be a minimal contribution in the port expansion required to meet increased commercial, industrial, and recreational demand (BOEM 2019).

3.5.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, bats would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on bats. These effects are primarily driven by 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 onshore habitat may occur as a result of offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area. The No Action Alternative would result in **negligible** to **minor** impacts on bats.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and bats would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on bats due to habitat loss from increased onshore construction. BOEM anticipates that the cumulative impacts of the No Action Alternative would likely be **negligible** to **minor** because bat presence on the OCS is anticipated to be limited and onshore bat habitat impacts are expected to be minimal.

3.5.4 Relevant Design Parameters & Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; BOEM expects any potential variances in the proposed Project build-out within the range of the PDE to result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix E) would influence the magnitude of the impacts on bats:

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

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

- WTG number, size, and location: The level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would present less hazard to bats.
- 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 a lesser impact on bats than construction during the active season.

Ocean Wind has committed to measures to minimize impacts on bats. Trees would be cleared during winter months to the extent practicable (BAT-01), and if tree clearing is required in areas with trees suitable for bat roosting habitat when northern long-eared bats may be present, avoidance and minimization measures would be developed in coordination with USFWS and NJDEP (BAT-02). Also, Ocean Wind would use lighting technology that minimizes impacts on bat species (BIRD-04) (COP Volume II, Table 1.1-2; Ocean Wind 2023) and has committed to implementing an *Avian and Bat Post-Construction Monitoring Framework* (COP Appendix AB; Ocean Wind 2023) that outlines an approach to post-construction bat monitoring that supports advancement of the understanding of bat interactions with offshore wind farms.

3.5.5 Impacts of the Proposed Action on Bats

3.5.5.1. Impacts of the Proposed Action

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park, which is described in Section 3.5.7, *Impacts of Alternative E on Bats*.

The sections below summarize the potential impacts of the Proposed Action on bats during the various phases of the proposed Project. Routine activities would include construction, O&M, and decommissioning of the proposed Project, as described in Chapter 2, *Alternatives*. BOEM prepared a BA for the potential effects on USFWS federally listed species, which found that the Proposed Action was *not likely to adversely affect*, or had *no effect*, on listed species (BOEM 2022). BOEM requested concurrence 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* northern long-eared bat. There is no critical habitat designated for this species. The results of consultation with USFWS pursuant to Section 7 of the ESA will be included in the Final EIS.

Noise: Pile-driving noise and onshore and offshore construction noise associated with the Proposed Action is expected to result in temporary, highly localized, and negligible 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).

Presence of Structures: The various types of impacts on bats that could result from the presence of structures, such as migration disturbance and turbine strikes, are described in detail in Section 3.5.3.2. Up to 98 WTGs on the OCS would result from the proposed Project where few currently exist. The structures, and related bat impacts, associated with Proposed Action would remain at least until decommissioning of the proposed Project is complete. At this time, there is some uncertainty regarding the level of bat use of the OCS and the ultimate consequences of mortality, if any, associated with operating WTGs. Three years of post-construction bat monitoring around the Block Island Wind Farm found bats present and at wind speeds at or above the cut-in speeds for Ocean Wind 1's proposed WTGs (Stantec 2020), which could indicate vulnerability for bats. The cut-in speed for the proposed WTGs is 3.5 m/s and, based on the wind speeds that bats were observed at the Block Island Wind Farm, bats could be exposed to the turbine blades when they are turning. However, as previously mentioned, available data indicate that bat activity levels are generally lower offshore compared to onshore (Hein et al. 2021). A bat migration study in the North Sea off Belgium found that the number of bat detections was up to 24 times higher at onshore locations compared to offshore locations (Brabant et al. 2021). In addition, the proposed WTGs are very large and spin much slower (7.8 rotations per minute) compared to onshore wind turbines.

Existing data from meteorological buoys provide the best opportunity to further define bat use of open-water habitat far from shore where Ocean Wind would site the proposed Project WTGs. Relatively few (372) bat passes were detected at meteorological buoy sites and use was sporadic when compared to sites on offshore islands (Stantec 2016). In addition, the data from 3 years of post-construction monitoring around Block Island Wind Farm found relatively low numbers of bats and only during fall, and no northern long-eared bats (Stantec 2020). While the buoy data and Block Island Wind Farm data were collected outside of the Project's Wind Farm Area, the information is still applicable to the overall use of bats on the OCS. Furthermore, as previously mentioned, surveys conducted offshore New Jersey for the NJDEP EBS that cover the Project's Wind Farm Area recorded several observations of bats flying over the ocean, but not as far as Ocean Wind 1's Wind Farm Area (NJDEP 2010) (Figure 3.5-2). Therefore, because available information indicating bat presence on the OCS is limited, BOEM anticipates the presence of structures to have a negligible to minor impact on bats. Ocean Wind has also committed to implementing an *Avian and Bat Post-Construction Monitoring Framework* (COP Appendix AB; Ocean Wind 2023) that outlines an approach to post-construction bat monitoring that supports advancement of the understanding of bat interactions with offshore wind farms. The scope of monitoring is designed to meet federal requirements (30 CFR 585.626(b)(15) and 585.622(b)) and is scaled to the size and risk profile of the Project with a focus on species of conservation concern.

Land disturbance: Impacts associated with construction of onshore elements of the Proposed Action could occur if construction activities occur during the active season (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. There would be some potential for habitat impacts on bats as a result of the loss of potentially suitable roosting or foraging habitat. However, impacts on bat habitat from onshore construction activities would be limited because, whenever possible, facilities (including overhead transmission lines) would be co-located with existing developed areas (i.e., roads and existing transmission lines) to limit disturbance. Where necessary, construction of onshore facilities may require clearing and some permanent removal of some trees along the edge of the construction corridor. The existing habitat at the proposed onshore substation sites at BL England and Oyster Creek is already developed and fragmented. Any remnant habitat within the permanent substation site would be converted to developed land with landscaping for the duration of the Project's operational lifetime.

Approximately 12.6 acres of tree clearing would be required to construct the Oyster Creek substation (Table 3.5-3). However, the substation area is previously disturbed and sparsely vegetated, is characterized as upland meadow early-successional forest with some patches of emergent wetlands and small scattered trees, and is not suitable bat roosting habitat. The Oyster Creek onshore cable route does include tree clearing in some forested areas characterized as mixed pine barrens/oak-dominated forest. An estimated 4.1 acres would be permanently cleared and 10.3 acres temporarily cleared for the Oyster Creek onshore cable route (Table 3.5-3). However, these forested areas are predominantly previously disturbed farmland and are composed primarily of successional stage pitch pine and small mixed oaks typical of coastal New Jersey and are generally not suitable bat roosting habitat, with few trees at least 3 inches in diameter.

The BL England substation is predominantly upland meadow, as it occupies much of a former golf course that continues to be mowed regularly, but there are areas of upland forest with a moderate to dense tree canopy with a mix of pines and hardwoods. Forested areas within the substation parcel feature a moderate to dense tree canopy with a mix of coniferous and deciduous species, and an open shrub and sapling layer. Trees are generally small (6 to 10 inches in diameter) with the exception of a few larger pitch pines and red maples. Dominant tree species are red maple, pitch pine, Eastern red cedar, black tupelo, sweetgum, and white pine. Construction of the substation would not require permanent or temporary tree clearing (Table 3.5-3). The BL England onshore export cable route is mostly within paved roadways but would require 0.7 acre of permanent and 0.5 acre of temporary tree clearing near the proposed substation.

Table 3.5-3 Estimated Areas of Tree Clearing (Acres)

Location	Permanent Tree Clearing[1]	Temporary Tree Clearing[1,2]	Total Tree Clearing
Oyster Creek			
Oyster Creek Export Cable	4.1	10.3	14.4
Oyster Creek Substation	12.6	0	12.6
Oyster Creek Total	16.7	10.3	27.0
BL England			
BL England Export Cable	0.7	0.5	1.2
BL England Substation	0	0	0
BL England Total	0.7	0.5	1.2

The areas in the table are based on the proposed limits of disturbance and canopy coverage from aerial photography. Once tree surveys are concluded, these areas will be refined.

[1] Some areas within the limit of disturbance will be cleared of trees permanently; however, much of this area is not forested.

[2] Temporary tree clearing may be required for construction laydown and access and will be allowed to naturally revegetate or be replanted.

To avoid and minimize impacts on bats, Ocean Wind is proposing to conduct tree clearing during winter months, to the extent practicable, to develop avoidance and minimization measures with USFWS and NJDEP specific to the northern long-eared bat and to conduct pre-construction habitat surveys for northern long-eared bat (BAT-01, BAT-02; see COP Volume II, Table 1.1-2; Ocean Wind 2023). Additional measures proposed by Ocean Wind that are not specific to bats would further avoid and minimize land disturbance impacts on bats (GEN-01, GEN-13, TCHF-01, and TCHF-02; see COP Volume II, Table 1.1-2; Ocean Wind 2023). BOEM anticipates that impacts would be negligible to minor given the limited amount of habitat removal, and that any potential impact would be avoided or significantly reduced due to Ocean Wind's proposed APMs; therefore, impacts would not result in individual fitness or population-level effects.

3.5.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities. 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. 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 2,952 WTGs, to which the Proposed Action would contribute 98 WTGs or 3 percent.

The cumulative impacts on bats would likely be negligible to minor 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.

3.5.5.3. Conclusions

Impacts of the Proposed Action. BOEM anticipates construction and installation, O&M, and conceptual decommissioning of the Proposed Action would have **negligible** to **minor** impacts on bats, especially if tree clearing is conducted outside the active season. The primary risks would be from potential onshore removal of habitat and operation of the offshore WTGs, which could lead to negligible to minor 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 of pile-driving or construction activity that would cease once construction is complete.

Cumulative Impacts of the Proposed Action. BOEM anticipates that the cumulative impacts on bats in the geographic analysis area would be **negligible** to **minor**. The incremental impacts contributed by the Proposed Action to the cumulative impacts on bats would be undetectable. Because the occurrence of bats offshore is low, the Proposed Action would contribute to the cumulative impacts primarily through the permanent impacts from onshore habitat loss related to onshore cable installation and substation construction.

3.5.6 Impacts of Alternatives B, C, and D on Bats

Impacts of Alternatives B, C, and D. The impacts resulting from individual IPFs associated with construction and installation, O&M, and conceptual decommissioning of the Project under Alternatives B, C, and D would be similar to those described under the Proposed Action. BOEM expects the elimination of WTGs under Alternatives B-1 (up to 9 WTGs), B-2 (up to 19 WTGs), and D (up to 15 WTGs) to have a reduced impact on bats given the smaller number of WTGs compared to the Proposed Action. BOEM does not expect relocation of the eight WTGs and compression of the 98 WTGs under Alternatives C-1 and C-2, respectively, to significantly change the potential impacts compared to the Proposed Action because the total number of WTGs would remain the same, the overall footprint would be the same or slightly less, and the Wind Farm Area does not include areas with high bat densities.

Given the infrequent and limited use of the OCS by bats during spring and fall migration and the similar or smaller footprints under Alternatives B-1, B-2, C-1, C-2, and D, BOEM does not anticipate impacts to be materially different than those described under the Proposed Action.

Cumulative Impacts of Alternatives B, C, and D. The cumulative impacts on bats would likely be negligible to minor because the occurrence of bats offshore is low, and onshore habitat loss is expected to be minimal. The incremental impacts contributed by Alternatives B, C, and D to the cumulative impacts on bats would be similar to those described under the Proposed Action.

3.5.6.1. Conclusions

Impacts of Alternatives B, C, and D. As discussed in the above sections, the anticipated negligible to minor impacts associated with the Proposed Action would not change substantially under Alternatives B, C, and D. While Alternatives B, C, and D could slightly change the impacts on bats within the Offshore and Onshore Project areas, ultimately the same construction, O&M, and decommissioning impacts would still occur. Alternatives B-1, B-2, and D may result in slightly less, but not materially different, negligible to minor impacts on bats than those described under the Proposed Action. Alternative C-1 would have the same WTG number and Wind Farm Area footprint as the Proposed Action and, therefore, would have similar negligible to minor impacts on bats. Alternative C-2 would have the same number of WTGs as the Proposed Action, but compressed in a smaller footprint, and, therefore, would have similar negligible to minor impacts on bats. Therefore, the **negligible** to **minor** impacts would be very similar among the Proposed Action and Alternatives B, C, and D.

Cumulative Impacts of Alternatives B, C, and D. The incremental impacts contributed by Alternatives B, C, and D to the cumulative impacts on bats would be undetectable. However, the differences in impacts among Alternatives B, C, and D should still be considered alongside the impacts of other factors. Therefore, impacts on bats would be slightly less, but not materially different, under Alternatives B-1, B-2, and D and similar, but not materially different, under Alternatives C-1 and C-2. BOEM anticipates the that the cumulative impacts of Alternatives B, C, and D would likely be **negligible** to **minor**. This impact rating is driven primarily by ongoing activities as well as limited disturbance and habitat removal associated with onshore construction of the alternatives.

3.5.7 Impacts of Alternative E on Bats

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park.

Impacts of Alternative E. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternative E would be similar to those described under the Proposed Action. In contrast to the Proposed Action, which includes two Oyster Creek cable route options as part of Ocean Wind’s PDE to cross Island Beach State Park, Alternative E would cross Island Beach State Park on the more northerly route where SAV impacts would be avoided (refer to Section 2.1.6). BOEM expects that the modifications to the Oyster Creek export cable route to avoid impacts on SAV in Barnegat Bay under Alternative E would not significantly change the potential impact compared to the Proposed Action. Alternative E would affect an additional 0.9 acre of undisturbed scrub/shrub and wetland habitat, which can support bats, compared to the southern cable route under the Proposed Action. This habitat impact would occur in the vicinity of an existing maintenance/storage yard across from the Park Office on Central Avenue/Shore Road and would be a primarily temporary impact to support HDD staging and workspace, but some permanent cable easements would be required after the staging and workspaces are restored. Alternative E would also slightly increase the length of the onshore cable route compared to the southern option under the Proposed Action, but the cable would be placed along the parking area and Central Avenue/Shore Road where vegetation impacts are anticipated to be minimal. While the construction duration under Alternatives E could be longer than under the Proposed Action if the southern cable route option is constructed due to the slightly increased cable length, non-habitat impacts (e.g., noise) would be temporary, lasting only the duration of construction. Any timing restrictions for construction to avoid impacts on bats (e.g., not clearing trees during winter) would be the same as under the Proposed Action. Impacts on bat habitat from onshore construction activities under

Alternative E would increase slightly compared to the Proposed Action due to HDD staging and workspace and permanent impacts from widening existing rights-of-way, but would still remain relatively limited because facilities would be co-located with existing developed areas (i.e., roads, parking areas, and maintenance yards) to limit disturbance and affected habitats would be mostly restored or would be minimal in the context of the surrounding available habitat.

Cumulative Impacts of Alternative E. The cumulative impacts on bats would likely be negligible to minor because the occurrence of bats offshore is low, and onshore habitat loss is expected to be minimal. The incremental impacts contributed by Alternative E to the cumulative impacts on bats would be similar to those described under the Proposed Action.

3.5.7.1. Conclusions

Impacts of Alternative E. The anticipated negligible to minor impacts associated with the Proposed Action alone would not change substantially under Alternative E. While Alternative E could slightly change the impacts on bats within the Onshore Project area, ultimately the same construction, O&M, and decommissioning impacts would still occur. Alternative E would have a slightly different onshore cable route than the southern option under the Proposed Action that could result in negligible to minor impacts for onshore ground disturbance due to potential temporary and permanent impacts, but impacts on bat habitat from onshore construction activities would not be materially different than those of the Proposed Action and would still remain limited. Therefore, Alternative E would have negligible to minor impacts on bats.

Cumulative Impacts of Alternative E. The incremental impacts contributed by Alternative E to the cumulative impacts on bats would be undetectable. Considering all the IPFs together, BOEM anticipates that the cumulative impacts on bats associated with Alternative E would be **negligible** to **minor**. This impact rating is driven primarily by ongoing activities as well as limited disturbance and habitat removal associated with onshore construction of Alternative E.

3.5.8 Proposed Mitigation Measures

Several measures are proposed minimize impacts on bats (Appendix H, Table H-2). If the measures analyzed below are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced.

Table 3.5-4 Measures Resulting from Consultations (Also Identified in Appendix H, Table H-2): Bats

Measure[1]	Description	Effect
Adaptive mitigation for birds and bats	BOEM will require that Ocean Wind develops and implements an Avian and Bat Post-Construction Monitoring Plan based on COP Appendix III, Appendix AB Avian and Bat Post-Construction Monitoring Framework in coordination with USFWS, NJDEP, and other relevant regulatory agencies. Annual monitoring reports will be used to determine the need for adjustments to monitoring approaches, consideration of new monitoring technologies, and/or additional periods of monitoring (see Appendix H, Table H-2 for more detail).	If the reported post-construction bat monitoring results (generated as part of Ocean Wind's *Avian and Bat Post-Construction Monitoring Framework* [COP Appendix AB, Ocean Wind 2023]) indicate bat impacts deviate substantially from the impact analysis included in this EIS, then Ocean Wind must make recommendations for new mitigation measures or monitoring methods (refer to Appendix H, Table H-2).
Annual bird and	Annual Bird Mortality Reporting during	Annual bat mortality reporting can

Measure[1]	Description	Effect
bat mortality reporting	construction and operation, and decommissioning. The Lessee must submit an annual report covering each calendar year, due by January 31 of the following year, documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning. The report must be submitted to BOEM (at renewable_reporting@boem.gov) and BSEE (at OSWSubmittals@bsee.gov) and USFWS. The report must contain the following information: the name of species, date found, location, a picture to confirm species identity (if possible), and any other relevant information. Carcasses with federal or research bands must be reported to the United States Geological Survey Bird Band Laboratory. Any occurrence of dead ESA birds or bats must be reported to BOEM, BSEE, and USFWS as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours after the sighting, and if practicable, carefully collect the dead specimen and preserve the material in the best possible state.	inform the Avian and Bat Post-Construction Monitoring Plan (see previous measure), which could lead to Ocean Wind recommending new mitigation measures or monitoring methods to reduce impacts on bats. In addition, mortality data can inform future BOEM offshore wind EIS analyses for proposed wind farms on the Atlantic OCS.
Survey (ESA-listed bats)	BOEM will require that Ocean Wind conducts pre-construction surveys for ESA-listed bats and implements avoidance and minimization measures in coordination with USFWS and NJDEP.	Pre-construction surveys would identify the potential presence of ESA-listed bats, and the survey results would inform whether measures should be implemented to avoid or minimize impacts on ESA-listed bats. While Ocean Wind has already proposed pre-construction surveys for northern long-eared bat and to conduct clearing during the winter (as much as practicable), as well as already having conducted bat surveys in 2022 along its preferred route (see results in Section 3.5.1), this measure could result in additional impact reduction on ESA-listed bats, proposed ESA-listed bats, and non protected bats.
Bat habitat impact reduction	GEN-13 will be modified to enhance bat habitat in coordination with USFWS and NJDEP. Ocean Wind 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	Coordination with USFWS and NJDEP on restoring temporarily disturbed areas during construction would ensure that any bat habitat disturbed would be enhanced to minimize any potential loss or modification of bat habitat.

Measure[1]	Description	Effect
	order to provide high-quality bat habitat and must be provided to BOEM and USFWS for approval prior to commencing onshore construction activities.	
Surveys, Avoidance, and Minimization (bat acoustic surveys)	If Ocean Wind elects to construct an Oyster Creek onshore cable route option other than the Holtec route, Ocean Wind must coordinate with BOEM, USFWS, and NJDEP prior to commencing onshore construction activities. After coordination with BOEM, USFWS, and NJDEP, Ocean Wind must retain the services of a USFWS Recognized and Qualified Bat Surveyor to conduct presence/absence surveys (acoustic or mist netting) along the proposed route that are consistent with the USFWS' Rangewide Indiana Bat and Northern Long-eared Bat Survey Guidelines. A survey work plan must be submitted to USFWS for approval before commencing the survey. A survey report, including maps and associated spatial files in an ESRI ArcGIS/ArcPro compatible format, must be provided to BOEM and USFWS for review no later than 30 calendar days after the survey has been completed. BOEM and USFWS will complete their reviews and identify any deficiencies that require a report revision by Ocean Wind. Based on the results of the presence/ absence surveys, USFWS may recommend additional field investigations, such as a tree survey to assess roost habitat suitability and/or a mist netting/bat tracking effort to locate occupied roosts. If potential NLEB or tricolored bat roosting habitat will be impacted by Project activities, Ocean Wind must coordinate with USFWS to develop appropriate conservation measures that Ocean Wind is required to implement to avoid adverse effects to this species. Conservation Measures may include a seasonal restriction on tree clearing and avoidance of likely or known roost trees.	Pre-construction surveys along the Oyster Creek onshore cable route would identify the potential presence of ESA listed and proposed bats, and the survey results would inform the coordination with BOEM, NJDEP, and USFWS on whether or not measures should be implemented to avoid or minimize impacts on these bats. While Ocean Wind has already proposed pre-construction surveys for Northern long-eared bat and to conduct clearing during the winter (as much as practicable), this measure could result in additional impact reduction on ESA-listed bats, proposed ESA-listed bats, and non protected bats.
Bat habitat impact reduction (non-routine tree clearing)	Ocean Wind will coordinate with the USFWS prior to any clearing of trees (> 3 inches dbh) required during operation and maintenance.	Prior to tree clearing during O&M, coordinating with USFWS on the removal of trees that may be suitable for bat use would ensure that impacts on bats and their habitat would be avoided or minimized to the extent practicable.
Bat habitat impact reduction (building/structure	Ocean Wind must contact USFWS to assess the potential risk to ESA-listed bat species should any abandoned or dilapidated	Coordinating with USFWS on potential bat habitat impacts, in this case abandoned or dilapidated

Measure[1]	Description	Effect
demolition)	buildings or structures require demolition during the O&M phase. If USFWS determines that adverse effects exist, Ocean Wind must coordinate with USFWS to develop appropriate mitigation measures that Ocean Wind is required to implement to avoid adverse effects to listed bat species.	buildings/structures, would ensure that impacts on bats would be avoided or minimized to the extent practicable.

[1] All BOEM bat measures in this table are a result of BOEM's ESA Section 7 consultation with USFWS. These same measures are listed in BOEM's BA for species under USFWS jurisdiction and would likely benefit non ESA-listed bat species in the Project area.
dbh = diameters at breast height; NLEB = northern long-eared bat

3.5.8.1. Measures Incorporated in the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.5-4 and Table H-2 in Appendix H, *Mitigation and Monitoring*, are incorporated in the Preferred Alternative. These measures would further define how the effectiveness and enforcement of APMs would be ensured and improve accountability for compliance with APMs by requiring monitoring, reporting, and adaptive management of potential bat impacts on the OCS. However, given the infrequent and limited anticipated use of the OCS by migrating tree bats during spring and fall migration, and given that cave bats do not typically occur on the OCS, offshore wind activities are unlikely to appreciably contribute to impacts on bats regardless of measures intended to address potential offshore bat impacts. In the onshore environment, conducting pre-construction surveys and coordinating with NJDEP and USFWS would ensure impacts on bats and their habitats would be avoided and minimized to the extent practicable. Because these measures ensure the effectiveness of and compliance with APMs that are already analyzed as part of the Proposed Action, implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.5.2, *Environmental Consequences*.

This page intentionally left blank.

3.7. 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 for birds, as shown on Figure 3.7-1, includes the United States coastline from Maine to Florida; the offshore limit is 100 miles (161 kilometers) from the Atlantic shore and the onshore limit is 0.5 mile (0.8 kilometer) inland. The geographic analysis area was established to capture resident species and migratory species that winter as far south as South America and the Caribbean, and those that breed in the Arctic or along the Atlantic Coast that travel through the area. The offshore limit was established to cover the migratory movement of most species in this group. The onshore limit was established to cover onshore habitats used by the species that may be affected by onshore and offshore components of the proposed Project.

3.7.1 Description of the Affected Environment for Birds

This section discusses bird species that use onshore and offshore habitats, including both resident bird species that use the proposed Project area during all (or portions of) the year and migrating bird species with the potential to pass through the proposed Project area during fall migration, spring migration, or both. Detailed information regarding habitats and bird species potentially present can be found in the COP Volume II, Section 2.2.3, and Appendix H (Ocean Wind 2023). Given the differences in life history characteristics and habitat use between offshore and onshore bird species, the sections below provide a separate discussion of each group. This section also discusses bald and golden eagles. In addition, this section addresses federally listed threatened and endangered birds, which are further addressed in the Ocean Wind 1 BA prepared for USFWS (BOEM 2022).

The mid-Atlantic Coast plays an important role in the ecology of many bird species. The Atlantic Flyway is a major route for migratory birds, which are protected under the Migratory Bird Treaty Act of 1918. 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. Birds in the geographic analysis area are subject to pressure from ongoing activities, such as onshore construction, marine minerals extraction, port expansions, and installation of new structures in the OCS, but particularly from accidental releases; new cable, transmission line, and pipeline emplacement; interactions with fisheries and fishing gear; and climate change. More than one-third of bird species that occur in North America (37 percent, 432 species) are at risk of extinction unless significant conservation actions are taken (NABCI 2016). This is likely representative of the conditions of birds within the geographic analysis area. Species that live or migrate through the Atlantic Flyway have historically been, and will continue to be, subject to a variety of ongoing anthropogenic stressors, including hunting pressure (approximately 86,000 seaducks are 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, which have the potential to have adverse impacts on bird species.

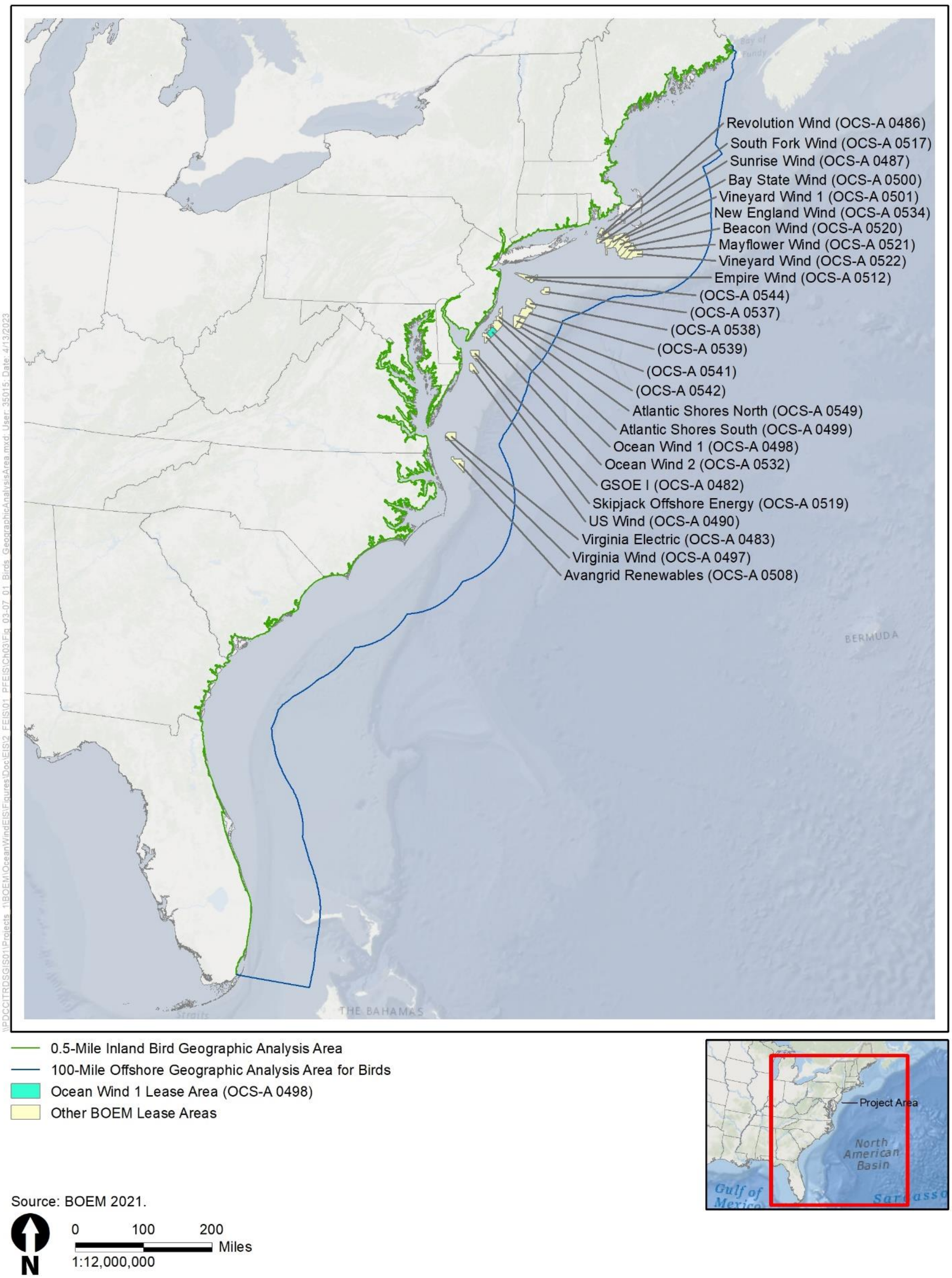


Figure 3.7-1 Birds Geographic Analysis Area

According to the North American Bird Conservation Initiative (NABCI), more than half of the offshore bird species (57 percent, 31 species) have been placed on the NABCI watch list as a result of small ranges, small and declining populations, and threats to required habitats. 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. Overall, offshore bird populations are decreasing; however, considerable differences in population trajectories of offshore bird families have been documented.

Coastal birds, especially those that nest in coastal marshes and other low-elevation habitats, are vulnerable to sea-level rise and the increasing frequency of strong storms as a result of global climate change. According to NABCI, nearly 40 percent of the more than 100 bird species that rely on coastal habitats for breeding or for migration are on the NABCI watch list. Many of these coastal species have small population size 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, 20 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. These ongoing impacts on birds would continue regardless of the offshore wind industry.

A broad group of avian species may pass through the Offshore Project area, including migrants (such as raptors and songbirds), coastal birds (such as shorebirds, waterfowl, and waders), and marine birds (such as seabirds and seaducks). The migration of birds along the coast of New Jersey is notable, with an average of nearly 800,000 birds counted annually at the Avalon Seawatch – Cape May Bird Observatory; in some years the bird count approaches one million (New Jersey Audubon Society n.d.). Approximately 159 bird species have been identified as potentially occurring in the Offshore Project area through public databases and baseline studies (see Table 3-1 in COP Volume III Appendix H; Ocean Wind 2023). Of these 159 species, nine are state-listed as endangered for at least one life stage (i.e., breeding or non-breeding), four are state-listed as threatened for at least one life stage, 19 are state-listed as special concern species for at least one life stage, two are federally listed as threatened, and one is federally listed as endangered. There is high diversity of marine birds that may use the Wind Farm Area because it is in the Mid-Atlantic Bight, which overlaps with the ranges of both northern and southern species and falls within the Atlantic Flyway (a major migratory pathway for birds in the eastern United States and Canada). Migrant terrestrial species may follow the coastline on their annual trips or choose more direct flight routes over expanses of open water. Many marine birds also make annual migrations up and down the eastern seaboard (e.g., gannets, loons, and seaducks), taking them directly through the mid-Atlantic region in spring and fall. This results in a complex ecosystem where the community composition shifts regularly and temporal and geographic patterns are highly variable. The mid-Atlantic supports large populations of birds in summer, some of which breed in the area, such as coastal gulls and terns. Other summer residents, such as shearwaters and storm-petrels, visit from the Southern Hemisphere (where they breed during the austral summer). In the fall, many of the summer residents leave the area and migrate south to warmer climates, and are replaced by species that breed farther north and winter in the mid-Atlantic. Table 3.7-1 summarizes the bird presence in the Offshore Project area by bird type.

Table 3.7-1 Bird Presence in the Offshore Project Area by Bird Type

Bird Type	Potential Bird Presence in Offshore Project Area
Non-Marine Migratory Birds	
Shorebirds	Shorebirds are coastal breeders and foragers and generally avoid straying out over deep waters during breeding. Of the shorebirds, only red phalarope and red-necked phalarope are generally considered marine species. Overall, exposure of shorebirds to the offshore infrastructure will be limited to migration, and, with the exception of phalaropes, the offshore marine environment does not provide habitat for shorebirds.
Wading Birds	Most long-legged wading birds breed and migrate in coastal and inland areas. Like the smaller shorebirds, wading birds are coastal breeders and foragers and generally avoid straying out over deep waters, but may traverse the Wind Farm Area during spring and fall migration periods. The USFWS IPaC database did not indicate any wading birds in the Wind Farm Area or adjacent waters that are identified as vulnerable or Birds of Conservation Concern, and the NJDEP EBS surveys detected few herons and egrets offshore (see COP Volume III, Appendix H).
Raptors	Except for falcons, most raptors do not fly in the offshore marine environment due to their wing morphology, which requires thermal column formation to support their gliding flight. Falcons are encountered offshore because they can make large water crossings. Merlins and peregrine falcons are commonly observed offshore, fly offshore during migration, and have been observed on offshore oil platforms. Therefore, falcons may pass through the Wind Farm Area during migration. Ospreys fly over open water crossings; however, satellite telemetry data from ospreys in New England and the mid-Atlantic suggest these birds generally follow coastal or inland migration routes.
Songbirds	Songbirds almost exclusively use terrestrial, freshwater, and coastal habitats and do not use the offshore marine system except during migration. Songbirds regularly cross large bodies of water, and there is some evidence that species migrate over the northern Atlantic. Some birds may briefly fly over the water while others, like the blackpoll warbler, can migrate over vast expanses of ocean. Evidence for a variety of species suggests that overwater migration in the Atlantic is much more common in fall (than in spring), when the frequency of overwater flights increases perhaps due to consistent tailwinds from the northwest. Overall, the exposure of songbirds to the Wind Farm Area will be limited to migration.
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 or use saltmarshes, beaches, and other strictly coastal habitats and are unlikely to pass through the Wind Farm Area. Seaducks are discussed below in the marine bird section.
Marine Birds	
Loons	Common loons and red-throated loons 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 Wind Farm Area during spring migration. However, large aggregations of common loons intersect the western boundary of the Wind Farm Area in fall, winter, and spring as detected by the AMAPPS and other offshore survey programs. The NJDEP EBS surveys and MDAT models show higher use of the Wind Farm Area by loons in the spring than other seasons.

Bird Type	Potential Bird Presence in Offshore Project Area
Seaducks	The seaducks use the Atlantic OCS heavily in winter. Most seaducks 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. Surf scoters tracked with satellite transmitters remained largely inshore of the Wind Farm Area. Exposure to the Wind Farm Area will be primarily limited to migration or travel between wintering sites.
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 Wind Farm Area. These species use the Atlantic OCS region heavily, but mostly concentrate offshore and in the Gulf of Maine.
Gannets, Cormorants, and Pelicans	Northern gannets use the Atlantic OCS primarily during winter. They breed in southeastern Canada and winter along the mid-Atlantic region and in the Gulf of Mexico. They are opportunistic foragers, capable of long-distance oceanic movements, and large aggregations intersect the western boundaries of the Wind Farm Area regularly during the non-breeding period as detected on surveys conducted by the AMAPPS and other offshore survey programs. The double-crested cormorant is the most likely species of cormorant exposed to the Wind Farm Area, but regional MDAT abundance models show that cormorants are concentrated closer to shore and not commonly encountered well offshore. Brown pelicans are rare in the area and unlikely to pass through the Wind Farm Area in any numbers.
Gulls, Skuas, and Jaegers	Nine species in this group were observed in the NJDEP EBS surveys and could potentially pass through the Wind Farm Area. The regional MDAT abundance models show that these birds have wide distributions, ranging from near shore (gulls) to offshore (jaegers). The herring gull and great black-backed gull reside in the region year-round, and are found farther offshore outside of the breeding season. The parasitic jaeger is often observed closer to shore during migration than the other species and great skuas may pass along the Atlantic OCS outside the breeding season.
Terns	Seven species of tern are present in New Jersey during the spring, summer, and fall. Of these, there are breeding records in New Jersey of Caspian tern, common tern, Forster's tern, gull-billed tern, least tern, and royal tern. Terns generally restrict themselves to coastal waters during breeding, although they may pass through the Wind Farm Area to forage and during migration. Roseate terns are federally and state-listed, and infrequently occur in New Jersey during summer and fall.
Auks	Auk species present in New Jersey offshore waters 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, however, depending upon broad climatic conditions and the availability of prey. In winters with prolonged harsh weather, which may prevent foraging for extended periods, these generally pelagic species often move inshore or are driven considerably farther south than usual. The MDAT abundance models show that auks are generally concentrated offshore and south of Nova Scotia, but some individuals may pass through the Wind Farm Area during winter.

Source: COP Appendix H; Ocean Wind 2023; USFWS 2021a.
IPaC = Information for Planning and Consultation; MDAT = Marine-life Data and Analysis Team

The Onshore Project area includes multiple potential onshore export cable routes that contain a diverse set of habitats, including coastal wetlands, forested wetlands, forested uplands, forested lowlands, barrier beaches, and bay island habitats. A broad group of avian species utilize these onshore habitats during breeding, wintering, and migration periods, and avian groups found in these habitats include songbirds, shorebirds, raptors, waterfowl, waders, and seabirds. See Tables 4-5 and 4-6 in COP Volume III, Appendix H (Ocean Wind 2023) for a list of bird species with potential to occur in proximity to the BL England and Oyster Creek substations and onshore export cable routes. These birds include 59 species that are federally listed as threatened and endangered, USFWS-designated Birds of Conservation Concern, state-listed threatened and endangered birds, and state Special Concern birds (see Table 2.2.3-1 in COP Volume II; Ocean Wind 2023). The BL England Onshore Project area is within the Delaware Bay and Atlantic Coastal landscape regions, where the Focal Species of Greatest Conservation Need (SGCN)[1] include American oystercatcher, American woodcock, black rail, black skimmer, bluewinged warbler, common tern, Forster's tern, least tern, little blue heron, northern harrier, peregrine falcon, pied-billed grebe, piping plover, red knot, red-headed woodpecker, ruddy turnstone, scarlet tanager, snowy egret, tricolored heron, bobolink, eastern meadowlark, grasshopper sparrow, Kentucky warbler, northern bobwhite, prothonotary warbler, vesper sparrow, and wood thrush. The nearest recorded peregrine falcon nesting activity in 2019 was in the vicinity of the BL England landfall site in Ocean City on a nesting platform in a marsh, as well as on the Ocean City-Longport Bridge. COP Appendix H, Figure 3-11, shows documented locations of peregrine falcons in the Onshore Project area. The Oyster Creek Onshore Project area is within the Pinelands and Atlantic Coastal landscape regions, where the Focal SGCN are the same as in the BL England Onshore Project area but with one additional species: cerulean warbler. The nearest recorded peregrine falcon nesting activity in 2019 was reported along the barrier beaches at Sedge Island approximately 4.4 miles to the east and southeast of the Oyster Creek landfall site (Ocean Wind 2023).

There are multiple onshore export cable system route options to the BL England and Oyster Creek substations. The onshore export cable system route options would be co-located with existing developed areas (e.g., roads, existing transmission lines, rail) to the extent practicable. Habitat along the route options varies, but includes high-density urban residential areas (edge habitat), commercial areas, salt marsh, shrubs, grasses, mixed forest (predominantly deciduous forest with scattered cedars and pines), and deciduous forest. The cable landfall locations are in the Atlantic Coastal Landscape Region, which includes barrier islands, beaches, tidal salt marshes, rivers, shallow bays, and lagoons. The BL England substation parcel consists of a preexisting substation bordered by Great Egg Harbor Bay, salt marsh, and mowed lawn with scattered deciduous tree habitat. The grid interconnection would be in an existing highly disturbed and industrialized area adjacent to a golf course; the area is primarily covered with existing impervious surfaces that effectively do not provide viable bird habitat. The parcels for the Oyster Creek substation are in areas of pineland forest and shrubland. The grid interconnection would be in an existing and highly disturbed and industrialized area that is primarily covered with existing impervious surfaces and sparse vegetation, which does not provide viable bird habitat. A short section of overhead transmission line, extending up to 0.5 mile (0.8 kilometer), would potentially be installed in this area.

Bald eagles (*Haliaeetus leucocephalus*), which are listed as endangered (breeding) and threatened (non-breeding) in New Jersey, are federally protected by the Bald and Golden Eagle Protection Act, 16 USC § 668 et seq., as are golden eagles (*Aquila chrysaetos*). Bald eagles are broadly distributed across North America and generally nest and perch in areas associated with water (lakes, rivers, bays) in both freshwater and marine habitats, often remaining largely within roughly 1,640 feet of the shoreline. Bald eagles are present year-round in New Jersey and nesting is concentrated on the edge of Delaware Bay. In a study evaluating the space use of bald eagles captured in Chesapeake Bay, the coast of New Jersey was associated with moderate levels of use. The general morphology of bald eagles dissuades long-distance

[1] SGCN are wildlife species with low, declining, or vulnerable populations, and for whom conservation actions are needed to prevent or reverse declines over the next 10 years (NJDEP 2018). Focal SGCN are considered "upper tier" SGCN that include a discrete set of wildlife that are both in need of immediate protection and perceived to be responsive to known and feasible conservation actions (NJDEP 2018). Implementing targeted efforts toward their conservation will benefit many other species (NJDEP 2018).

movements in offshore settings, as the species generally relies upon thermal formations, which develop poorly over the open ocean, during long-distance movements. As such, bald eagles are unlikely to fly through the Wind Farm Area. In 2019, bald eagle nesting activity was recorded at Beesley’s Point, within a few kilometers of the BL England landfall site and proposed substation location and in Waretown, within a few kilometers of the Oyster Creek landfall site and proposed substation location. This nest fledged two young (Ocean Wind 2023).

Golden eagles are found throughout the United States, but mostly in the western half of the United States and are rare in the eastern states (Cornell University 2019). In New Jersey, golden eagles are associated with forest habitats in the Delaware Bay, Piedmont Intercoastal Plain, Pinelands, and Skylands landscape regions (NJDEP 2018). The Onshore Project area is primarily within the Atlantic Coastal Landscape region, which is not associated with golden eagles; however, portions of the Onshore Project areas are within the Pinelands and Delaware Bay landscape region and include some forested areas (New Jersey Bureau of GIS 2018). Like with bald eagle, the general morphology of golden eagle dissuades long-distance movements in offshore settings (Kerlinger 1985), as the species generally relies upon thermal formations, which develop poorly over the open ocean, during long-distance movements. As such, golden eagles are unlikely to fly through the Wind Farm Area.

Four species of birds listed as threatened or endangered under the ESA may occur in the Onshore and Offshore Project areas: the threatened piping plover (*Charadrius m. melodus*), endangered roseate tern (*Sterna d. dougallii*), threatened eastern black rail (*Laterallus jamaicensis* ssp. *jamaicensis*), and threatened *Rufa* subspecies of the red knot (*Calidris canutus rufa*) (USFWS 2021a; Ocean Wind 2021). The Ocean Wind 1 BA provides a detailed discussion of ESA-listed species and potential impacts on these species as a result of the Project (BOEM 2022).

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 Ocean Wind 1 Project, each proposed project will be required to address ESA-listed species at 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.

3.7.2 Environmental Consequences

3.7.2.1. Impact Level Definitions for Birds

Definitions of impact levels are provided in Table 3.7-2.

Table 3.7-2 Impact Level Definitions for Birds

Impact Level	Impact Level	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
	Beneficial	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Most impacts would be avoided; if impacts occur, the loss of one or few individuals or temporary alteration of habitat could represent a minor impact, depending on the time of year and number of individuals involved.
	Beneficial	Impacts would be localized to a small area but with some measurable effect on one or a few individuals or habitat.

Impact Level	Impact Level	Definition
Moderate	Adverse	Impacts would be unavoidable but would not result in population-level effects or threaten overall habitat function.
	Beneficial	Impacts would affect more than a few individuals in a broad area but not regionally, and would not result in population-level effects.
Major	Adverse	Impacts would result in severe, long-term habitat or population-level effects on species.
	Beneficial	Long-term beneficial population-level effects would occur.

3.7.3 Impacts of the No Action Alternative on Birds

Section 3.1 of the Final EIS explains the approach to predicting impacts related to the No Action Alternative. When analyzing the impacts of the No Action Alternative on birds, 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 birds. 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 F, *Planned Activities Scenario*. Separate impact conclusions are presented for both scenarios.

3.7.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for birds described in Section 3.7.1, *Description of the Affected Environment for Birds*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing 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.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on birds include:

- Continued O&M of the Block Island project (five WTGs) installed in state waters;
- Continued O&M of the Coastal Virginia Offshore Wind project (two WTGs) installed in OCS-A 0497; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

The effects of approved projects have been evaluated through previous NEPA review and are incorporated by reference. Ongoing O&M of the Block Island and Coastal Virginia Offshore Wind projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect birds through the primary IPFs of accidental releases, lighting, cable emplacement and maintenance, noise, presence of structures, traffic (aircraft), and land disturbance. Ongoing offshore wind activities would have the same type of impacts from accidental releases, lighting, cable emplacement and maintenance, noise, presence of structures, traffic (aircraft), and land disturbance that are described in detail in Section 3.7.3.2 for planned offshore wind activities but the impacts would be of lower intensity.

3.7.3.2. Cumulative Impacts of the No Action Alternative

Other 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 F.2 in Appendix F for a complete description of planned activities). These activities may result in temporary and permanent impacts on birds including disturbance, displacement, injury, mortality, habitat degradation, and habitat conversion. See Table F1-4 for a summary of potential impacts associated with planned non-offshore wind activities by IPF for birds.

BOEM expects future 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 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). Based on the volumes potentially involved (refer to Table F-3 in Appendix F, *Planned Activities Scenario*), the likely amount of releases associated with 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 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.

Lighting: Nighttime lighting associated with offshore wind structures and vessels could represent a source of bird attraction. Under the No Action Alternative, up to 2,946 WTGs and 163 OSS would have hazard and aviation lighting that would be incrementally added beginning in 2023 and continuing through 2030. However, BOEM anticipates this impact to be significantly reduced due to the anticipated use of ADLS, which is a system that would activate WTG lighting only when an aircraft enters a predefined airspace. For example, the recently approved Vineyard 1 offshore wind project will implement ADLS and, based on historical air traffic data, WTG light activation under ADLS is estimated to occur 235 times per year, for a total illumination duration of less than 4 hours per year (illuminating less than 0.1 percent of the nighttime hours per year) (BOEM 2021a). Another recently approved offshore wind project—South Fork—will also implement ADLS as part of BOEM's COP approval terms and conditions, and several offshore wind projects currently under BOEM consideration are proposing/considering ADLS (pending FAA and BOEM approval) (e.g., Atlantic Shores, Ocean Wind, Coastal Virginia Offshore Wind). As such, BOEM anticipates ADLS to significantly reduce the potential WTG lighting impacts on birds. In addition, and as discussed in more detail below in the presence of structures IPF, the abundance of bird species that overlap with the anticipated development of wind energy facilities on the Atlantic OCS is relatively small (Figure 3.7-2), and the relative seasonal exposure of bird populations is generally very low (Table 3.7-2).

Construction vessels are also a source of artificial lighting, which could attract birds and cause disorientation and collision or predation risk. However, the potential impact would be short term, lasting only the duration of construction and, as previously described, the abundance of bird species on the OCS that overlap with the anticipated wind development of wind energy facilities is relatively small. Overall, BOEM anticipates lighting impacts related to offshore wind structures and vessels would be negligible.

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 inter-array cables for offshore wind facilities is estimated to be up to 32,346 acres (131 km^2). Impacts associated with cable emplacement would be temporary 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 offshore wind projects may affect some bird prey species; however, assuming future projects use installation procedures similar to those proposed in the Ocean Wind 1 COP, the duration and extent of impacts would be limited and short term, and benthic assemblages would recover from disturbance. Section 3.6, *Benthic Resources*, and Section 3.13, *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.

Noise: Anthropogenic noise on the OCS associated with offshore wind development, including noise from aircraft, pile-driving activities, G&G surveys, offshore construction, and vessel traffic, has the potential to 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 temporary. Potential impacts could be greater if avoidance and displacement of birds occurs during seasonal migration periods.

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

Construction of up to 3,101 offshore structures 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 short-term 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, G&G 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 temporary 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, temporary 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 impacts, both beneficial and adverse, on birds through fish aggregation and associated increase in foraging opportunities, as well as entanglement and gear loss or damage, 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 pathway 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 annual migrations between wintering and breeding grounds (Watts 2010). Within the Atlantic Flyway along the North American Atlantic Coast, much of the bird activity is concentrated along the coastline (Watts 2010). Waterbirds use a corridor between the 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 Wilmott et al. (Robinson Wilmott 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 (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. (Robinson Wilmott et al. 2013) and consistent with Garthe and Hüppop (Garthe and Hüppop 2004), Furness and Wade (Furness and Wade 2012), and Furness et al. (Furness et al. 2013), species with high scores for sensitivity for collision include gulls, jaegers, and the northern gannet (*Morus bassanus*). In many cases, high collision sensitivity was 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. (Robinson Willmott et al. 2013) had low collision sensitivity including passerines that spend very little time on the Atlantic OCS during migration and typically fly above the RSZ. As described by Watts (2010), 55 seabird species occur on the Atlantic OCS at a distance from shore where WTGs could be operating. 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 3.7-2).

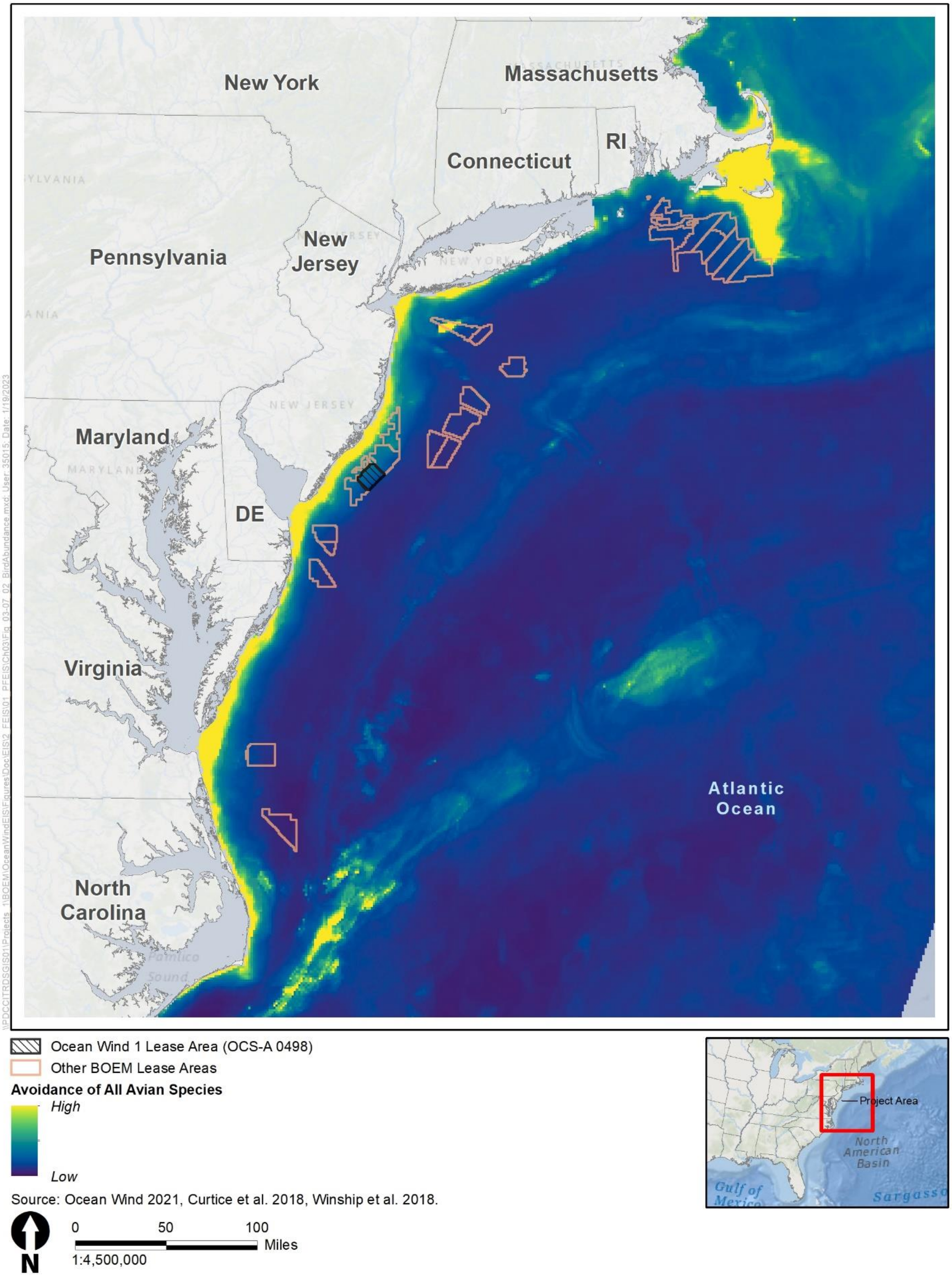


Figure 3.7-2 Total Avian Relative Abundance Distribution Map

Of the 55 seabird species, 47 seabird species 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 is generally very low, ranging from 0.0 to 5.2 percent (Table 3.7-3). The estimated percentage of the more sensitive Birds of Conservation Concern populations that overlap offshore wind development areas is 0 percent for three birds and between 0.1 and 0.9 percent for two birds (Table 3.7-3). 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.

Table 3.7-3 Percentage of Each Atlantic Seabird Population that Overlaps with Anticipated Offshore Wind Energy Development on the Outer Continental Shelf by Season

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*)[2]	0.0	0.0	0.0	0.0
Black-capped Petrel (*Pterodroma hasitata*)[2]	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*)[2]	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*)[2]	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, 2]	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

Species	Spring	Summer	Fall	Winter
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*)	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
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 used in collision risk modeling.
[2] Species considered Birds of Conservation Concern by USFWS (USFWS 2021b).
NA = not applicable

The greatest risk to birds associated with offshore wind development would be collision with operating WTGs while flying through lease areas or approaching WTGs to perch on the structure. Motion smear, a phenomenon where spinning turbine blades become deceptively transparent to the eye, can also factor into collision risk (Hodos 2013). Offshore wind development would add up to 2,946 WTGs in the bird geographic analysis area (Table F-3). In the contiguous United States, bird collisions with operating WTGs are relatively rare events, with an estimated 140,000 to 500,000 (mean = 320,000) birds killed annually from about 49,000 onshore wind turbines in 39 states (USFWS 2018). Bird collisions with turbines in the eastern United States is estimated at 6.86 birds per turbine per year (USFWS 2018). Based on this mortality rate, an estimated 20,210 birds could be killed annually from the 2,946 WTGs that would be added for offshore wind development. This represents a worst-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 WTGs (see Figure 3.7-2) and annual per-turbine mortalities are anticipated to be lower offshore compared to onshore. Potential annual bird kills from 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 2021c). 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 offshore wind development. Generally, only a small percentage of a species' seasonal population would potentially encounter operating WTGs (Table 3.7-3). 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. Impacts on birds due to the presence of operating WTGs would likely be minor, with no individual fitness or population-level impacts expected to occur.

Because most structures would be spaced 0.6 to 1 nm apart, ample space between WTGs should allow birds that are not flying above WTGs to fly through individual lease areas without changing course or to make minor course corrections to avoid operating WTGs. The effects of offshore wind farms on bird movement ultimately depends on the bird species, size of the offshore wind farm, spacing of the turbines, and 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, Madsen et al. found the proportion of birds traveling between turbines increased as distance between turbines increased. With eight WTG columns at 200-meter (0.1-nm) spacing, no birds passed between the turbines. However, increasing inter-turbine distance to 500 meters (0.27 nm) increased the percentage of birds to more than 20 percent, while a spacing of 1,000 meters (0.54 nm) increased this further to 99 percent. The 0.6- to 1-nm spacing estimated for most structures that will be proposed on the Atlantic OCS is greater than the distance at which 99 percent of the birds passed through in the model. As such, adverse impacts of additional energy expenditure due to minor course corrections or complete avoidance of offshore wind lease areas would not be expected to be biologically significant. Any additional flight distances would likely be small for most migrating birds when compared with the overall migratory distances traveled, and no individual fitness or population-level effects would be expected to occur.

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

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

Traffic (aircraft): General aviation traffic accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2019). 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 not expected to appreciably contribute to overall impacts on birds.

Land disturbance (onshore construction): Onshore construction of offshore wind development infrastructure has the potential to result in some impacts 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 development activities. Furthermore, construction would be expected to generally occur in previously disturbed habitats, and no individual fitness or population-level impacts on birds would be expected to occur. As such, onshore construction impacts associated with offshore wind development would be negligible and not expected to appreciably contribute to overall impacts on birds.

3.7.3.3. Conclusions

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

BOEM anticipates that the 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 the offshore wind development. Migratory birds that use the offshore wind lease areas during all or parts of the year would either be exposed to new collision risk or 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 resulting from these IPFs would be localized and temporary and would not be expected to be biologically significant.

BOEM anticipates that the cumulative impacts of the No Action Alternative would have **moderate** adverse impact on birds but could include **moderate beneficial** impacts because of the presence of offshore structures.

3.7.4 Relevant Design Parameters & Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; BOEM expects any potential variances in the proposed Project build-out within the range of the PDE to result in impacts similar to or less than described in the sections below. The following proposed PDE parameters (Appendix E) would influence the magnitude of the impacts on birds:

- The new onshore substations, which could require the removal of trees on the edge of the construction footprint;
- The number, size, and location of the WTGs;

- The routing variants within the selected onshore export cable system, which could require removal of trees on the edge of the construction corridor; and
- The time of year during which construction occurs.

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

- WTG number, size, and location: the level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would present less hazard to birds.
- Onshore export cable routes and substations footprint: the route chosen (including variants within the general route) and substation footprint would determine the amount of habitat affected.
- 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.

Ocean Wind has committed to measures to minimize impacts on birds. These measures include, but are not limited to, cutting trees and vegetation, where possible, during the winter months when most migratory birds are not present (BIRD-03) and using lighting technology that minimizes impacts on avian species to the extent practicable (BIRD-04) (COP Volume II, Table 1.1-2; Ocean Wind 2023).

3.7.5 Impacts of the Proposed Action on Birds

3.7.5.1. Impacts of the Proposed Action

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park, which is described in Section 3.7.7, *Impacts of Alternative E on Birds*.

The sections below summarize the potential impacts of the Proposed Action on birds during the various phases of the proposed Project. Routine activities would include construction, O&M, and decommissioning of the proposed Project, as described in Chapter 2, *Alternatives*. The most impactful IPF is expected to be the presence of structures, which could lead to adverse impacts including injury and mortality or elicit an avoidance response. BOEM prepared a BA for the potential effects on USFWS federally listed species, which found that the Proposed Action was *not likely to adversely affect*, or would have *no effect*, on listed species (BOEM 2022). BOEM requested concurrence 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* piping plovers, roseate terns, eastern black rails, and rufa red knots. There are no critical habitats designated for these species in the action area defined in the BA (BOEM 2022). Consultation with USFWS pursuant to Section 7 of the ESA is ongoing and results of consultation will be presented in the Final EIS.

Accidental releases: Some potential exists for mortality, decreased fitness, and health effects due to the accidental release of fuel, hazardous materials, and trash and debris from vessels associated with 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). In addition, Ocean Wind has committed to preparing and implementing waste management plans and hazardous materials plans, which would minimize the potential for spills and identify procedures in the event of a spill (GEN-10). All vessels would be certified to conform to vessel O&M protocols designed to minimize the risk of fuel spills and leaks (WQ-01). These releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized, temporary, and negligible impacts on birds. 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 offshore wind and the Proposed Action would be low.

Lighting: Under the Proposed Action, up to 98 WTGs and three OSS would be lit with 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 (2021c) and as outlined in the Ocean Wind 1 COP (Volume I, Section 7.4; Ocean Wind 2023), each WTG above 699 feet about ground level would be lit with two FAA model L-864 aviation red flashing obstruction lights on the highest point of the nacelle and up to four FAA model L-810 red flashing lights at mid-mast level, adding up to 588 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 flashing yellow lights on each WTG and on the corners of each OSS.

The Project is proposing to use an ADLS, which if implemented would only activate WTG lighting when aircraft enter a predefined airspace. The short-duration synchronized flashing of the ADLS would have less impact on birds at night than the standard continuous, medium-intensity red strobe light aircraft warning systems. Based on Ocean Wind's ADLS Efficacy Analysis that looked at historical air traffic data from FAA, ADLS-controlled obstruction lights would be activated for a total of 1 hours and 19 minutes and 17 seconds over a 1-year period. While the activation time ranged from 40 seconds (January) to 23 minutes and 40 seconds (February), for most months of the year the activation time would be less than 10 minutes. This would reduce impacts already associated with WTG lighting. To further reduce impacts on birds, Ocean Wind proposes to use lighting technology that minimizes impacts on avian species to the extent practicable (BIRD-04). As such, BOEM expects impacts, if any, to be long term but negligible from lighting. Vessel lights during construction, O&M, and decommissioning would be minimal and likely 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. Under the planned action scenario, up to 2,952 WTGs and 64 OSS would have lights, and these would be incrementally added over time beginning in 2023 and continuing through 2030. Lighting of WTGs and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM (2021c) guidance.

Cable emplacement and maintenance: The Proposed Action would disturb up to 3,785 acres (15 km^2) of seafloor associated with the installation of array cable and offshore cable, which would result in turbidity effects that have the potential to reduce marine bird foraging success or have temporary and localized impacts on marine bird prey species. These impacts are expected to be temporary, with sediments settling quickly to the seabed and potential plumes limited to right above the seabed and not within the water column; turbidity concentrations greater than 10 mg/L would be short in duration—up to 6 hours—and limited to within approximately 50 to 200 meters of the trench in offshore areas. Dredging, which may also occur along the proposed cable route in locations where sand waves (naturally mobile slopes on the seabed) are encountered or when crossing federal and state navigation channels, would produce similar effects, but with plumes likely to last longer and extend farther out. As BOEM (2018) notes, while turbidity would likely be high in the areas affected by dredging, the sediment would not affect water quality after it settles, and the period of sediment suspension would be very short term and localized. 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 temporary 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 negligible.

Noise: The expected impacts of aircraft, G&G survey, and pile-driving noise associated with Proposed Action alone would not increase the impacts of noise beyond those described under the No Action Alternative. Effects on offshore bird species could occur during the construction phase of the Proposed Action because of equipment noise (including pile-driving noise). The pile-driving noise impacts would be short term (4 hours per pile). Vessel and construction noise could disturb offshore bird species, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012). BOEM anticipates the temporary impacts, if any, related to construction and installation of the offshore components would be negligible.

Normal operation of the substations would generate continuous noise, but BOEM expects negligible long-term impacts when considered in the context of the other commercial and industrial noises near the proposed substations.

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 detail in Section 3.7.3.2, *Cumulative Impacts of the No Action Alternative*. The impacts of the Proposed Action alone as a result of presence of structures would be long term but minor, and may include some minor beneficial impacts. Due to the anticipated use of flashing red tower lights, restricted time period of exposure during migration, and small number of migrants that could cross the Wind Farm Area, BOEM concludes that the Proposed Action would not likely adversely affect roseate terns, piping plovers, eastern black rail, and red knots. See the Ocean Wind 1 BA (BOEM 2022) for a complete discussion of the potential collision risk to ESA-listed species as a result of operation of the proposed Project.

As previously described and depicted for the offshore wind lease areas on Figure 3.7-3 and Figure 3.7-4, the locations of the OCS offshore wind lease areas were selected to minimize impacts on all resources, including birds. Within the Atlantic Flyway along the North American Atlantic Coast, much of the bird activity is concentrated along the coastline (Watts 2010). Waterbirds use a corridor between the 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). However, operation of the Proposed Action would result in impacts on some individuals of offshore bird species and possibly some individuals of coastal and inland bird species during spring and fall migration. These impacts could arise through direct mortality from collisions with WTGs or through behavioral avoidance and habitat loss (Drewitt and Langston 2006, Fox et al. 2006, Goodale and Millman 2016). The predicted activity of bird populations that have a higher sensitivity to collision (as defined by Robinson Willmott et al. [2013]) is relatively low in the OCS during all seasons of the year (Figure 3.7-3), 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 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). Vattenfall (a European energy company) recently studied bird movements within an offshore wind farm situated 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)[2] 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 crossed the RSZ without making any adjustments to the spinning rotors. The study concluded that, together with the recorded high levels of micro-avoidance in all species (greater than 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 (greater than 0.96) is similar to that reported in Skov et al. (2018).

Ocean Wind performed an exposure assessment to estimate the risk of various offshore bird species encountering the Wind Farm Area (COP Volume III, Appendix H; Ocean Wind 2023). Most species were identified as having "minimal" to "low" overall exposure risk. Of the approximately 40 species of marine birds that use the mid-Atlantic marine environment, the northern gannet and loons had the highest potential exposure, both considered "low-medium" exposure risk. In addition, two raptors—peregrine falcon and merlin—were found to have "low-medium" exposure risk; non-falcon raptors were found to have limited use of the offshore environment. While some non-marine birds have the potential to be exposed to the Wind Farm Area, the Wind Farm Area is far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species. Of the species considered to have a higher overall exposure risk (i.e., loons, northern gannet, peregrine falcon, and merlin), two have a special status designation: red-throated loon is a Bird of Conservation Concern and peregrine falcon is state-listed as endangered (breeding) and special concern (non-breeding).

During migration, many bird species, including songbirds, likely fly at heights well above or below the RSZ (70.8 feet to 906 feet [22 to 276 meters] above MLLW) (COP Volume III, Appendix H; Ocean Wind 2023 and references in COP Volume III, Appendix H; Ocean Wind 2023). As shown in Robinson Willmott et al. (Robinson Willmott et al. 2013), species with low sensitivity scores include many passerines that only cross the Atlantic OCS briefly during migration and typically fly well above the RSZ.

[2] Micro-avoidance is flight behavior within and in the immediate vicinity of individual wind turbine RSZs (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).

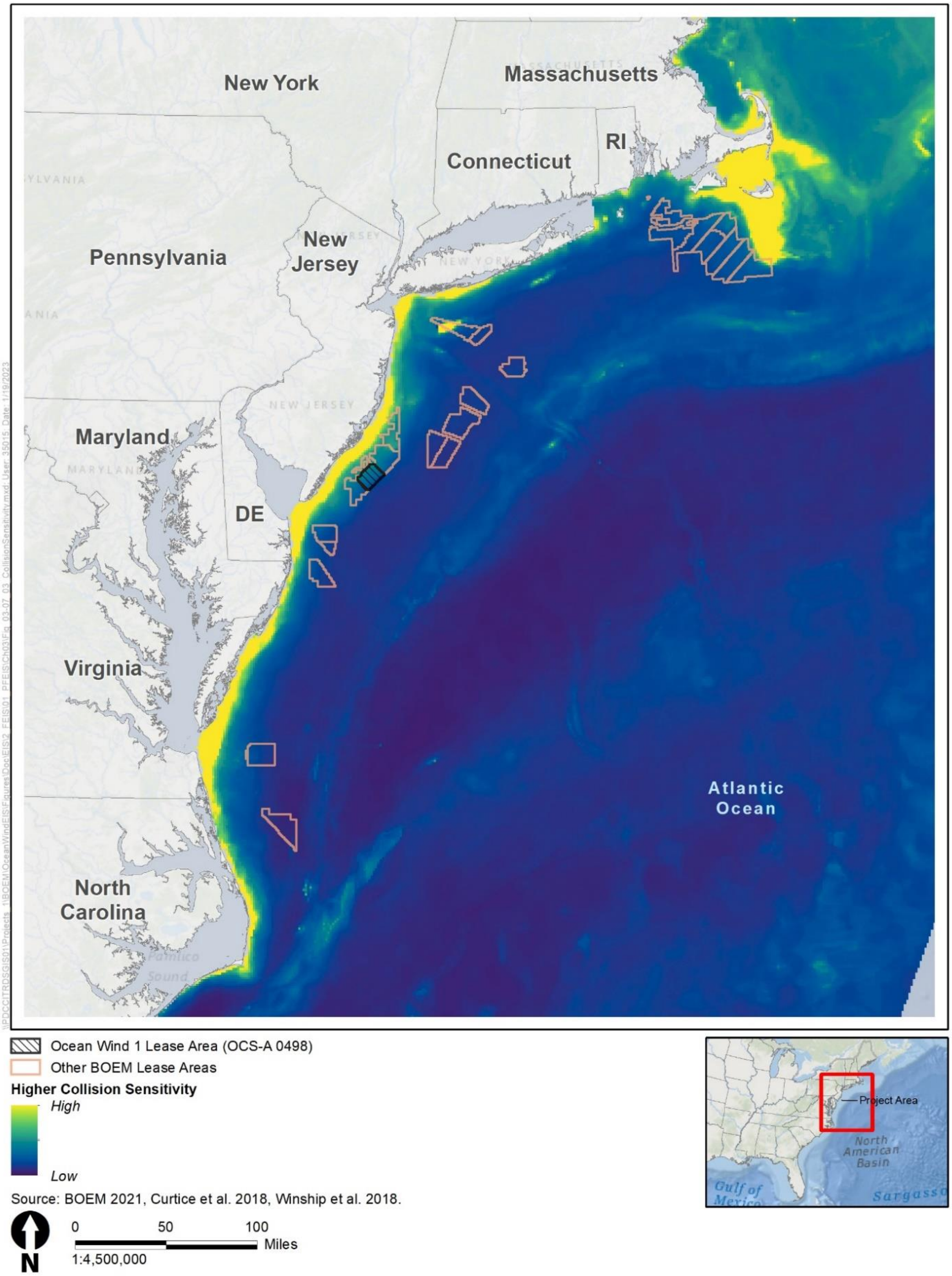


Figure 3.7-3 Total Avian Relative Abundance Distribution Map for the Higher Collision Sensitivity Species Group

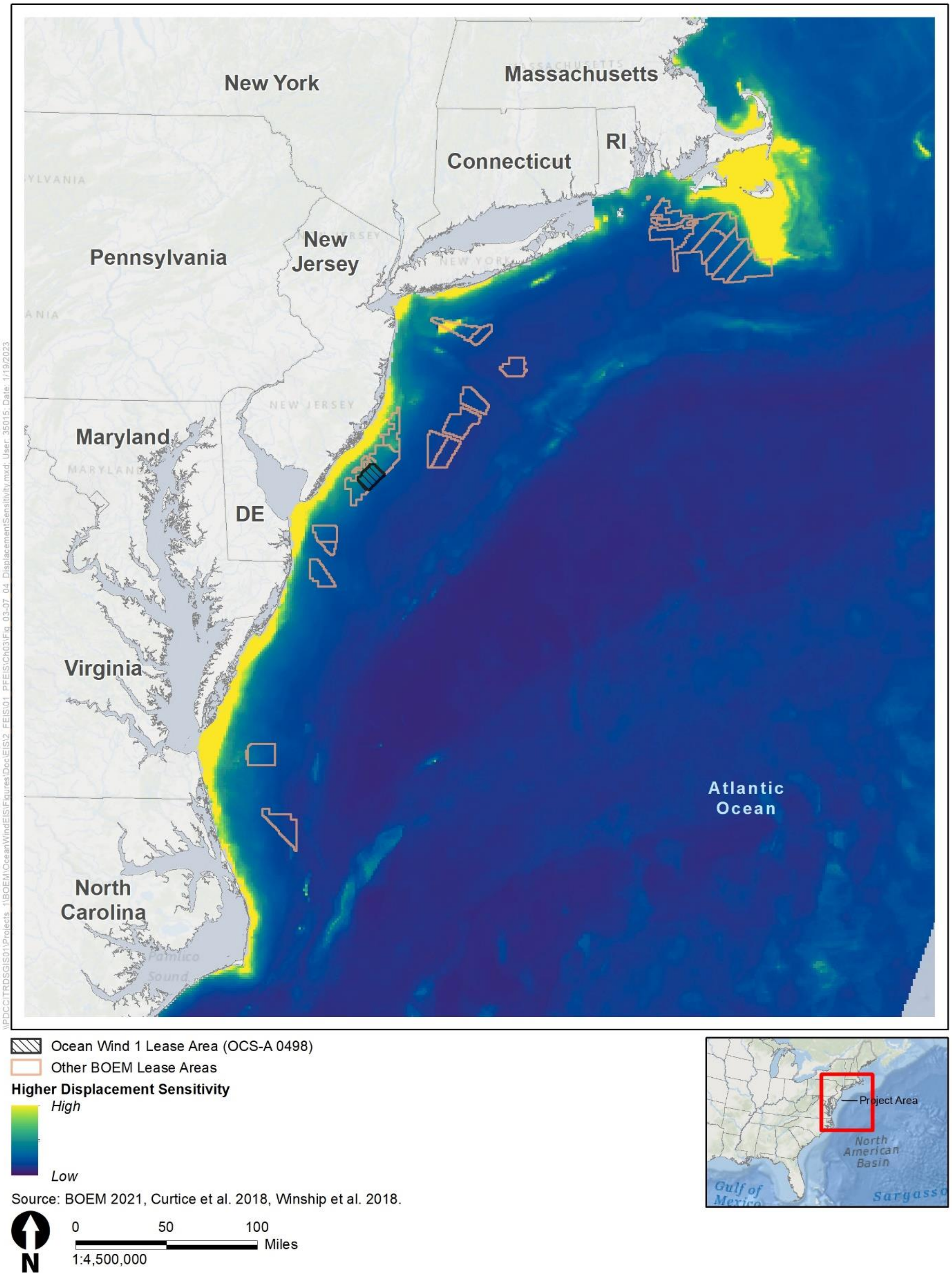


Figure 3.7-4 Total Avian Relative Abundance Distribution Map for the Higher Displacement Sensitivity Species Group

It is generally assumed that inclement weather and reduced visibility cause changes to migration altitudes (Ainley et al. 2015) and could potentially lead to large-scale mortality events. 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 of these passerine species, while detected on the OCS during migration as part of BOEM's Acoustic/Thermographic Offshore Monitoring project (Robinson Willmott and Forcey 2014), they were documented in relatively low numbers. While several studies documenting bird flight and wind speeds over terrestrial environments have shown birds to fly at variable wind speeds, including above the typical cut-in speeds of wind turbines (Abdulle and Fraser 2018; Bloch and Bruderer 1982; Bruderer and Boldt 2001; Chapman et al. 2016), Robinson Willmott and Forcey (2014) found that most of the bird activity (including blackpoll warblers) in the offshore environment on the OCS occurred during windspeeds below 10 kilometers per hour (2.8 m/s) (see Figure 109 in Robinson Willmott and Forcey 2014). The cut-in speed for the Ocean Wind 1 WTGs is 3.5 m/s; therefore, based on the Robinson Willmott and Forcey (2014) offshore study, passerines would likely be migrating when the turbine blades are idle (Ørsted 2022). Furthermore, most carcasses of small migratory songbirds found at land-based wind energy facilities in the Northeast were within 2 meters of the turbine towers, suggesting that they are colliding with towers rather than moving turbine blades (Choi et al. 2020). Although it is possible that migrating passerines could collide with offshore structures, migrating passerines are also occasionally found dead on boats, presumably from exhaustion (e.g., Stabile et al. 2017).

Some marine bird species might avoid the Wind Farm Area 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), seaducks (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. As depicted on Figure 3.7-4, modeled use of the Wind Farm Area by bird species with high displacement sensitivity is low. A complete list of species included in the higher displacement sensitivity group can be found in Robinson Willmott et al. (Robinson Willmott et al. 2013)). Although the proposed Project may no longer provide foraging opportunities to species with high displacement sensitivity, suitable foraging habitat exists in the immediate vicinity of the proposed Project and throughout the region. Because the Wind Farm Area 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.

Generally, onshore operation is not expected to pose any significant IPFs (i.e., hazards) to birds because activities would disturb little if any habitat, and the transmission lines would be primarily below ground. Overhead transmission lines are unlikely to be a significant IPF because they are short (less than 0.5 mile [0.8 kilometer]); they are in existing, highly disturbed, industrial areas that are unlikely to provide important bird habitat; and best practices, such as implementing Avian Power Line Interaction Committee (2012) standard design guidance to the extent practicable, would be used to minimize potential impacts from collision and electrocution.

Traffic (aircraft): The expected impacts of aircraft traffic associated with the Proposed Action would be negligible, similar to those of the No Action Alternative.

Land disturbance (onshore construction): The expected 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. Ocean Wind proposes to use trenchless technology (e.g., HDD) to go under barrier beaches, which would avoid beach habitat for nesting shorebirds; as such, temporary impact on birds, particularly nesting shorebirds, resulting from the landfall location would be negligible.

Collisions between birds and vehicles or construction equipment have some limited potential to cause mortality. However, these temporary impacts, if any, would be negligible, as most individuals would avoid noisy construction areas (Bayne et al. 2008, Goodwin and Shriver 2010, McLaughlin and Kunc 2013).

Overall, impacts on bird habitat from onshore construction activities would be limited because, whenever possible, facilities (including overhead transmission lines) would be co-located with existing developed areas (i.e., roads and existing transmission lines) to limit disturbance. The maximum design for the Oyster Creek cable corridor would require an approximate construction disturbance up to 5.3 miles long and 50 feet wide and a permanent easement up to 30 feet wide, equating to approximately 32 acres of total disturbance and 19 acres of permanent disturbance. The maximum design for the BL England cable corridor would require an approximate construction disturbance up to 8 miles long and 50 feet wide and a permanent easement up to 30 feet wide, equating to approximately 48 acres of total disturbance and 29 acres of permanent disturbance. While most of this disturbance would occur in already disturbed areas that would provide little, if any, bird habitat, construction of onshore facilities may require clearing and some permanent removal of some trees and shrubs (COP Volume II, Sections 2.2.1.2.1 and 2.2.3.2.1; Ocean Wind 2023).

Clearing and grading during construction within temporary workspaces would result in temporary loss of forage and cover for birds within the area. Construction of the onshore substations would result in temporary and permanent impacts on habitat from construction of the permanent substation facilities and use of temporary construction workspace. However, the existing habitat at the proposed onshore substation sites at BL England and Oyster Creek is already developed and fragmented. The BL England and Oyster Creek substation sites would require approximately 13 and 31.5 acres, respectively. Any remnant habitat within the permanent substation site would be converted to developed land with landscaping for the duration of the Project's operational lifetime (COP Volume 2, page 126; Ocean Wind 2023). Landscaped areas would provide some habitat for species acclimated to human activity. However, the work would not affect habitat outside the construction area.

Impacts on nesting bald eagles are not anticipated because, as described in Section 3.7.1, no bald eagle nest activity has been identified along or adjacent to any of the onshore Project components. Peregrine falcons have been documented throughout the Onshore Project area (see COP Appendix H, Figure 3-11; Ocean Wind 2023), with nesting documented in the vicinity of the landfall sites (see Section 3.7.1) but none in the location of an onshore Project component. Due to the short duration of the activities and the APMs (see COP Volume II, Table 1.1-2; Ocean Wind 2023) that Ocean Wind has committed to implementing to reduce impacts, population-level impacts on birds from habitat modification and impacts are unlikely. Given the nature of the existing habitat, its abundance on the landscape, and the temporary nature of construction, the impacts on birds are expected to be negligible.

3.7.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities. Ongoing and planned non-offshore wind activities related to installation of new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS would contribute to impacts on birds through the primary IPFs of accidental releases, lighting, cable emplacement and maintenance, presence of structures, traffic (aircraft), and land disturbance. The construction, O&M, and decommissioning of both onshore and offshore infrastructure for offshore wind activities across the geographic analysis area would also contribute to the primary IPFs of accidental releases, 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 2,952 WTGs, to which the Proposed Action would contribute 98 or about 3 percent, and would include up to more than 185,762 acres (752 km^2) of seafloor disturbed from the offshore export cable and inter-array cables.

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 undetectable increment to the cumulative accidental releases, lighting, cable emplacement and maintenance, presence of structures, traffic (aircraft), and land disturbance impacts on birds.

3.7.5.3. Conclusions

Impacts of the Proposed Action. Overall, the Proposed Action would have **minor** impacts on birds, depending on the location, timing, and species affected by an activity. The primary factors of the Proposed Action affecting birds are habitat loss and collision-induced mortality from rotating WTGs and permanent habitat loss and conversion from onshore construction. The Proposed Action would also result in potential **minor beneficial** impacts for marine birds associated with foraging opportunities due to the presence of structures.

Cumulative Impacts of the Proposed Action. BOEM anticipates that the cumulative impacts on birds in the geographic analysis area would be **moderate**, as well as **moderate beneficial**. The incremental impacts contributed by the Proposed Action to the cumulative impacts on birds would be undetectable. The Proposed Action would contribute to the cumulative impacts primarily through the permanent impacts from the presence of structures and long-term impacts from habitat loss related to construction and O&M of the onshore Project components.

3.7.6 Impacts of Alternatives B, C, and D on Birds

Impacts of Alternatives B, C, and D. The impacts resulting from Alternatives B, C, and D would be less than or similar to those described under the Proposed Action. BOEM expects the elimination of WTGs under Alternatives B-1 (up to 9 WTGs), B-2 (up to 19 WTGs), and D (up to 15 WTGs) to have a reduced impact on birds given the smaller number of WTGs compared to the Proposed Action. BOEM does not expect relocation of the eight WTGs and compression of the 98 WTGs under Alternatives C-1 and C-2, respectively, to significantly change the potential impacts compared to the Proposed Action because the total number of WTGs would remain the same, the overall footprint would be the same or slightly less, and the Wind Farm Area does not include areas with high bird densities.

Cumulative Impacts of Alternatives B, C, and D. The cumulative impacts on birds would be moderate and moderate beneficial for the same reasons described for the Proposed Action. The incremental impacts contributed by Alternatives B, C, and D to the cumulative impacts on birds would be similar to those described under the Proposed Action. However, the differences in impacts among Alternatives B, C, and D would still apply when considered alongside the impacts of other ongoing and planned activities. Therefore, impacts on birds would be similar under Alternatives C-1 and C-2 and slightly lower but not materially different under Alternatives B-1, B-2, and D.

3.7.6.1. Conclusions

Impacts of Alternatives B, C, and D. As discussed in the above sections, the expected **minor** impacts and potential **minor beneficial** impacts associated with the Proposed Action would not change substantially under Alternatives B, C, and D. While Alternatives B, C, and D have some potential to result in slightly different impacts on birds, the same construction, O&M, and decommissioning activities would still occur, albeit at differing scales in some cases. Alternatives B-1, B-2, and D may result in slightly less, but not materially different, minor impacts and minor beneficial impacts on species with high collision sensitivity and high displacement sensitivity due to a reduced number of WTGs and Project area. Alternative C-1 would have the same WTG number and overall Wind Farm Area footprint as the Proposed Action and, therefore, would have similar minor impacts and minor beneficial impacts on species with higher collision sensitivity and higher displacement sensitivity. Alternative C-2 would have the same number of WTGs as the Proposed Action, but compressed into a smaller footprint, and, therefore, would have similar minor impacts and minor beneficial impacts on species with higher collision sensitivity and higher displacement sensitivity.

Cumulative Impacts of Alternatives B, C, and D. The incremental impacts contributed by Alternatives B, C, and D to the cumulative impacts on birds would be undetectable. Because the impacts of the Proposed Action would not substantially change under Alternatives B, C, and D, BOEM anticipates that the cumulative impacts of Alternatives B, C, and D would be the same as those described for the Proposed Action. Therefore, cumulative impacts of Alternatives B, C, and D would be **moderate** adverse due to behavioral avoidance and temporary or permanent displacement, injury, and mortality, and may include **moderate beneficial** impacts due to the presence of structures, which may provide increased foraging opportunities for bird species within the geographic analysis area.

3.7.7 Impacts of Alternative E on Birds

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park.

Impacts of Alternative E. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternative E would be similar to those described under the Proposed Action because Alternative E would differ only with respect to a short distance of onshore export cable at the landing site for Oyster Creek (see Figure 2-11). The only IPFs that would be meaningfully different under Alternative E compared to the Proposed Action are land disturbance and new cable emplacement/maintenance. All other offshore and onshore Project components of Alternative E would be the same as those of the Proposed Action and the other IPFs are not anticipated to differ.

In contrast to the Proposed Action, which includes two Oyster Creek cable route options as part of Ocean Wind's PDE to cross Island Beach State Park, Alternative E would cross Island Beach State Park on the more northerly route where SAV impacts would be avoided (refer to Section 2.1.6). BOEM expects that the modifications to the Oyster Creek export cable route to avoid impacts on SAV in Barnegat Bay under Alternative E would not significantly change the overall potential impact compared to the Proposed Action. While minimization of SAV impacts under Alternative E would benefit bird species that could use this habitat, Alternative E would affect an additional 0.9 acre of undisturbed scrub/shrub dune and wetland habitat compared to the southern cable route under the Proposed Action. The impact on this habitat, which can support federally and state-listed bird foraging and nesting habitat, would occur in the vicinity of an existing maintenance/storage yard across from the Park Office on Central Avenue/Shore Road and would be a primarily temporary impact to support HDD staging and workspace, but some permanent cable easements would be required after the staging and workspaces are restored.

Alternative E would place the export cable route along the parking area and Central Avenue/Shore Road, where vegetation impacts are anticipated to be minimal. While the construction duration under Alternative E could be longer than under the Proposed Action if the southern cable route option is constructed due to the slightly increased cable length, non-habitat impacts (e.g., noise) would be temporary and short term, lasting only the duration of construction. Any timing restrictions for construction to avoid impacts on birds would be the same as under the Proposed Action for potential habitats for sensitive species or as required by federal and state agency requirements.

In the aquatic environment, cable emplacement would still result in short-term and localized sediment suspension and individual birds would be expected to successfully forage in nearby areas. Impacts on bird habitat from onshore construction activities under Alternative E would remain relatively limited because facilities would be co-located with existing developed areas (i.e., roads, parking areas, and existing maintenance yards) to limit disturbance and affected habitats would be mostly restored. The impacts of Alternative E would not be materially different than those described under the Proposed Action.

Cumulative Impacts of Alternative E. The cumulative impacts on birds would be moderate and moderate beneficial for the same reasons described for the Proposed Action. The incremental impacts contributed by Alternative E to the cumulative impacts on birds would be similar to those described under the Proposed Action because Alternative E would not significantly change the overall potential impact compared to the Proposed Action.

3.7.7.1. Conclusions

Impacts of Alternative E. The expected **minor** impacts and potential **minor beneficial** impacts associated with the Proposed Action alone would not change substantially under Alternative E. While Alternative E has some potential to result in slightly different impacts on birds, the same construction and installation, O&M, and decommissioning activities would still occur. Alternative E would result in similar negligible impacts on birds in relation to sediment disturbance and turbidity, and minor impacts for onshore ground disturbance due to the potential temporary and permanent impacts on bird habitat.

Cumulative Impacts of Alternative E. The incremental impacts contributed by Alternative E to the cumulative impacts on birds would be undetectable. Because the impacts of the Proposed Action would not substantially change under Alternative E, BOEM anticipates that the cumulative impacts on birds associated with Alternative E would be the same as those described for the Proposed Action. Therefore, cumulative impacts of Alternative E would be **moderate** adverse and may include **moderate beneficial** impacts due to the presence of structures, which may provide increased foraging opportunities for bird species within the geographic analysis area.

3.7.8 Proposed Mitigation Measures

Several measures are proposed to minimize impacts on birds (Appendix H, Table H-2). If the measures analyzed below are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced.

Table 3.7-4 Measures Resulting from Consultations (Also Identified in Appendix H, Table H-2): Birds

Measure[1]	Description	Effect
Adaptive mitigation for birds and bats	BOEM will require that Ocean Wind develops and implements an Avian and Bat Post-Construction Monitoring Plan based on COP Appendix III, Appendix AB Avian and Bat Post-Construction Monitoring Framework in coordination with USFWS, NJDEP, and other relevant regulatory agencies. Annual monitoring reports will be used to determine the need for adjustments to monitoring approaches, consideration of new monitoring technologies, and/or additional periods of monitoring (see Appendix H, Table H-2 for more detail).	If the reported post-construction bird monitoring results (generated as part of Ocean Wind's *Avian and Bat Post-Construction Monitoring Framework* [COP Appendix AB, Ocean Wind 2023]) indicate bird impacts deviate substantially from the impact analysis included in this EIS, then Ocean Wind must make recommendations for new mitigation measures or monitoring methods (refer to Appendix H, Table H-2).
Reporting	Annual Bird Mortality Reporting during construction and operation, and decommissioning. The Lessee must submit an annual report covering each calendar year, due by January 31 of the following year, documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning. The report must be submitted to BOEM (at renewable_reporting@boem.gov) and BSEE (at OSWSubmittals@bsee.gov) and USFWS. The report must contain the following information: the name of species, date found, location, a picture to confirm species identity (if possible), and any other relevant information. Carcasses with Federal or research bands must be reported to the United States Geological Survey Bird Band Laboratory. Any occurrence of dead ESA birds or bats must be reported to BOEM, BSEE, and USFWS as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours after the sighting, and if practicable, carefully collect the dead specimen and preserve the material in the best possible state.	Annual bird mortality reporting can inform the Avian and Bat Post-Construction Monitoring Plan (see previous measure), which could lead to Ocean Wind recommending new mitigation measures or monitoring methods to reduce impacts on birds. In addition, mortality data can inform future BOEM offshore wind EIS analyses for proposed wind farms on the Atlantic OCS.
Monitoring	BOEM will require that Ocean Wind implements monitoring and/or other conservation measures to minimize disturbance of rufa red knots and other ESA-listed birds, in coordination with USFWS and NJDEP.	Coordination with USFWS and NJDEP in developing monitoring or conservation measures would avoid or reduce noise disturbance on ESA-listed birds during construction in the onshore environment, primarily those disturbances that could affect energy budgets or displacement from otherwise suitable habitat.

Measure[1]	Description	Effect
Bird Perching Deterrent	To minimize attracting birds to operating turbines, Ocean Wind must install bird perching-deterrent devices on each WTG and OSS. Ocean Wind must submit a plan to deter perching on offshore infrastructure by roseate terns and other marine birds for BOEM and USFWS approval. The plan must include the type(s) and locations of bird perching deterrent devices, include a maintenance plan for the life of the project, allow for modifications and updates as new information and technology becomes available, and track the efficacy of the deterrents. The location of bird perching-deterrent devices must be proposed by Ocean Wind based on best management practices applicable to the appropriate operation and safe installation of the devices. Ocean Wind must confirm the locations of bird perching-deterrent devices as part of the documentation it must submit with the FDR.	While bird presence on the OCS is anticipated to be low, potential collision impacts with offshore WTGs and OSS could be reduced by requiring installation of bird perching–deterrent devices to minimize bird attraction to operating WTGs and on the OSS.
Light Impact Reduction	Ocean Wind must use an FAA-approved vendor for the Aircraft Detection Lighting System (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. Ocean Wind must confirm the use of an FAA-approved vendor for ADLS on WTGs and OSSs in the FIR.	While the presence of birds on the OCS is anticipated to be low, implementation of ADLS would reduce bird attraction to and potential collisions with offshore WTGs and OSS, given the limited amount of time that lights would actually be illuminated.
Light Impact Reduction	Ocean Wind must light each WTG and OSS in a manner that is visible by mariners in a 360-degree arc around the WTG and OSS. To minimize the potential of attracting migratory birds, the top of each light shall be shielded to minimize upward illumination (Conditional on USCG approval) BOEM must provide USFWS with a copy of Ocean Wind's application to USCG to establish Private Aids to Navigation (PATON), which includes a lighting, marking, and signaling plan. The PATON application will include design specifications for maritime navigational lighting. Upon approval of the PATON by USCG, BOEM and USFWS will work together to determine the color, intensity, and duration of any light from maritime lanterns that is likely to reach the typical flight heights of listed birds, and will assess the degree to which the lighting is likely to attract or disorient birds.	While the presence of birds on the OCS is anticipated to be low, shielding of light downward could minimize the potential for light attraction and collision.

Measure[1]	Description	Effect
Collision Reduction	For overhead power lines, Ocean Wind must follow best practices from the Avian Power Line Interaction Committee.	While only a very short distance of overhead power line would be constructed (up to 0.5 mile), installing bird-deterrent or collision-avoidance devices per the Avian Power Line Interaction Committee could avoid and minimize potential bird collisions and electrocutions.
Habitat Impact Reduction	Both during and after construction, Ocean Wind must avoid Project-related intrusion (i.e., access through or disturbance from personnel or equipment) into any beach or dune from March 1 to August 31. In the event that emergency access to this area is needed during the restricted season, Ocean Wind must coordinate with the USFWS and the NJDEP’s Endangered and Nongame Species Program to seek approval.	While Ocean Wind proposes to avoid barrier beaches and dunes (via HDD), coordination with and approval from USFWS and NJDEP for an unforeseen circumstance that requires intrusion into this habitat between March 1 and August 31 would avoid and minimize potential impacts on bird habitat and disturbances that affect bird energy budgets or displacement from otherwise suitable habitat.
Species Disturbance Reduction	Both during and after construction, Ocean Wind must avoid Project activities within 500 feet of any beach or dune from March 15 to August 31. In the event that essential access to this area is needed during the restricted season, Ocean Wind must coordinate with the USFWS and the NJDEP’s Endangered and Nongame Species Program to seek approval.	Coordination with USFWS and NJDEP for any Project activities within 500 feet of beach or dune habitat between March 15 and August 31 would avoid and minimize potential impacts on bird habitat and disturbances that affect bird energy budgets or displacement from otherwise suitable habitat.
Habitat Impact Reduction	Rufa red knot: Along onshore export cable routes, Ocean Wind must avoid permanent modification of suitable red knot habitats. Where temporary habitat disturbance is unavoidable, Ocean Wind must develop a restoration plan in coordination with USFWS for BOEM and USFWS approval.	Avoiding permanent modifications to suitable red knot habitat and developing a restoration plan in coordination with USFWS for unavoidable temporary habitat impacts would ensure no permanent loss or alteration of rufa red knot habitat. Non-ESA listed birds that have similar habitat requirements as red knot would also benefit from this measure.

Measure[1]	Description	Effect
Species Disturbance Reduction	Roseate tern: Ocean Wind must avoid disturbing roosting 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. USFWS anticipates most staging flocks of terns will occur from July through September.	Establishing a 300-foot buffer around roosting roseate terns would minimize and avoid potential disturbances that result in flushing of birds, which could affect energy budgets or displacement from otherwise suitable habitat. This measure would also benefit other bird species with similar habitat requirements and presence from July through September.
Surveys, Avoidance, and Minimization	Eastern black rail and saltmarsh sparrow: No planned or routine Project entry or intrusion into Wetlands A, B, or C (adjacent to Roosevelt Blvd.) either during or after construction will occur. Emergency access must be coordinated with USFWS and NJDEP. If Ocean Wind elects to construct an Oyster Creek onshore cable route option other than the Holtec property route, Ocean Wind must retain a species expert to conduct a desktop and field assessment and to map suitable eastern black rail and saltmarsh sparrow habitat within the limits of disturbance. Ocean Wind must provide the assessment, mapping and associated spatial files in an ESRI ArcMap/ArcPro compatible format, and qualifications of the expert to BOEM and USFWS for review no later than 30 calendar days after the assessment has been completed. BOEM and USFWS will complete their reviews and identify any deficiencies that require a report revision by Ocean Wind within 30 calendar days of receipt of the assessment. If areas of suitable eastern black rail and/or saltmarsh sparrow habitat will be impacted by Project activities, Ocean Wind must coordinate with USFWS to develop appropriate conservation measures that Ocean Wind is required to implement to avoid adverse effects to these species. Conservation measures will include that construction activities and other Project-related intrusions into areas of suitable habitat will be seasonally restricted from April 1 through September 30 (April 1 through September 30 for eastern black rail and May 1 to September 30 for saltmarsh sparrow) in order to minimize the risk of directly disturbing or injuring adults, eggs, or chicks during sensitive periods of the breeding season.	Although there would be no anticipated impacts on wetlands A and C because construction is outside of these wetlands and generally within existing paved road, this measure would ensure Ocean Wind would avoid these wetlands during construction and routine maintenance. If emergency access is needed, coordination with USFWS and NJDEP would ensure impacts would be avoided or minimized to the extent practicable. A desktop and field assessment along the Oyster Creek onshore cable route would identify the potential presence of eastern black rail and saltmarsh sparrow habitat, and the survey results would inform the coordination with BOEM, NJDEP, and USFWS on whether measures (including the specific measures listed) should be implemented to avoid or minimize impacts on these birds. Measures implemented would avoid or reduce disturbance on these birds during construction and other Project intrusions in the habitat, primarily those disturbances that could affect energy budgets or displacement from otherwise suitable habitat. This measure would also benefit other bird species with similar habitat requirements and similar time frames of presence.

Measure[1]	Description	Effect
USFWS Biological Opinion Conservation Measures and Reasonable and Prudent Measures/Terms and Conditions	Conservation Measures and Reasonable and Prudent Measures/Terms and Conditions for activities under BOEM's jurisdiction were provided related to the design of the turbine configuration, offshore lighting, ongoing support for and regular utilization of a Collision Risk Model, monitoring and data collection as part of implementation of an Avian and Bat Post-Construction Monitoring Plan, incidental mortality reporting, and compensatory mitigation for collisions of listed birds. collision mitigation.	These measures would reduce potential for collision risk to listed birds posed by operation of the WTGs. These measures also include an ongoing, long-term commitment to reduce the uncertainty associated with the estimated rates of collision mortality for each of the three listed bird species. Implementation of these conservation measures would provide incremental reductions in impacts on birds, would improve accountability, and would reduce uncertainty associated with estimated rates of collision mortality, but would not alter the overall impact determination of the Proposed Action.

[1] Most of the bird measures in this table are a result of BOEM's ESA Section 7 consultation with USFWS. These same measures are listed in BOEM's BA for species under USFWS jurisdiction and would likely benefit non-ESA-listed bird species with similar habitat in the Project area.
FDR = Facility Design Report; FIR = Fabrication and Installation Report

3.7.8.1. Measures Incorporated in the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.7-4 and Table H-2 in Appendix H, *Mitigation and Monitoring*, are incorporated in the Preferred Alternative. These measures would further define how the effectiveness and enforcement of APMs would be ensured and improve accountability for compliance with APMs by requiring monitoring, reporting, and adaptive management of potential bird impacts on the OCS. In addition, implementation of collision and light reduction measures on the offshore Project components would ensure interactions between birds and the offshore wind infrastructure would be minimized. However, given bird use of the OCS is anticipated to be low, offshore wind activities are unlikely to appreciably contribute to impacts on birds regardless of measures intended to address potential offshore bird impacts. In the onshore environment, conducting surveys and coordinating with NJDEP and USFWS, and implementing species- and habitat-avoidance measures, would ensure impacts on birds and their habitats would be avoided and minimized to the extent practicable. Because most of these measures ensure the effectiveness of and compliance with APMs that are already analyzed as part of the Proposed Action, and because added measures are not anticipated to appreciably reduce impacts on birds (e.g., establishing buffers, temporary avoidance), implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.7.2, *Environmental Consequences*.

3.8. Coastal Habitat and Fauna

This section discusses potential impacts on coastal habitat and fauna resources from the Proposed Action, alternatives, and ongoing and planned activities in the coastal habitat and fauna geographic analysis area. Coastal habitat includes flora and fauna within state waters (which extend 3 nm from the shoreline) inland to the mainland, including the foreshore, backshore, dunes, and interdunal areas. The coastal habitat and fauna geographic analysis area, as shown on Figure 3.8-1, includes the area within a 1.0-mile (1.6-kilometer) buffer of the Onshore Project area that includes the export cable landfalls, onshore export cable routes, the onshore substation, and the connection from the onshore substation to the points of interconnection at Oyster Creek and BL England. BOEM expects the resources in this area to have small home ranges. These resources are unlikely to be affected by impacts outside their home ranges.

This section analyzes the affected environment and environmental consequences of the Proposed Action and alternatives on coastal flora and fauna, including special-status species. The affected environment and environmental consequences of Project activities that are within the geographic analysis area and extend into state waters (i.e., HDD for cable landfalls and cable laying within 1 mile [1.6 kilometers] of cable landfalls) are presented in Sections 3.6, *Benthic Resources*; 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*; 3.15, *Marine Mammals*; 3.19, *Sea Turtles*; and 3.21, *Water Quality*. Additional information on birds, bats, and wetlands is presented in Section 3.7, *Birds*; Section 3.5, *Bats*; and Section 3.22, *Wetlands*, respectively.

3.8.1 Description of the Affected Environment for Coastal Habitat and Fauna

This section describes vegetation communities under existing conditions in upland portions of the geographic analysis area and includes information about special-status species and habitats within the Onshore Project area. Vegetation communities occurring in wetlands are described in Section 3.22, *Wetlands*. Benthic resources, including SAV, are described in Section 3.6, *Benthic Resources*.

The Project is within the Atlantic and Gulf Coast Lowland Forest and Crop Region. This land resource region is composed of coastal lowlands, coastal plains, drowned estuaries, tidal marshes, islands, and beaches along the Atlantic Coast. Native vegetation in most of the region is a mixture of pines and hardwoods (USDA NRCS 2006). This section also describes fauna occurring in upland portions of the geographic analysis area. Bats and birds are described in Sections 3.5 and 3.7, respectively.

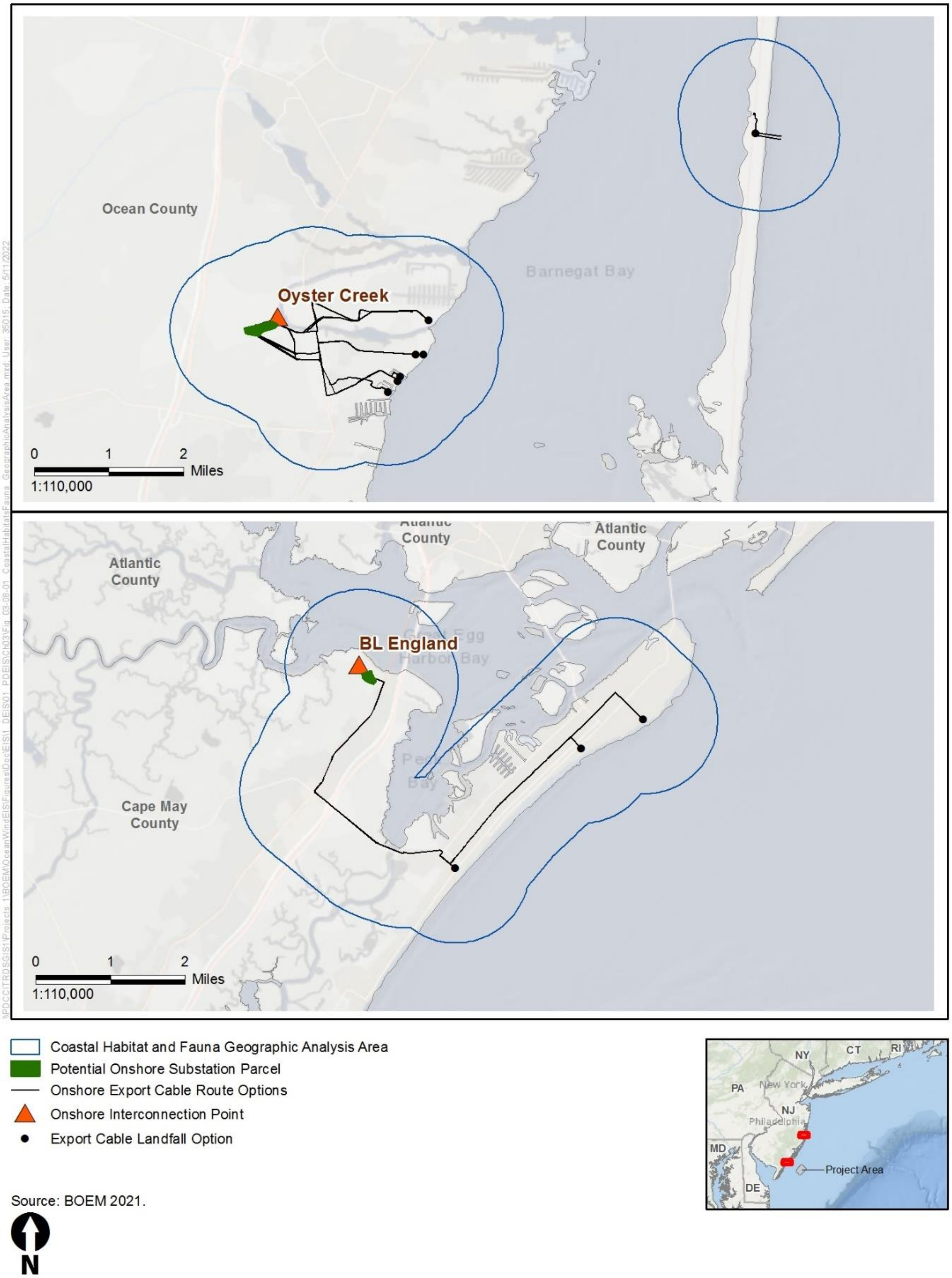


Figure 3.8-1 Coastal Habitat and Fauna Geographic Analysis Area

Coastal Flora Special-Status Species and Habitats

Based on BOEM's BA that addresses federally listed species under USFWS jurisdiction, there are five threatened or endangered plant species may occur within the geographic analysis area: American chaffseed (*Schwalbea americana*—endangered), Knieskern's beaked-rush (*Rhynchospora knieskernii*—threatened), seabeach amaranth (*Amaranthus pumilus*—threatened), sensitive joint-vetch (*Aeschynomene virginica*—threatened), and swamp pink (*Helonias bullata*—threatened). USFWS has not designated or proposed critical habitat for any of these listed species. The habitat requirements for these five species are summarized below, taken from federally listed species descriptions provided by the New Jersey Field Office of USFWS (USFWS 2023).

- **American chaffseed** occurs in highly diverse communities consisting of grasses, sedges, and savanna dicots. It is mainly found in early successional habitats described as open, moist pine flatwoods, fire-maintained savannas, ecotonal areas between peaty wetlands and dry sandy soils, bog borders, and other open grass-sedge systems. This species is dependent on fire, mowing, or fluctuating water tables to maintain the open to partly open conditions it requires.
- **Knieskern's beaked-rush** is an obligate wetland species that is endemic to New Jersey. It occurs in early successional wetland habitats, often on bog-iron substrates adjacent to slow-moving streams in the Pinelands region. This species is also found in abandoned borrow pits, clay pits, ditches, rights-of-way, and unimproved roads that exhibit similar early successional stages due to water fluctuation or periodic disturbance from vehicles, mowing, or fire. It is intolerant of shade and competition, especially from woody species, and is sometimes found on relatively bare substrates.
- **Seabeach amaranth** is an annual plant that is endemic to Atlantic Coast beaches and barrier islands. The primary habitat of seabeach amaranth consists of overwash flats at accreting ends of islands, lower foredunes, and upper strands of non-eroding beaches (landward of the wrack line). The plant grows on a nearly pure sand substrate, occasionally with shell fragments mixed in, above the high tide line and is intolerant of even occasional flooding during its growing season.
- **Sensitive joint-vetch** is an annual member of the pea family that inhabits the intertidal zone of fresh to brackish tidal river segments, typically in areas where sediments accumulate and extensive marshes are formed. It requires bare or sparsely vegetated substrate and usually grows on river banks within 6 feet of the low water mark. It can also occur on accreting point bars and in sparsely vegetated microhabitats of tidal marsh interiors.
- **Swamp pink** is an obligate wetland species that occurs in a variety of palustrine forested wetlands, including swampy forested wetlands bordering meandering streamlets, headwater wetlands, sphagnous Atlantic white-cedar swamps, and spring seepages. Specific hydrologic requirements limit its occurrence within these wetlands to areas that are perennially saturated, but not inundated. Swamp pink is shade tolerant and is often found growing on hummocks formed by trees, shrubs, and sphagnum moss (*Sphagnum* spp.).

The New Jersey Natural Heritage Database has documented several rare plants in the Oyster Creek Onshore Project area in addition to those described above, including smooth orange milkweed (*Asclepias lanceolata*), seabeach sedge (*Carex silicea*), large-fruit fireweed (*Erechtites hieraciifolia* var. *megalocarpa*), swamp-pink (*Helonias bullata*), seabeach sandwort (*Honckenya peploides* var. *robusta*), bog asphodel (*Narthecium americanum*) (three records), sea-beach knotweed (*Polygonum glaucum*), pale beaked-rush (*Rhynchospora pallida*), curly grass fern (*Schizaea pusilla*) (two records), saltmarsh bulrush (*Schoenoplectus maritimus*), and pine barren bellwort (*Uvularia puberula* var. *nitida*). The BL England Onshore Project area contains one record of a New Jersey state rare plant: sea-beach evening-primrose (*Oenothera humifusa*). The New Jersey Natural Heritage Database also identified one rare ecological community in the Oyster Creek Onshore Project area: coastal dune woodland. Ocean Wind would coordinate with NJDEP and USFWS to identify unique or protected habitat or known habitat for threatened or endangered and candidate species and avoid these areas to the extent practicable (APM TCHF-01; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2023). In addition, Island Beach State Park and Ocean City have Beach Management Plans that provide a framework for protecting federally and state-listed plant species that occur along the beach habitats (Island Beach State Park 2017; City of Ocean City 2016). Ocean Wind would need to coordinate with the local beach management entity and comply with any requirements of the beach management plans.

Coastal Fauna Special-Status Species

The geographic analysis area contains protected species habitat based on NJDEP's Landscape Project 3.3 data. Areas with Rank 3, 4, or 5 designations are considered most critical because they represent habitat areas utilized by species on the State Threatened, State Endangered, and Federal Threatened and Endangered Species lists (NJDFW 2017a, 2017b). As depicted on Figure 2.2.1-1 of the COP (Ocean Wind 2023), most of the BL England area contains Rank 4 habitat, indicating documented occurrences of state-listed endangered species or habitats. Portions of the coastline are designated as Rank 5 habitat, indicating documented occurrences of federally listed endangered species or habitats. All Rank 5 habitat is classified based on the potential occurrence of federally listed birds, which are addressed in Section 3.7. As depicted on Figure 2.2.1-2 of the COP, the Oyster Creek area contains a mix of Rank 3 and Rank 4 habitat, indicating documented occurrences of state-listed threatened and endangered species or habitat, respectively (Ocean Wind 2023). Fragmented Rank 1 habitat, indicating habitat patches meeting habitat-specific suitability requirements but no confirmed occurrences of special-status species, is mapped throughout, and Rank 5 habitat is designated within Oyster Creek for federally listed sea turtles, which are addressed in Section 3.19. Additionally, the proposed HDD exit pits and export cable routes on Island Beach State Park are adjacent to habitats designated as Rank 5 for federally listed birds (see Section 3.7).

Based on BOEM's BA that addresses federally listed species under USFWS jurisdiction, there are six faunal species under the jurisdiction of USFWS may occur: northern long-eared bat (*Myotis septentrionalis*—threatened), eastern black rail (*Laterallus jamaicensis* ssp. jamaicensis—threatened), piping plover (*Charadrius melodus*—threatened), red knot (*Calidris canutus rufa*—threatened), roseate tern (*Sterna dougallii*—endangered), and bog turtle (*Clemmys muhlenbergii*—threatened). The monarch butterfly (*Danaus plexippus*) is currently a candidate for federal listing and could occur in the geographic analysis area. Candidate species are provided no statutory protection under the ESA. USFWS has either not designated or proposed critical habitat for these species or designated or proposed critical habitat is not within the geographic analysis area. In addition to the federally listed species, the following state-listed species may occur, according to the NJDEP Landscape Project: bobcat (*Lynx rufus*—state-listed as endangered), corn snake (*Elaphe guttata*—state-listed as endangered), northern pine snake (*Pituophis melanoleucus*—state-listed as threatened), timber rattlesnake (*Crotalus horridus*—state-listed as endangered), wood turtle (*Glyptemys insculpta*—state-listed as threatened), Pine Barrens treefrog (*Hyla andersonii*—state-listed as threatened), and Cope's gray treefrog (*Hyla chrysoscelis*—state-listed as endangered). Northern long-eared bats are discussed in Section 3.5, and eastern black rail, piping plover, red knot, and roseate tern are discussed in Section 3.7. The remaining species' habitat requirements are summarized below, taken from the New Jersey Endangered and Threatened Species Field Guide (Conserve Wildlife Foundation of New Jersey 2021) and USFWS species reports (USFWS 2023).

- **Bog turtle** habitat includes well-drained, calcareous fens, sphagnum bogs, and wet, grassy pastures with soft, thick, mucky substrates and tussock-forming herbaceous vegetation. Open areas are required for basking and nesting. Emergent wetland areas recently or currently used as pastures are common places to find bog turtles, as grazing maintains open areas and keeps the ground soft.

- **Monarch butterfly** caterpillars feed almost exclusively on milkweed (*Asclepias* spp.) and as adults feed on nectar from a wide range of flowers. In the spring, summer, and early fall, they can be found in New Jersey wherever there is milkweed and other native nectar plants.
- **Bobcat** habitat typically consists of large areas of contiguous forest and fragmented forests interspersed with agricultural areas or early successional vegetation. Bobcats often utilize rock outcrops, caves, and ledges for shelter and cover for hunting, resting, and rearing young. When rocky areas are unavailable, swamps, bogs, conifer stands, and rhododendron and mountain laurel thickets can provide cover and hunting grounds.
- **Corn snake** habitat is primarily mature upland pine forests with stump holes, uprooted trees, rotten logs, and sandy or loamy soils. These features allow corn snakes to burrow. Abandoned buildings or foundations provide nesting and hibernation habitat. They require a nearby water source such as a stream or pond and utilize open fields and forest edges for foraging.
- **Northern pine snakes** live in dry pine and oak forests with sandy soils. Disturbances, both natural and human, create openings used for nesting, basking, and burrowing, and sandy soils allow them to dig out burrows for hibernating and summer denning.
- **Timber rattlesnakes** are typically found in pinelands habitats in southern New Jersey that consist primarily of pitch pine, shortleaf pine, scrub oak, blackjack oak, and blueberry (*Vaccinium* spp.). Dens are usually found in cedar swamps and along streambanks.
- **Wood turtles** reside in both aquatic and terrestrial environments. Aquatic habitats are required for mating, feeding, and hibernation, while terrestrial habitats are used for foraging and egg laying. Freshwater streams, brooks, creeks, or rivers that are relatively remote provide the habitat needed by these turtles. These tributaries are characteristically clean, free of litter and pollutants, and located within undisturbed uplands such as fields, meadows, or forests. Wood turtle habitats typically contain few roads and are often over 0.5 mile away from developed or populated areas.
- **Pine Barrens treefrog** habitat consists of acidic Atlantic white cedar swamps and pitch pine lowlands associated with dense sphagnum moss. The species requires an open-canopy, dense shrub layer, and heavy ground cover in sandy and mucky soils. Breeding areas include vernal pools, bogs, and seepage areas with approximately 12 to 24 inches (30 to 61 centimeters) of acidic water. More-disturbed areas such as roadside ditches, vehicle ruts, and borrow pits may also serve as breeding areas, provided enough associated vegetation is present.
- **Cope's gray treefrogs** utilize both aquatic and terrestrial habitats. They spend most of their time high in the trees, except during breeding season when they are at the water's edge. Breeding pools include vernal pools, gravel pits, retention basins, floodplain corridors, bogs, weedy lakes, cattail or sedge marshes, and farm ponds, typically within or near deciduous or mixed forest, with bare horizontal branches over water near preferred calling sites.

Other state special concern species that could potentially occur in the geographic analysis area include the spotted turtle (*Clemmys guttata*), northern diamondback terrapin (*Malaclemys terrapin terrapin*), and eastern box turtle (*Terrapene carolina carolina*) (Ocean Wind 2023). Ocean Wind would coordinate with NJDEP and USFWS to identify unique or protected habitat or known habitat for threatened or endangered and candidate species and avoid these areas to the extent practicable (APM TCHF-01; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2023). In addition, Island Beach State Park and Ocean City have Beach Management Plans that provide a framework for protecting federally and state-listed animal species that occur along the beach habitats (Island Beach State Park 2017; City of Ocean City 2016). Ocean Wind would need to coordinate with the local beach management entity and comply with any requirements of the beach management plans.

BL England

BL England Flora

The proposed landfall sites are along the coastline of the barrier island, within Ocean City, New Jersey. The landfall locations would be primarily in developed areas. However, unvegetated beaches and vegetated dunes occur along the coastline. American beachgrass (*Ammophila breviligulata*) is the primary plant species found on foredunes in New Jersey (New Jersey Sea Grant Consortium n.d.). Multiple species of plants colonize areas landward of the foredunes; in New Jersey, these species typically include rugosa rose (*Rugosa rosa*), bayberry (*Morella pensylvanica*), and goldenrod (*Solidago* sp.) (New Jersey Sea Grant Consortium n.d.).

From the coastline, the onshore export cable route(s) would traverse heavily developed sections of Ocean City, New Jersey. This area is largely devoid of vegetation except for some landscape plants and maintained lawns. Farther inland, the onshore export cable route(s) would traverse areas of mixed forested communities interspersed with suburban development. The upland forests are characterized by pines, especially pitch pine (*Pinus rigida*) and shortleaf pine (*P. echinata*). Pitch pine is the most abundant, and its associations include shortleaf pine and oaks. Communities within the upland association include pine-black oak (*Quercus velutina*), pine-black oak-scrub oak (*Q. berberidifolia*), and oak-pine (Ocean Wind 2023 citing Atlantic County 1973). The location proposed for the onshore substation was once a golf course and is now dominated by herbaceous vegetation and interspersed trees. The vegetation communities at the substation site are similar to those along the onshore export cable route(s). Table 2.2.1-1 of the COP provides a list of common plant species occurring in the BL England area (COP Volume II, Section 2.2.1.1.1; Ocean Wind 2023).

Suitable habitat for seabeach amaranth is present along the Ocean City coastline within the upper beach zone, above the high tide line. These areas are generally depicted as “barren land” along the coastline on Figure 2.3.5-1 of the COP (Ocean Wind 2023). Open meadows that would provide suitable habitat for American chaffseed are present within the BL England area, although it is unlikely that any areas provide the appropriate disturbance regime required for the plant to germinate and grow. Wetland habitats that would provide suitable habitat for Knieskern’s beaked-rush, sensitive joint-vetch, and swamp pink do not occur within the BL England area.

BL England Fauna

Ghost or sand crabs (Ocypodidae) are likely to occur on the upper beach and edge of the dunes (Wootton et al. 2016). Due to the fragmentation and urbanization of the upland forest along the export cable route, animal species commonly found in these habitats in New Jersey would be most likely to occur. Common mammal species would likely include the gray squirrel (*Sciurus carolinensis*), eastern cottontail (*Sylvilagus floridanus*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), red fox (*Vulpes vulpes*), and house mouse (*Mus musculus*). Common reptiles would likely include the black rat snake (*Pantherophis obsoletus*) and eastern garter snake (*Thamnophis sirtalis*). Common amphibians may include the spring peeper (*Pseudacris crucifer*) and gray treefrog (*Hyla versicolor*). The open fields at the proposed onshore substation site likely contain small mammals such as the deer mouse (*Peromyscus maniculatus*), white-footed mouse (*Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), eastern mole (*Scalopus aquaticus*), and short-tailed shrew (*Blarina brevicauda*). As the location of the proposed onshore substation site is less developed, additional species such as the white-tailed deer (*Odocoileus virginianus*) and gray fox (*Urocyon cinereoargenteus*) may inhabit the area. Table 2.2.2-1 of the COP provides a list of animal species potentially occurring in the BL England area (Ocean Wind 2023).

In coordination with USFWS and NJDEP, Ocean Wind commissioned species surveys within portions of the Onshore Project area that contained potentially suitable habitat for listed species. Based on this coordination, a bog turtle Phase 1 Habitat Assessment Survey was conducted on the BL England onshore substation parcel. The surveys found that suitable bog turtle habitat does not occur on the substation parcel. Surveys were not conducted along the BL England landfall site or export cable route(s) because potentially suitable habitat does not occur. As depicted on Figure 2.3.5-1 of the COP (Ocean Wind 2023), the proposed landfall sites and cable route corridors are highly developed, and the wetland crossing along Roosevelt Boulevard contains brackish water, whereas bog turtles are freshwater species. The federal candidate species, monarch butterfly, is likely to utilize the open fields and other undeveloped land where milkweed and other native nectar plants are present. The preferred remote, undisturbed habitats for wood turtle are not present. Corn snake, timber rattlesnake, and northern pine snake may occur in forested uplands, particularly in less developed areas near the substation site. Breeding and non-breeding habitats for Pine Barrens and Cope’s gray treefrog could also occur.

Oyster Creek

Oyster Creek Flora

This EIS evaluates six landfall sites for the Oyster Creek area. All export cable routes would landfall and cross Island Beach State Park prior to traversing Barnegat Bay to the mainland landfall. The mainland landfall site options include landfall locations in Waretown (Ocean Township) and Forked River (Lacey Township). These landfall sites are described in further detail below. From the selected landfall site, the onshore export cable would extend to the proposed onshore substation next to the Oyster Creek Generating Station, which consists of previously disturbed herbaceous vegetation.

Island Beach State Park. The proposed onshore export cable route at Oyster Creek would first make landfall in a parking lot in Island Beach State Park on the Barnegat Peninsula before crossing Barnegat Bay to landfall sites on the mainland. Upland vegetation communities at Island Beach State Park include primary dune, secondary dune, road edge, thicket, bayshore, and maritime forest. The primary dunes are dominated by American beachgrass, with beach pea (*Lathyrus maritimus*), Japanese sedge (*Carex kobomugi*), seaside goldenrod (*Solidago sempervirens*), and sea rocket (*Cakile edentula*) also occurring. The secondary dune community is more diverse than the primary dune community, with representative species including beach plum (*Prunus maritima*), bayberry (*Myrica pensylvanica*), beach heather (*Hudsonia tomentosa*), pineweed (*Hypericum gentianoides*), and salt spray rose (*Rosa rugosa*). Within the thicket, edge, and bayshore communities, 73, 140, and 22 plant species have been identified, respectively. The maritime forest community is dominated by American holly (*Ilex opaca forma sabintegra*), Atlantic white cedar (*Chamaecyparis thyoides*), white oak, and pitch pine (Kennish n.d.; Save Barnegat Bay 2019).

Island Beach State Park is designated as a Natural Heritage Priority Site (i.e., Island Beach Macrosite) and supports populations of state-listed endangered plant species and species of concern plant species such as the seaside sandplant (*Honckenya peploides* var. robusta), seabeach knotweed (*Polygonum glaucum*), seabeach sedge (*Carex silicea*), and sickle-leaf golden-aster (*Pityopsis falcate*) (Ocean Wind 2023).

Waretown and Forked River Landfalls. Six mainland landfall site options and onshore export cable routes would be in Waretown (Ocean Township) and Forked River (Lacey Township), New Jersey. The Lighthouse Drive option is in a developed area devoid of vegetation. Holtec Property and Bay Parkway occur in wetland areas (see Section 3.22 for a description of vegetative communities in wetlands). Other options would landfall within the Lighthouse Marina or Nautilus Drive and predominantly follow public right-of-way and previously disturbed areas or traverse private land. Upland communities farther west from the landfall site options along the onshore export cable route options include coniferous and mixed forests. These communities are typically dominated by oaks and pines. Table 2.2.1-2 of the COP provides a list of common plant species occurring in the Waretown and Forked River portions of the Oyster Creek area (COP Volume II, Section 2.2.1.1.1; Ocean Wind 2023).

Suitable habitat for seabeach amaranth is present within all of the Oyster Creek landfall and export cable route options, including on Island Beach State Park. Suitable locations are present along the coastline within the upper beach zone, above the high tide line. In 2019, 1,591 seabeach amaranth plants were counted at Island Beach State Park, a more than 500-percent increase from the 2018 total of 307 plants (Conserve Wildlife Foundation of New Jersey 2019). Open meadows that would provide suitable habitat for American chaffseed are not present. Wetlands within the Holtec Property and Bay Parkway landfall sites may provide suitable habitat for Knieskern's beaked-rush, sensitive joint-vetch, and swamp pink; wetland habitats are discussed in detail in Section 3.22. In coordination with USFWS, Ocean Wind commissioned species surveys within portions of the Onshore Project area that contained potentially suitable habitat for listed species. Based on this coordination, surveys were conducted for swamp pink and Knieskern's beaked-rush within the forested wetlands and ditch areas of the Holtec Property of Lacey Township. These surveys were conducted by a Professional Wetland Scientist with rare plant survey experience and were timed to coincide with the fruiting/blooming period for the species. No individuals of either species were observed during these surveys.

Oyster Creek Fauna

Long Beach Island would be expected to support wildlife species adapted to suburban and urban environments such as the Virginia opossum, eastern cottontail, Norway rat (*Rattus norvegicus*), house mouse, red fox, and raccoon. Reptile and amphibian species may include the American bullfrog (*Lithobates catesbeianus*), green frog (*Lithobates clamitans*), common snapping turtle (*Chelydra serpentina*), northern water snake (*Nerodia sipedon*), eastern garter snake, and rough green snake (*Opheodrys aestivus*) (Ocean County Planning Department 1976).

More than 30 species of land mammals occur in the Barnegat Bay watershed, which encompasses the remaining landfall sites and onshore export cable routes in the Oyster Creek area. Forest-dwelling species include the red fox, gray fox, raccoon, long-tailed weasel (*Mustela frenata*), short-tailed weasel (*Mustela erminea*), striped skunk, Virginia opossum, gray squirrel, red squirrel (*Tamiasciurus hudsonicus*), chipmunk (*Tamias striatus*), southern flying squirrel (*Glaucomys volans*), white-footed mouse, and pine vole (*Microtus pinetorum*). Species such as the red fox and raccoon occur on both the mainland and barrier islands, while white-tailed deer is found only on the mainland. Shrubland and grassland mammals include the meadow vole, meadow jumping mouse (*Zapus hudsonius*), woodchuck (*Marmota monax*), and eastern cottontail, as well as several of the species also found in forested areas (Kennish n.d.).

Three species of lizards occur in the Barnegat Bay region: the fence lizard (*Sceloporus undulatus hyacinthinus*), ground skink (*Scincella lateralis*), and five-lined skink (*Eumeces fasciatus*). Upland snake species include the black racer (*Coluber constrictor*), northern pine snake, corn snake, worm snake (*Carphophis punctatus*), and eastern hognose snake (*Heterodon platirhinos*). The box turtle (*Terrapene carolina*) is the only upland turtle species occurring in the area. Common salamander species include the red-backed salamander (*Plethodon cinereus*), northern two-lined salamander (*Eurycea bislineata*), four-toed salamander (*Hemidactylium scutatum*), and northern red salamander (*Pseudotriton ruber*). Widespread frog and toad species include the northern spring peeper (*Pseudacris crucifer*), northern gray treefrog (*Hyla versicolor*), New Jersey chorus frog (*Pseudacris triseriata kalmi*), bullfrog (*Rana catesbeiana*), green frog (*Rana clamitans melanota*), wood frog (*Rana sylvatica*), southern leopard frog (*Rana utricularia*), pickerel frog (*Rana palustris*), and Fowler's toad (*Bufo woodhousii fowleri*) (Kennish n.d.). Table 2.2.2-2 of the COP provides a list of animal species potentially occurring in the Waretown and Forked River portions of the Oyster Creek area (COP Volume II, Section 2.2.2; Ocean Wind 2023).

Suitable habitat for the federally listed threatened bog turtle does not occur in the Oyster Creek area. Suitable habitat for bog turtle is only present where open-canopy freshwater wetlands with mucky substrates and tussock-forming vegetation are present. The state-listed threatened bobcat is unlikely to frequent the area due to the urban environment and proximity to roads and other human disturbance. Monarch butterfly is likely to occur throughout the Oyster Creek area in undeveloped lands or gardens where milkweed and other native nectar plants are present. Suitable habitat for the northern pine snake, timber rattlesnake, Pine Barrens treefrog, and Cope's gray treefrog is likely present in the less developed portions of the landfall sites, onshore export cable route, and substation area.

3.8.2 Environmental Consequences

3.8.2.1. Impact Level Definitions for Coastal Habitat and Fauna

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

Table 3.8-1 Impact Level Definitions for Coastal Habitat and Fauna

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

3.8.3 Impacts of the No Action Alternative on Coastal Habitat and Fauna

Section 3.1 of the Final EIS explains the approach to predicting impacts related to the No Action Alternative. When analyzing the impacts of the No Action Alternative on coastal habitat and fauna, 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 coastal habitat and fauna. 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 F, *Planned Activities Scenario*. Separate impact conclusions are presented for both scenarios.

3.8.3.1. Impacts of the No Action Alternative

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

There are no ongoing offshore wind activities within the geographic analysis area for coastal habitat and fauna.

3.8.3.2. Cumulative Impacts of the No Action Alternative

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

Other planned non-offshore wind activities that may affect coastal habitat and fauna primarily include increasing onshore development activities (see Section F.2 in Appendix F for descriptions). These activities may result in temporary and permanent impacts on animals and vegetation, including disturbance, displacement, injury, mortality, habitat and plant degradation and loss, and habitat conversion.

BOEM reviewed available information regarding the potential for planned offshore wind activities to occur within the geographic analysis area for coastal habitat and fauna. Atlantic Shores South proposes points of interconnection at the Cardiff Substation and Larrabee Substation (COP Volume I, Figure E-1 [Ocean Wind 2023]; Atlantic Shores 2021). Transmission lines rated at 138 kV and higher have sufficient thermal capability to deliver power from an offshore wind project to the utility's load center. The *New Jersey Offshore Wind Energy: Feasibility Study* identified existing transmission lines and substations rated at 138 kV and above. These substations would be likely potential points of interconnection for future offshore wind activities; however, the substations and likely onshore routes to reach the substations are outside of the geographic analysis area.

Because cable landfalls and onshore infrastructure for other offshore wind projects would not be in the geographic analysis area for coastal habitat and fauna, BOEM does not expect other offshore wind activities to affect coastal habitat and fauna through the primary IPFs. Noise and lighting from other offshore wind construction activities are not expected to reach the geographic analysis area for Ocean Wind 1, which includes onshore and nearshore areas within 1.0 mile (1.6 kilometers) of landfalls and proposed onshore infrastructure. Therefore, increased noise and lighting resulting from other offshore wind activities would not affect coastal habitat and fauna, resulting in a negligible impact.

3.8.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, coastal habitat and fauna would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities would have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on coastal habitat and fauna, primarily through onshore construction and climate change. BOEM anticipates that the potential impacts of ongoing activities on coastal habitat and fauna due to ongoing construction activities would likely be minor, but impacts from climate change could be moderate. Therefore, the No Action Alternative would result in **moderate** impacts on coastal habitats, primarily driven by climate change. Currently, there are no other offshore wind activities proposed in the geographic analysis area.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and coastal habitat and fauna would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to the impacts on coastal habitat and fauna through construction-related activities that affect habitat, vegetation, and wildlife. Currently there are no future offshore wind activities proposed in the geographic analysis area. BOEM anticipates the No Action Alternative would result in **moderate** impacts on coastal habitat and fauna, primarily driven by climate change.

3.8.4 Relevant Design Parameters & Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; BOEM expects any potential variances in the proposed Project build-out within the range of the PDE to result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix E) would influence the magnitude of the impacts on coastal habitat and fauna:

- The onshore export cable routes, including routing variants, and extent of land disturbance for new onshore substations, which could require the removal of vegetation.

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

- Onshore export cable routes and substation footprints: The route chosen (including variations of the general route) and substation footprints would determine the amount of habitat affected.

Ocean Wind has committed to measures to minimize impacts on coastal habitat and fauna, including avoiding areas of unique or protected habitat or known habitat for threatened or endangered and candidate species to the extent practicable (TCHF-01) and conducting maintenance and repair activities in a manner to avoid or minimize impacts on sensitive species and habitat such as beaches, dunes, and the near-shore zone (TCHF-02) (COP Volume II, Table 1.1-2; Ocean Wind 2023).

3.8.5 Impacts of the Proposed Action on Coastal Habitat and Fauna

3.8.5.1. Impacts of the Proposed Action

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park, which is described in Section 3.8.7, *Impacts of Alternative E on Coastal Habitat and Fauna*.

The sections below summarize the potential impacts of the Proposed Action on coastal habitat and fauna and special-status species during the various phases of the Project. Routine activities would include construction, O&M, and decommissioning of the Project, as described in Chapter 2, *Alternatives*. BOEM prepared a BA for the potential effects on USFWS federally listed species, which found that the Proposed Action was *not likely to adversely affect*, or had *no effect*, on listed species (BOEM 2022). BOEM requested concurrence 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 affec*t Knieskern's beaked-rush, sensitive joint-vetch, and swamp pink. The BA concluded that the Proposed Action would have *no effect* on bog turtle, American chaffseed, and seabeach amaranth. Results of consultation with USFWS pursuant to Section 7 of the ESA will be presented in the Final EIS.

Noise: Onshore construction noise associated with the Proposed Action alone is expected to result in short-term, temporary, highly localized, and negligible impacts. Impacts, if any, are expected to be limited to behavioral avoidance of construction activity and noise. The state-listed bobcat, although unlikely to be present within the Onshore Project area due to existing development, could experience stress and negative physiological effects that could affect individuals; however, the species can habituate to human presence (Carroll 2019). Construction would predominantly occur in already developed areas where wildlife is habituated to human activity and noise. Displaced wildlife could use adjacent habitat and would repopulate these areas once construction ceases.

Land disturbance: Impacts from the export cable landfall would vary based on the export cable route option chosen. Landfall would require up to 2 acres of workspace to accommodate two HDD exit pits and workspace, and additional workspace would be required for storage and staging. Most landfall options occur in developed areas; however, some clearing of vegetation may be required. Impacts on unvegetated beaches and vegetated dunes would be avoided for all options by using HDD to transition from offshore to onshore. Construction of the onshore export cable may require clearing and permanent removal of some trees along the edge of the construction corridor. Impacts on herbaceous communities would result from excavation, rutting, compaction, mixing of topsoil and subsoil, and potential alteration of habitat. The maximum design for the Oyster Creek cable corridor would require an approximate construction disturbance up to 5.3 miles long and 50 feet wide and a permanent easement up to 30 feet wide, equating to approximately 32 acres of total disturbance and 19 acres of permanent disturbance. The maximum design for the BL England cable corridor would require an approximate construction disturbance up to 8 miles long and 50 feet wide, and a permanent easement up to 30 feet wide, equating to approximately 48 acres of total disturbance and 29 acres of permanent disturbance. Installation of onshore cable is expected to take up to 30 months. The BL England and Oyster Creek substation sites would require approximately 13 and 31.5 acres, respectively. During construction, up to 3 acres would be required for temporary workspace. Construction of each onshore substation is expected to take up to a maximum of 36 months. The planned improvements to the onshore O&M facility would require permanently filling 0.15 acre of open water habitat, and Ocean Wind has already submitted a permit application to the USACE Philadelphia District for authorization of this impact.

To minimize impacts on sensitive habitat from land disturbance during construction, Ocean Wind proposes to use appropriate installation technology designed to minimize disturbance to sensitive habitat (such as beaches and dunes, wetlands and associated buffers, streams, hard-bottom habitats, seagrass beds, and the near-shore zone) (APM GEN-08; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2023). Areas that would require extensive onshore alterations would be avoided to the extent practicable (APM GEN-03; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2023). Ocean Wind proposes to restore disturbance areas in the Onshore Project area to pre-existing contours (maintaining natural surface drainage patterns) and allow vegetation to become reestablished once construction activities are completed, to the extent practicable (APM GEN-13; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2023). Temporarily affected upland and wetland communities would be expected to become reestablished within 1 to 3 years following construction. Permanent loss of wetland habitat could occur if placement of fill is required in wetlands. NJDEP-regulated adjacent transition areas may also be affected by clearing and soil disturbance. Ocean Wind proposes to avoid or minimize wetland impacts by implementing a site-specific monitoring program to ensure compliance with permit conditions during the construction, operation, and decommissioning phases (APM GEN-06; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2023). A detailed discussion of impacts on wetland communities is provided in Section 3.22. See Section 3.6 for information on potential impacts on SAV. In combination with federal, state, and local government agencies, academic institutions, non-governmental organizations, and businesses, the Barnegat Bay Partnership has established a Comprehensive Conservation and Management Plan for the Barnegat Bay-Little Egg Harbor Estuary. The plan identifies a living resources goal to protect, restore, and enhance habitats in Barnegat Bay and its watershed as well as ensure healthy and sustainable natural communities of plants and animals both now and in the future. BOEM is continuing to consult with USFWS on potential impacts of the Proposed Action on ESA-listed species and multiple mitigation measures have resulted from that consultation (Table H-2, Appendix H). Additionally, Ocean Wind has committed to avoidance and minimization of impacts on SAV and to restoration activities to mitigate impacts on SAV as a result of construction activities (Table H-2, Appendix H).

Impacts on habitat from onshore construction activities would be limited because, whenever possible, facilities (including overhead transmission lines) would be co-located with existing developed areas (i.e., roads and existing transmission rights-of-way) to limit disturbance (APM GEN-01; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2023). The existing habitat at the proposed onshore substation sites at BL England and Oyster Creek is already developed and fragmented. Any remnant habitat within the substation sites would be converted to developed land with landscaping for the duration of the Project’s operational lifetime. Impacts on special-status plants species could occur due to the degradation of habitat and direct loss of individuals during construction. However, BOEM anticipates that any habitat impacts would not result in population-level effects, given the limited amount of habitat removal. Ocean Wind would coordinate with NJDEP and USFWS to identify unique or protected habitat or known habitat for threatened or endangered and candidate species and avoid these areas to the extent practicable (APM TCHF-01; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2023). Project implementation would be conditioned upon issuance of applicable federal and state permits and conducted in accordance with federal and state permit conditions. It is anticipated that permit conditions may include BMPs such as implementing seasonal work restrictions to avoid and minimize potential adverse effects on wetlands and protected species, clearly demarcating sensitive areas to avoid disturbance during construction, and controlling runoff and stabilizing soils to minimize the potential for soil erosion and sedimentation in wetlands during construction. Impacts on coastal habitat and fauna from land disturbance would be temporary, localized, and negligible.

For temporary impacts, including the effects of onshore construction, it is likely that a portion, possibly a majority, of such impacts from other planned activities would not overlap temporally or spatially with the Proposed Action. However, temporary impacts can also result in long-term to permanent impacts that would likely be negligible. Ocean Wind would likely abandon the onshore cables in place and relocate components of the onshore electrical infrastructure that may still have substantial life expectancies after 35 years (Chapter 2). Land disturbance during decommissioning would be limited to soil compaction and vegetation trampling, and minimal excavation to bury the ends of abandoned cables and remove certain electrical infrastructure. Therefore, onshore temporary impacts of decommissioning would be negligible.

Traffic: Collisions between wildlife and vehicles or construction equipment would be rare because most individuals are expected to avoid construction areas or have the mobility to avoid construction equipment. However, individuals of burrowing species (e.g., moles, voles) or those with limited mobility, especially herpetofauna, could be more vulnerable to this impact, particularly during land clearing and ground excavation. Impacts would be short term, temporary during the construction period, and negligible.

3.8.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities. 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 noise, traffic, and land disturbance. BOEM is not aware of any future offshore wind activities other than the Proposed Action that would overlap the geographic analysis area for coastal habitat and fauna.

The cumulative impact on coastal habitat and fauna would likely be moderate, mostly driven by climate change. The onshore cable routes and substation location are primarily within developed areas along coastal New Jersey, where large areas of natural habitat and habitat connectivity are more limited. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the cumulative noise, traffic, and land disturbance impacts on coastal habitat and fauna.

3.8.5.3. Conclusions

Impacts of the Proposed Action. BOEM expects the incremental impact of construction and installation, O&M, and conceptual decommissioning of the Proposed Action, when compared with the No Action Alternative, to have minor impacts on coastal habitat and fauna because habitat impacts would be limited and construction would predominantly occur in already developed areas where wildlife is habituated to human activity and noise. When including the baseline status (No Action Alternative), impacts on coastal habitats and fauna resulting from the Proposed Action would be **moderate**, primarily driven by climate change.

Cumulative Impacts of the Proposed Action. BOEM anticipates that the cumulative impacts on coastal habitat and fauna in the geographic analysis area would be **moderate**, primarily driven by climate change. The incremental impacts contributed by the Proposed Action to the overall impacts on coastal habitat and fauna would be undetectable. The Proposed Action would contribute to the cumulative impacts on coastal habitat and fauna in the geographic analysis area primarily through the permanent impacts on habitat associated with construction and O&M of the onshore Project components.

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

Impacts of Alternatives B, C, and D. Because Alternatives B, C, and D involve modifications only to offshore components not within the geographic analysis area for coastal habitat and fauna, impacts on coastal habitat and fauna from those alternatives would be the same as those under the Proposed Action.

Cumulative Impacts of Alternatives B, C, and D. The cumulative impacts on coastal habitat and fauna would be moderate for the same reasons described for the Proposed Action. The incremental impacts contributed by Alternatives B, C, and D to the cumulative impacts on coastal habitat and fauna would be the same as those described for the Proposed Action for the reason described above.

3.8.6.1. Conclusions

Impacts of Alternatives B, C, and D. As discussed above, the anticipated **moderate** impacts associated with the Proposed Action would not change under Alternatives B, C, and D.

Cumulative Impacts of Alternatives B, C, and D. The incremental impacts contributed by Alternatives B, C, and D to the cumulative impacts on coastal habitat and fauna would be undetectable. Because the impacts of the Proposed Action would not change under Alternatives B, C, and D, BOEM anticipates that the cumulative impacts of Alternatives B, C, and D would be the same as those of the Proposed Action.

Therefore, cumulative impacts of Alternatives B, E, and F would be **moderate**, primarily driven by climate change.

3.8.7 Impacts of Alternative E on Coastal Habitat and Fauna

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park.

Impacts of Alternative E. The types of impacts under Alternative E would be the same as those described for the Proposed Action. The onshore export cable route on Island Beach State Park under Alternative E would be limited to the slightly longer (about 2,000 feet [600 meters]) northern option. The construction of temporary workspace and installation of the export cable along the parking lot and across Central Avenue/Shore Road would result in 0.9 acre of vegetation clearing. Affected vegetation communities include roadside edges, forested wetlands, and scrub/shrub wetlands which are/are not are designated by NJDFW (2017a) as Rank 4 and 5 habitat due to documented occurrences of state- and federally listed endangered species or habitats; however, these special-status species are all birds and there is no suitable habitat for any non-avian special-status species. Impacts from noise and vehicle collisions would be similar to those of the Proposed Action. Alternative E would traverse Barnegat Bay and use the same landfall sites within the Oyster Creek area.

Cumulative Impacts of Alternative E. The cumulative impacts on coastal habitat and fauna would be moderate for the same reasons described for the Proposed Action. The incremental impacts contributed by Alternative E to the cumulative impacts on coastal habitat and fauna would be the same as those described for the Proposed Action.

3.8.7.1. Conclusions

Impacts of Alternative E. Alternative E could affect slightly more habitat at Island Beach State Park than under the Proposed Action and Alternatives B, C, and D (see Figure 3.22-2 in Section 3.22, *Wetlands*), but impacts on coastal habitat and fauna from onshore construction activities would still remain limited overall. Therefore, the **moderate** impacts associated with the Proposed Action would not substantially change under Alternative E.

As with the Proposed Action, if Alternative E is selected, Ocean Wind would conduct site-specific habitat surveys and surveys for individuals in suitable habitat to determine the location and extent of special-status species in the geographic analysis area so they can be avoided during construction, O&M, and decommissioning (TCHF-01).

Cumulative Impacts of Alternative E. The incremental impacts contributed by Alternative E to the overall impacts on coastal habitat and fauna would be undetectable. Because the impacts of the Proposed Action would not substantially change under Alternative E, BOEM anticipates that the cumulative impacts of Alternative E would be the same as described for the Proposed Action. Therefore, cumulative impacts of Alternative E would be **moderate**, primarily driven by climate change.

3.8.8 Proposed Mitigation Measures

Several measures are proposed to minimize impacts on coastal habitat and fauna (Appendix H, Table H-2 and Table H-3). If the measures analyzed below are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced.

Table 3.8-2 Measures Resulting from Consultations (Also Identified in Appendix H, Table H-2): Coastal Habitat and Fauna

Measure	Description	Effect
Surveys, Avoidance, and Minimization (ESA-listed plants)	Ocean Wind must conduct pre-construction habitat surveys for ESA-listed plants and implement avoidance and minimization measures in coordination with USFWS and NJDEP.	Identifying habitat and presence of ESA-listed plants and coordination with USFWS and NJDEP would ensure that if ESA-listed plants are identified during pre-construction surveys, potential impacts would be avoided and/or minimized.
Surveys, Avoidance, and Minimization (ESA-listed plants; swamp pink)	Swamp Pink: If Ocean Wind elects to construct an Oyster Creek onshore cable route option other than the Holtec property route, Ocean Wind must retain a USFWS qualified surveyor to conduct a survey in accordance with USFWS swamp pink survey guidelines of all suitable habitats (i.e., forested wetlands) that will be subject to temporary disturbance or permanent modification as a result of Project activities, both during construction and from post-construction O&M activities, including areas crossed by HDD. The survey area will also include all forested wetlands within 300 feet of upland disturbance. Ocean Wind must submit the survey area(s), timing, methods, and qualifications of the surveyor(s) for BOEM/USACE and USFWS approval prior to the start of the survey. A survey report, including maps and associated spatial files in an ESRI ArcMap/ArcPro compatible format, must be provided to BOEM/USACE and USFWS for review no later than 30 calendar days after the survey has been completed. BOEM/USACE and USFWS will complete their reviews and identify any deficiencies that require a report revision by Ocean Wind within 30 calendar days of receipt of the survey report. If any swamp pink is found during the survey, the surveyor must document the distribution and abundance of plants and submit both the full survey report and a completed Natural Heritage Rare Plant Species Reporting Form (https://www.nj.gov/dep/parksandforests/natural/docs/NHRPSR_Form.pdf) to BOEM/USACE, USFWS, and the New Jersey Natural Heritage Program. If swamp pink is present in or adjacent to Project activities, Ocean Wind must coordinate with USFWS to develop appropriate conservation measures that Ocean Wind is required to implement to avoid adverse effects to this species including through direct and indirect effects to its habitat and seek any required authorizations to perform such activities.	Identifying habitat and presence of swamp pink along the Oyster Creek onshore cable route and coordination with USFWS and NJDEP would ensure that if swamp plants are identified during pre-construction surveys, potential impacts would be avoided and/or minimized.

Measure	Description	Effect
Surveys, Avoidance, and Minimization (ESA-listed plants; Knieskern's beaked-rush)	Knieskern's beaked-rush: If Ocean Wind elect to construct an Oyster Creek onshore cable route option other than the Holtec property route, Ocean Wind must retain a USFWS qualified surveyor to conduct a survey between July and September and in accordance with USFWS Knieskern's beaked-rush survey guidelines of all suitable habitats that will be subject to temporary disturbance or permanent modification as a result of Project activities, both during construction and from post-construction O&M activities, including areas crossed by HDD. Survey areas must not be mowed for at least one month prior to the survey. Ocean Wind must submit the survey area(s), timing, methods, and qualifications of the surveyor(s) for BOEM/USACE and USFWS approval prior to the start of the survey. A survey report, including maps and associated spatial files in an ESRI ArcGIS/ArcPro compatible format, must be provided to BOEM/USACE and USFWS for review no later than 30 calendar days after the survey has been completed. BOEM/USACE and USFWS will complete their reviews and identify any deficiencies that require a report revision by Ocean Wind within 30 calendar days of receipt of the survey report. If any Knieskern's beaked-rush is found during the survey, the surveyor must document the distribution and abundance of plants, and submit both the full survey report and a completed Natural Heritage Rare Plant Species Reporting Form to both USFWS and the New Jersey Natural Heritage Program. If Knieskern's beaked-rush is present in or adjacent to Project activities, Ocean Wind must coordinate with USFWS to develop appropriate conservation measures that Ocean Wind is required to implement to avoid adverse effects to this species and seek any required authorizations to perform such activities.	Identifying habitat and presence of Knieskern's beaked-rush along the Oyster Creek onshore cable route and coordination with USFWS and NJDEP would ensure that if Knieskern's beaked-rush plants are identified during pre-construction surveys, potential impacts would be avoided or minimized.

Measure	Description	Effect
Surveys, Avoidance, and Minimization (ESA-listed plants, American chaffseed)	American chaffseed: Ocean Wind must retain a USFWS qualified surveyor to conduct a survey of all suitable American chaffseed habitats between June 1 and August 15 that will be subject to temporary disturbance or permanent modification as a result of Project activities, both during construction and from post-construction O&M activities, including areas crossed by HDD. Survey areas must not be mowed for at least one month prior to the survey and the survey will cover all areas of suitable habitat, not just transects. Ocean Wind must submit the survey area(s), timing, methods, and qualifications of the surveyor(s) for BOEM/USACE and USFWS approval prior to the start of the survey. A survey report, including maps and associated spatial files in an ESRI ArcGIS/ArcPro compatible format, must be provided to BOEM/USACE and USFWS for review no later than 30 calendar days after the survey has been completed. BOEM/USACE and USFWS will complete their reviews and identify any deficiencies that require a report revision by Ocean Wind within 30 calendar days of receipt of the survey report. If any American chaffseed is found during the survey, the surveyor must document the distribution and abundance of plants and submit both the full survey report and a completed Natural Heritage Rare Plant Species Reporting Form to BOEM, USFWS, and the New Jersey Natural Heritage Program. If American chaffseed is present in or adjacent to Project activities, Ocean Wind must coordinate with USFWS to develop appropriate conservation measures that Ocean Wind is required to implement to avoid adverse effects to this species and seek any required authorizations to perform such activities.	Identifying habitat and presence of American chaffseed and coordination with USFWS and NJDEP would ensure that if American chaffseed plants are identified during pre-construction surveys, potential impacts would be avoided or minimized.
Restoration with Native Vegetation	GEN-13 will be modified to clarify that disturbed areas would be reestablished with native vegetation, and in areas that are permanently landscaped (e.g., substation site), Ocean Wind would coordinate with NJDEP Fish & Wildlife to determine if wildlife friendly habitats could be created.	Coordination with NJDEP on restoring temporarily disturbed areas with native vegetation would minimize the establishment and potential spread of non-native plant species that could outcompete native vegetation that is important to the plant and animal ecosystem.
Surveys, Avoidance, and Minimization (monarch butterfly)	Monarch butterfly: Ocean Wind must conduct pre-construction surveys for milkweed (*Asclepias* spp.) and implement monarch butterfly avoidance and minimization measures in coordination with USFWS and NJDEP.	Identifying areas of milkweed and coordination with USFWS and NJDEP would ensure that potential impacts on monarch butterflies would be avoided or minimized to the extent practicable.

Measure	Description	Effect
Surveys, Avoidance, and Minimization (monarch butterfly; avoid in-season milkweed clearing)	Monarch butterfly: For areas where vegetation disturbance will occur during Project construction or post-construction operations and maintenance activities, Ocean Wind must survey the affected area for milkweed (*Asclepias* spp.) before the start of work. Ocean Wind must avoid clearing milkweed to the extent practical from May 15 through September 30 when monarch caterpillars may be present. If/when the monarch is proposed for federal listing, BOEM and Ocean Wind will coordinate with the USFWS prior to initiating any in-season vegetation disturbance that may involve milkweed.	Avoiding clearing areas of milkweed (if any identified during surveys) during the time period when the monarch butterfly could be present would avoid potential construction and maintenance impacts on the species.
Revegetation Plan	GEN-13 will be modified to enhance monarch butterfly habitat in coordination with USFWS and NJDEP. BOEM will require that Ocean Wind develops a Revegetation Plan to enhance monarch butterfly habitat for areas of temporary disturbance and incidental to other Project activities. Ocean Wind must consult the New Jersey Monarch Butterfly Conservation Guide in developing the plan and submit the plan for USFWS review.	Coordination with USFWS and NJDEP on restoring temporarily disturbed areas that are considered monarch butterfly habitat (if any is identified during surveys) would ensure that any monarch butterfly habitat disturbed would be enhanced to minimize any potential loss or modification of the habitat.
Milkweed Habitat Impact Reduction	Ocean Wind will not use herbicide for right-of way maintenance and in other portions of the Project where milkweed is likely to occur.	Not using herbicide for plant control in areas of milkweed (if any identified during surveys) would ensure that the potential effects of herbicide on milkweed (e.g., plant damage) would not occur and indirect effects on the monarch butterfly would not happen.

[1] Most of the measures in this table are a result of BOEM's ESA Section 7 consultation with USFWS. These same measures are listed in BOEM's BA for species under USFWS jurisdiction; some of these measures may also benefit non ESA-listed species.

Table 3.8-3 Additional Proposed Measures (Also Identified in Appendix H, Table H-3): Coastal Habitat and Fauna

Measure	Description	Effect
Revegetation	Areas of temporary disturbance on Island Beach State Park should be re-seeded or replanted with species native to New Jersey barrier islands, efforts to reduce soil erosion and sediment control should not include application of fertilizer or lime, and only native vegetation should be allowed to become re-established in other disturbed areas.	Re-seeding or replanting temporarily disturbed areas with native vegetation, allowing native vegetation to re-establish, and reducing soil erosion would minimize the establishment and potential spread of non-native plant species that could outcompete native vegetation that is important to the plant and animal ecosystem.

3.8.8.1. Measures Incorporated in the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.8-2 and Table H-2 in Appendix H, *Mitigation and Monitoring*, are incorporated in the preferred alternative. BOEM has identified the following additional measures in Table 3.8-3 as incorporated in the preferred alternative: revegetation. These measures, if adopted, would ensure and improve accountability for compliance with APMs by requiring surveys, coordination with NJDEP and USFWS, and appropriate restoration of disturbed areas. Because most of these measures ensure the effectiveness of and compliance with APMs that are already analyzed as part of the Proposed Action, implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.8.2, *Environmental Consequences*.

3.11. Demographics, Employment, and Economics

This section discusses potential impacts on demographics, employment, and economics from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown on Figure 3.11-1, includes the counties where proposed onshore infrastructure and potential port cities are located, as well as the counties in closest proximity to the Wind Farm Area: Atlantic, Cape May, Cumberland, Gloucester, Ocean, and Salem Counties, New Jersey; city of Norfolk, Virginia; and Charleston County, South Carolina. These counties are the most likely to experience beneficial or adverse economic impacts from the proposed Project.

3.11.1 Description of the Affected Environment for Demographics, Employment, and Economics

Atlantic, Cape May, and Ocean Counties

Atlantic, Cape May, and Ocean Counties are some of the most densely populated coastal communities in the U.S. These counties are notable for coastal activities such as swimming, fishing, surfing, and sailing over the 127 miles 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 2.3.1.1.1; Ocean Wind 2023).

Data on population, demographics, income, and employment for the state of New Jersey and for Atlantic, Cape May, and Ocean Counties are provided in Table 3.11-1 and Table 3.11-2. The population of Atlantic and Cape May Counties declined between 2010 and 2019 while the population of New Jersey and Ocean County increased. The U.S. Census Bureau estimated the 2019 population of Atlantic County at about 270,000 residents. Atlantic County has the lowest percentage of residents over age 65. The population of Ocean County grew by 4.7 percent from 2010 to 2019, while the population of Atlantic and Cape May Counties declined by 2.6 percent and 4.7 percent, respectively. The population of these counties are all older, on average, than New Jersey as a whole, with a higher percentage of residents aged 65 or older. Atlantic, Cape May, and Ocean Counties compose 10.8 percent of New Jersey's population (U.S. Census Bureau 2021a). In 2020, unemployment was 9.5 percent in Ocean County, 17.8 percent in Atlantic County, and 13.8 percent in Cape May County, compared to 9.8 percent in New Jersey (U.S. Bureau of Labor Statistics 2021). The average labor force participation rate, that is the proportion of the total population 16 years and older that are in the labor force, was 59 percent in Ocean County, 65 percent in Atlantic County, and 58 percent in Cape May County for the period from 2015 to 2019 (U.S. Census Bureau 2022a).

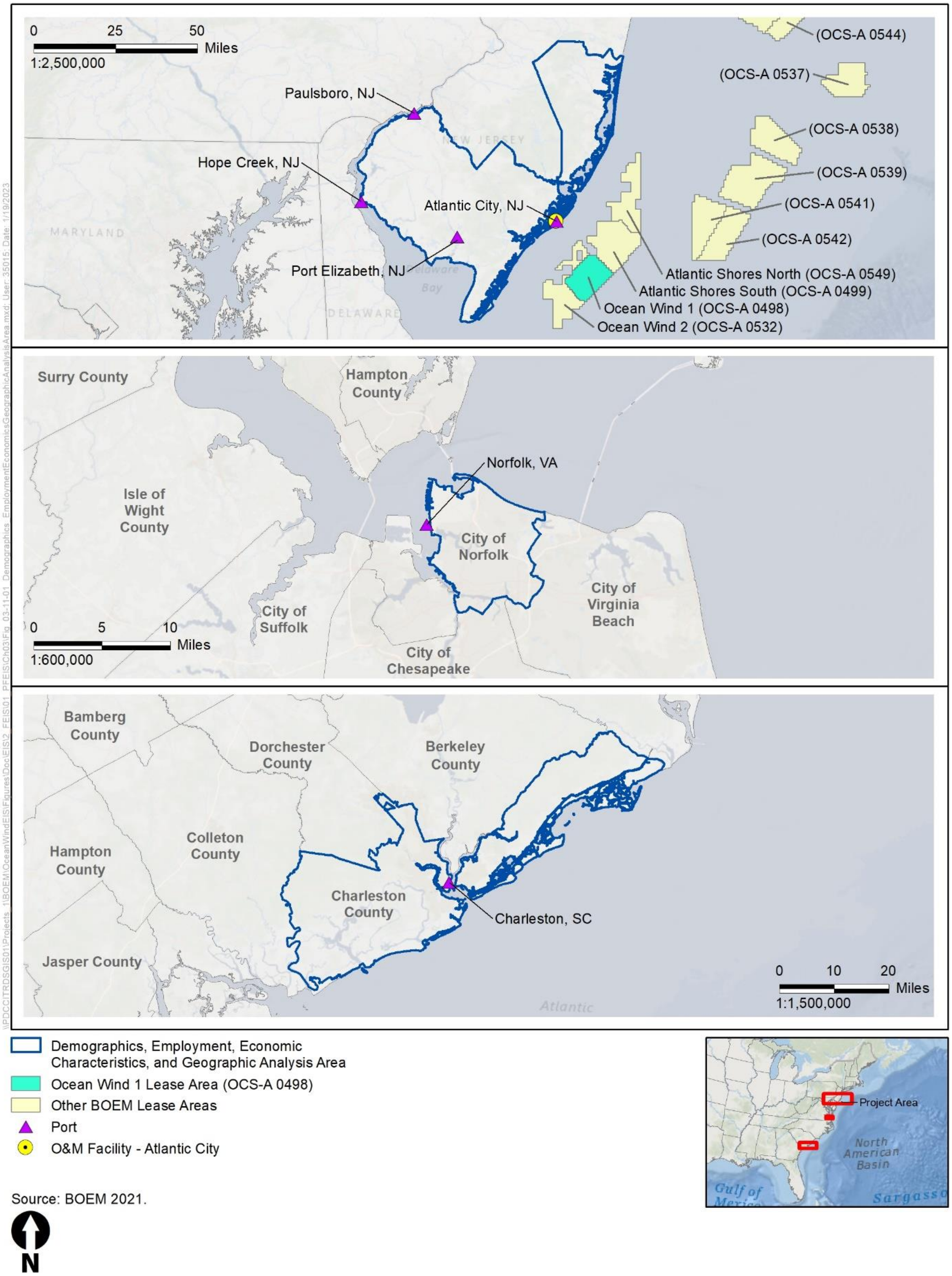


Figure 3.11-1 Demographics, Employment, and Economic Characteristics Geographic Analysis Area

Table 3.11-1 Demographic Trends, 2010–2019

Jurisdiction	2010 Population	2019 Population	Population Change, percent (2010–2019)	2019 Percent Population 18–64 Years	2019 Percent of Population 65 or Older	2019 Median Age
New Jersey	8,721,577	8,878,503	1.8	67.9	15.9	39.9
Ocean County	569,374	596,415	4.7	60.7	22.4	42.7
Atlantic County	273,162	266,105	-2.6	66.6	17.5	41.7
Cape May County	97,684	93,086	-4.7	61.1	25.8	49.6
Cumberland County	155,456	151,906	-2.3	61.3	14.9	37.6
Salem County	65,982	62,990	-4.5	65.5	18.3	42.1
Gloucester County	285,223	291,165	2.1	67.8	15.4	40.5
Virginia	7,841,754	8,454,463	7.8	68.9	15.0	38.2
City of Norfolk	242,143	244,601	1.0	76.0	10.9	30.7
South Carolina	4,511,428	5,020,806	11.3	66.6	17.2	39.4
Charleston County	342,434	401,165	17.2	70.2	15.9	37.8

Source: U.S. Census Bureau 2021a

Table 3.11-2 Population, Income, and Employment Data

Jurisdiction	Population (2019)	Population Density (persons per mi^2)	Per Capita Income (2019)	Total Employment (Jobs, 2019)	Labor Force Participation Rate	Unemployment Rate (2019)
New Jersey	8,878,503	1,207.4	42,745	4,689,849	66%	5.5
Ocean County	596,415	948.6	36,100	275,104	59%	5.1
Atlantic County	266,105	479.1	33,284	139,427	65%	8.4
Cape May County	93,086	369.2	40,389	45,904	58%	6.8
Cumberland County	151,906	314.4	25,694	66,521	56%	7.3
Salem County	62,990	189.1	34,047	31,221	61%	6
Gloucester County	291,165	904.5	39,337	158,168	67%	5.5
Virginia	8,454,463	214.2	39,278	4,477,253	69%	4.6
City of Norfolk	244,601	617.7	29,830	140,204	70%	7.6
South Carolina	5,020,806	167.1	29,426	2,447,854	61%	5.8
Charleston County	401,165	437.4	39,914	215,325	65%	3.7

Source: U.S. Census Bureau 2021b, 2022a, 2022b.
mi^2 = square mile

Ocean County occupies about 629 square miles of land area and contains 33 municipalities including its mainland and barrier island beaches. Ocean County is the second largest county in the state of New Jersey (COP Volume II, Section 2.3.1.1.1; Ocean Wind 2023). Atlantic County occupies about 556 square miles 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. Egg Harbor Township is the one municipality in the BL England study area that is in Atlantic County. Cape May County occupies 251 square miles 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 from Cape May City to Ocean City. These barrier beaches contain most of the county's infrastructure and are the heart of Cape May County's economy (Cape May County 2005).

Atlantic, Cape May, and Ocean Counties rely on tourism and visitors to their economies and have higher proportions of seasonal housing than New Jersey as a whole. Table 3.11-3 includes housing data for the geographic area of interest. Throughout New Jersey, 3.8 percent of housing units are seasonally occupied, compared to 6.4 percent of homes in Ocean County, 13.4 percent of homes in Atlantic County, and 50.9 percent of homes in Cape May County (U.S. Census Bureau 2021c). About 93,000 residents lived in Cape May County in 2019. During summer months, the population increases to at least six times the size of the permanent winter population because of tourism (Cape May County 2005). In 2013, Cape May County estimated its summer population at 796,695, or about eight times the permanent population (Cape May County 2013).

Table 3.11-3 Housing Data (2019)

Jurisdiction	Housing Units	Seasonal Vacant Units	Vacant Units (Non-Seasonal)	Non-Seasonal Vacancy Rate	Median Value (Owner-Occupied)	Median Monthly Rent (Renter-Occupied)
New Jersey	3,616,614	135,990	248,750	6.9	335,600	1,334
Ocean County	282,075	17,966	39,171	13.9	272,900	755
Atlantic County	127,987	17,190	11,211	8.8	218,300	890
Cape May County	99,157	50,452	8,689	8.8	296,600	1,884
Cumberland County	50,729	378	5,341	10.5	162,500	1,069
Salem County	27,644	3,472	190	0.7	185,300	794
Gloucester County	113,024	8,257	320	0.3	216,700	2,067
Virginia	3,491,091	87,550	275,437	7.4	264,900	1,767
City of Norfolk	97,257	8,768	549	0.6	199,400	1,532
South Carolina	2,286,826	128,239	236,725	10.4	162,300	1,246
Charleston County	184,610	17,348	11,410	6.2	295,600	1,701

Source: U.S. Census Bureau 2021c

Table 3.11-4 includes data on the industries where residents in these counties work. The industries that employ workers reflect recreation and tourism's importance to these counties. A greater proportion of residents in these counties work jobs in arts, entertainment, and recreation; and accommodation and food services (22.51 percent in Atlantic County, 16.4 percent in Cape May County, and 8.8 percent in Ocean

County) than in New Jersey as a whole (8.1 percent) (U.S. Census Bureau 2021d). Table 3.11-5 contains data on at-place employment by industry in the geographic areas of interest. A greater proportion of jobs in these counties are in accommodation and food services (37.4 percent in Atlantic County, 19.9 percent in Cape May County, and 10.2 percent in Ocean County) and retail trade (14.2 percent in Atlantic County, 21.7 in Cape May County, and 18.7 in Ocean County) than in New Jersey as a whole (8.9 percent and 11.9 percent, respectively) (U.S. Census Bureau 2021e).

NOAA tracks economic activity dependent upon the ocean in its “Ocean Economy” data, which generally include, among other categories, commercial fishing and seafood processing, marine construction, commercial shipping and cargo-handling facilities, ship and boat building, marine minerals, harbor and port authorities, passenger transportation, boat dealers, and coastal tourism and recreation. In Atlantic, Cape May, and Ocean Counties, tourism and recreation account for 94.2, 86.4, and 86.7 percent of the overall Ocean Economy gross domestic product (GDP), respectively (NOAA 2021a). 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. The living resource sector accounts for 2.6 percent of employment and 3.2 percent of the GDP of the U.S marine economy. However, seafood markets are the largest producer in the living resources sector, accounting for 41.5 percent of the sector’s GDP and for the most employed workers in the sector (NOAA 2021b). Among Atlantic, Cape May, Cumberland, Gloucester, Ocean, and Salem Counties, there are 88 living resources fisheries (NOAA 2021a).

The fishing industry is a large contributor to the economic vitality of New Jersey. The fishing industry has implications on fish and seafood markets and wholesalers, and seafood product preparation and packaging. In 2019, fish and seafood merchants brought in total annual wages of $61,404,501 with 1,083 average employees. Seafood product preparation and packaging brought in $26,374,344 with 517 average employees, and fish and seafood markets brought in $21,312,070 with 655 average employees (U.S. Bureau of Labor Statistics 2019).

Table 3.11-4 Employment of Residents, by Industry (2019)

Industry	New Jersey	Atlantic County	Cape May County	Cumberland County	Ocean County	Salem County	Gloucester County	Virginia	City of Norfolk	South Carolina	Charleston County
Agriculture, forestry, fishing	0.34%	0.46%	1.01%	4.00%	0.26%	1.98%	0.55%	0.88%	0.13%	0.96%	0.45%
Construction	5.94%	6.48%	9.63%	6.54%	8.16%	8.21%	6.70%	6.65%	6.98%	6.82%	7.43%
Manufacturing	8.15%	4.66%	2.91%	12.66%	5.20%	11.43%	7.32%	7.05%	7.06%	13.66%	6.25%
Wholesale trade	3.33%	2.12%	2.64%	4.17%	2.84%	3.94%	3.60%	1.76%	1.64%	2.40%	2.29%
Retail trade	10.89%	11.57%	10.44%	12.37%	13.60%	10.01%	11.76%	10.35%	11.20%	11.92%	10.21%
Transportation, warehousing, utilities	6.13%	4.36%	3.93%	5.45%	5.23%	10.32%	6.08%	4.41%	4.92%	5.1%	4.29%
Information	2.69%	1.15%	1.14%	0.99%	1.91%	1.02%	1.96%	1.91%	1.72%	1.61%	2.13%
Finance, insurance, real estate	8.48%	4.64%	7.09%	2.87%	6.54%	4.49%	6.65%	6.26%	5.72%	5.80%	6.61%
Professional services	13.50%	8.49%	7.68%	7.98%	10.64%	7.40%	11.23%	15.48%	11.68%	10.22%	15.41%
Educational, health care, social assistance	23.88%	23.85%	25.46%	25.61%	26.63%	25.35%	28.38%	22.22%	23.07%	21.75%	22.60%
Arts, entertainment, recreation, accommodation, food services	8.11%	22.51%	16.41%	6.40%	8.81%	6.51%	7.52%	8.94%	12.78%	10.18%	13.31%
Other services, except public administration	4.33%	4.38%	4.12%	3.70%	4.57%	4.57%	3.64%	5.29%	4.38%	5.16%	4.98%
Public administration	4.23%	5.34%	7.54%	7.24%	5.61%	4.77%	4.60%	8.81%	8.71%	4.42%	4.04%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: U.S. Census Bureau 2021d

Table 3.11-5 At-Place Employment, by Industry (2019)

Industry	New Jersey	Atlantic County	Cape May County	Cumber land County	Ocean County	Salem County	Gloucester County	Virginia	City of Norfolk	South Carolina	Charleston County
Agriculture, forestry, fishing	<0.1%	<0.1%	0.5%	0.1%	<0.1%	<0.1%	<0.1%	0.1%	<0.1%	0.2%	<0.1%
Mining, quarrying, oil and gas	<0.1%	<0.1%	0.2%	0.3%	<0.1%	<0.1%	<0.1%	0.2%	<0.1%	<0.1%	<0.1%
Utilities	0.5%	1.0%	0.4%	0.2%	0.7%	11.5%	0.2%	0.4%	<0.1%	0.6%	0.3%
Construction	4.3%	5.1%	8.6%	4.1%	5.7%	6.4%	7.9%	5.6%	3.6%	4.6%	5.4%
Manufacturing	5.9%	2.0%	2.3%	16.9%	3.3%	13.1%	9.9%	7.0%	6.4%	12.8%	7.4%
Wholesale trade	7.3%	2.2%	3.1%	10.1%	3.3%	7.7%	8.3%	3.1%	3.9%	3.9%	3.2%
Retail trade	11.9%	14.2%	21.7%	14.4%	18.7%	10.3%	17.4%	12.5%	10.7%	12.9%	14.1%
Transportation and warehousing	5.2%	2.0%	1.0%	6.5%	2.4%	6.5%	5.9%	3.3%	6.5%	3.8%	4.8%
Information	2.3%	0.9%	0.9%	1.0%	0.9%	0.3%	1.2%	2.9%	2.1%	1.9%	2.1%
Finance and insurance	5.2%	2.2%	4.1%	2.2%	2.2%	2.3%	1.8%	4.8%	4.1%	3.9%	3.2%
Real estate	1.6%	1.4%	2.9%	1.0%	2.3%	1.6%	17.4%	1.6%	3.3%	1.4%	2.3%
Professional services	8.8%	3.6%	3.7%	2.2%	5.2%	2.7%	3.8%	14.3%	10.4%	5.1%	7.9%
Management	3.4%	1.0%	0.3%	0.2%	0.8%	0.1%	0.5%	2.4%	2.4%	1.6%	1.4%
Administrative, business support, waste management	9.4%	3.2%	4.1%	3.7%	3.8%	2.5%	7.5%	8.1%	8.1%	14.6%	8.7%
Educational services	2.9%	1.1%	0.4%	2.4%	5.1%	0.7%	1.3%	2.4%	1.9%	1.6%	1.9%
Heath care and social assistance	16.4%	17.1%	15.7%	21.9%	26.3%	19.6%	15.8%	13.6%	19.4%	12.8%	12.5%
Arts, entertainment and recreation	1.8%	1.5%	4.1%	1.0%	3.0%	0.8%	1.6%	1.9%	1.4%	1.6%	2.2%

Industry	New Jersey	Atlantic County	Cape May County	Cumber land County	Ocean County	Salem County	Gloucester County	Virginia	City of Norfolk	South Carolina	Charleston County
Accommodation and food services	8.9%	37.4%	19.9%	7.8%	10.2%	10.0%	10.7%	10.8%	11.1%	12.3%	18.0%
Other services (e.g., public administration)	4.2%	3.9%	6.1%	4.0%	6.0%	3.6%	4.8%	5.0%	4.3%	4.3%	4.6%
Industries not classified	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: U.S. Census Bureau 2021e

Cumberland, Gloucester, and Salem Counties

Compared to Atlantic, Cape May, and Ocean Counties that have more ocean-based economies with seasonal work and recreation and tourism, Cumberland, Gloucester, and Salem Counties, which are along the Delaware Bay or on the Delaware River, in the case of Gloucester County, are less reliant on coastal industries. The population of Gloucester County grew 2.1 percent from 2010 to 2019 while the population of Cumberland and Salem Counties decreased by 2.3 percent and 4.5 percent, respectively. The share of New Jersey's population in Cumberland, Gloucester, and Salem Counties is 5.7 percent. Median age in Gloucester and Salem Counties (40.5 and 42.1 years, respectively) is older than New Jersey as a whole (39.9 years) while the median resident of Cumberland County (37.6 years) is younger than the median New Jersey resident (U.S. Census Bureau 2021f).

Cumberland, Gloucester, and Salem Counties are also less dependent on tourism than their coastal counterparts. The percentage of housing units that are seasonally occupied in these counties are 7.3, 12.6, and 5.8 percent, respectively (U.S. Census Bureau 2021b). Tourism and recreation likewise compose a smaller portion of Cumberland, Gloucester, and Salem Counties' Ocean Economies (19.0, 21.3, and 10.3 percent, respectively) (NOAA 2021a). 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 works in those sectors than those in New Jersey. Manufacturing, retail trade, and education, health care, and social assistance have greater representation in Cumberland County than in New Jersey (U.S. Census Bureau 2021d).

City of Norfolk

The city of Norfolk is in southeastern Virginia, 220 miles south of Washington, DC, and is home to miles of coastline, including beaches on Chesapeake Bay. Norfolk is a key contributor to the Port of Virginia. From 2010 to 2019, Norfolk's population grew by 1.0 percent while the population of Virginia grew by 7.8 percent. Norfolk's population is also much younger than Virginia's. The median age of Norfolk residents is 30.7 years while the median Virginia resident is 38.2 years old. Residents aged 65 or older are underrepresented in Norfolk relative to Virginia (10.9 percent of the population as opposed to 15.0 percent) while residents aged 18–64 are overrepresented (76.0 percent as opposed to 68.9 percent) (U.S. Census Bureau 2021f). Compared to Virginia as a whole, Norfolk has a higher portion of residents who work in arts, entertainment, and recreation; and accommodation and food services (12.8 percent) than Virginia as a whole (8.9 percent) (U.S. Census Bureau 2021d). Norfolk's more service-based economy experienced a greater unemployment rate (8.7 percent) than the Commonwealth of Virginia as a whole (6.2 percent) (U.S. Bureau of Labor Statistics 2021). Because of its coastal location and amenities, 9.0 percent of housing units in Norfolk are seasonally occupied, compared to 2.5 percent in Virginia (U.S. Census Bureau 2021c).

Charleston County

Charleston County is in eastern South Carolina and is bordered on the east by the Atlantic Ocean. Since 2010, Charleston County's population growth (17.2 percent) has outpaced that of South Carolina (11.3 percent) and the county represents 8 percent of South Carolina's total population. Charleston County's population is younger than the state average. The median age in Charleston County is 37.8 years while it is 39.4 years in South Carolina. The portion of Charleston County's population 65 years or older (15.9 percent) is smaller than that of South Carolina (17.2 percent) while the portion of the population between 18 and 64 (70.2 percent) is larger than that of South Carolina (66.6 percent). A greater portion of residents in Charleston County work in arts, entertainment, and recreation; and accommodation and food services (13.3 percent) than in all of South Carolina (10.2 percent). Charleston County also has a disproportionate number of residents who work in professional services (15.4 percent) compared to South Carolina (10.2

percent). Moreover, 9.4 percent of housing units in Charleston County are seasonally occupied while 5.6 percent of housing units in South Carolina are seasonal (U.S. Census Bureau 2021b).

3.11.2 Environmental Consequences

3.11.2.1. Impact Level Definitions for Demographics, Employment, and Economics

Definitions of impact levels are provided in Table 3.11-6.

Table 3.11-6 Impact Level Definitions for Demographics, Employment, and Economics

Impact Level	Impact Type	Definition
Negligible	Adverse	No impacts would occur, or impacts would be so small as to be unmeasurable.
	Beneficial	Either no effect or no measurable benefit.
Minor	Adverse	Impacts on the affected activity or geographic place would be avoided and would not disrupt the normal or routine functions of the affected activity or geographic place. Once the affecting agent is eliminated, the affected activity or geographic place would return to a condition with no measurable effects.
	Beneficial	Small but measurable benefit on demographics, employment, or economic activity.
Moderate	Adverse	Impacts on the affected activity or geographic place would be unavoidable. The affected activity or geographic place would have to adjust somewhat to account for disruptions due to impacts of the Project, or, once the affecting agent is eliminated, the affected activity or geographic place would return to a condition with no measurable effects if proper remedial action is taken.
	Beneficial	Notable and measurable benefit on demographics, employment, or economic activity.
Major	Adverse	The affected activity or geographic place would experience unavoidable disruptions to a degree beyond what is normally acceptable, and, once the affecting agent is eliminated, the affected activity or geographic place could retain measurable effects indefinitely, even if remedial action is taken.
	Beneficial	Large local or notable regional benefit to the economy as a whole.

3.11.3 Impacts of the No Action Alternative on Demographics, Employment, and Economics

Section 3.1 of the Final EIS explains the approach to predicting impacts related to the No Action Alternative. When analyzing the impacts of the No Action Alternative on demographics, employment, and economics, 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 demographics, employment, and economics. 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 F, *Planned Activities Scenario*. Separate impact conclusions are presented for both scenarios.

3.11.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, the demographics, employment, and economics of the geographic analysis area described in Section 3.11.1, *Description of the Affected Environment for Demographics, Employment, and Economics*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind activities. Tourism, recreation, and marine industries (e.g., fishing) would continue to be important components of the regional economy. Ongoing activities within the geographic analysis area that will contribute to impacts on demographics, employment, and economics include continued commercial shipping and commercial fishing; ongoing port maintenance and upgrades; periodic channel dredging; maintenance of piers, pilings, seawalls, and buoys; and climate change. Coasts are sensitive to sea level rise, changes in the frequency and intensity of storms, increases in precipitation, and warmer ocean temperatures. Sea level rise and increased storm frequency and severity could result in property or infrastructure damage, increase insurance cost, and reduce the economic viability of coastal communities. Impacts on marine life due to ocean acidification, altered habitats and migration patterns, and disease frequency would affect industries that rely on these species. The impacts of climate change are likely to, over time, worsen problems that coastal areas already face (Moser et al. 2014). The socioeconomic impact of ongoing activities varies depending upon each activity. Activities that generate economic activity, such as port maintenance and channel dredging, would generally benefit the local economy by providing job opportunities and generating indirect economic activity from suppliers and other businesses that support activity along the New Jersey coast. Conversely, ongoing activities that disrupt economic activity, such as climate change, may adversely affect businesses, resulting in impacts on employment and wages. There are no ongoing offshore wind activities within the geographic analysis area for demographics, employment, and economics.

3.11.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned activities (without the Proposed Action). Planned activities for coastal and marine activity include development of diversified, small-scale, onshore renewable energy sources; ongoing onshore development at or near current rates; continued increases in the size of commercial vessels; potential port expansion and channel-deepening activities; and efforts to protect against potential increased storm damage and sea level rise (see Section F.2 in Appendix F for a description of ongoing and planned activities). Similar to ongoing activities, other planned non-offshore wind activities may result in beneficial socioeconomic impacts by generating economic activity that boosts employment but there is also the potential for some adverse impacts. See Table F1-9 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for demographics, employment, and economics.

Offshore wind could become a new industry for the Atlantic states and the nation. Although most offshore wind component manufacturing and installation capacity exists outside of the U.S., some studies acknowledge that domestic capacity is poised to increase. This EIS uses available data, analysis, and projections to make informed conclusions on offshore wind’s potential economic and employment impacts within the geographic analysis area.

The BVG Associates Limited (2017) study estimated that the percentage of jobs sourced in the U.S. during the initial implementation of offshore wind projects along the U.S. northeast coast would range from 35 percent to 55 percent of jobs. As the offshore wind energy industry grows in the United States, this proportion of jobs would increase because of growth of a supply chain in the East Coast along with a growing number of maintenance and local operations jobs for established wind facilities. The proportion of jobs associated with offshore wind projected to be within the U.S. will be approximately 65 to 75 percent from 2030 through 2056. The high-energy production scenario for 30 GW of offshore wind energy by the year 2030 will make additional jobs more likely. Overseas manufacturers of components and specialized ships based overseas that are contracted for installation of foundations and WTGs would compose the rest of the jobs outside the U.S. (BVG Associates Limited 2017).

The American Wind Energy Association (AWEA) estimates that the offshore wind industry will invest between $80 and $106 billion in U.S. offshore wind development by 2030, of which $28 to $57 billion will be invested within the United States. This figure depends on installation levels and supply chain growth, as other investment would occur in countries manufacturing or assembling wind energy components for U.S.-based projects. While most economic and employment impacts would be concentrated in Atlantic coastal states where offshore wind development will occur—there are over $1.3 billion of announced domestic investments in wind energy manufacturing facilities, ports, and vessel construction—there would be nationwide effects as well (AWEA 2020). The AWEA report analyzes base and high scenarios for offshore wind direct impacts, turbine and supply chain impacts, and induced impacts. The base scenario assumes 20 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. It is unclear where in the U.S. supply chain growth would occur.

The University of Delaware projects that offshore wind power will generate 30 GW along the Atlantic coast through 2030. This initiative would require capital expenditures of $100 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 states with offshore wind projects (Connecticut, Massachusetts, Rhode Island, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina) ranged from $60.6 billion in Rhode Island to $1.72 trillion in New York (U.S. Bureau of Economic Analysis 2020) and totaled nearly $4.3 trillion. The $14.2 to $25.4 billion in offshore wind industry output would represent 0.3 to 0.6 percent of the combined GDP of these states.

The AWEA estimates that in 2030, offshore wind would support 45,500 (base scenario) to 82,500 (high scenario) full-time equivalent (FTE) jobs nationwide, including direct, supply chain, and induced jobs. Most offshore wind jobs (about 60 percent) are created during the temporary construction phase while the remaining 40 percent would be long-term O&M jobs. 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.

The New Jersey Economic Development Authority is providing $4.5 million in funds to support the wind energy work force, specifically the New Jersey Wind Turbine Technician Training Challenge and New Jersey Offshore Wind Safety Training Challenge. Recent solicitations in New Jersey contained equity provisions that support the development of a local workforce by requiring developers to provide workforce training and support minority-owned businesses (NREL 2022).

In 2020, employment in New Jersey was 4.1 million (Table 3.11-2). While the extent to which there will be impacts on the geographic analysis area is unclear due to the geographic versatility of offshore wind jobs, a substantial portion of the planned offshore wind projects in New Jersey would likely be within commuting distance of ports in Atlantic City, Paulsboro, Hope Creek, and Port Elizabeth in New Jersey; Norfolk, Virginia; Charleston, South Carolina; and other ports that would be used for offshore wind staging, construction, and operations.

In addition to the regional economic impact of a growing offshore wind industry, BOEM expects offshore wind development to affect demographics, employment, and economics through the following primary IPFs.

Energy generation and security: Once built, offshore wind energy projects could produce energy at long-term fixed costs. These projects could provide reliable prices once built compared to the volatility of fossil fuel prices. Approximately 16 GW of capacity is estimated to occur in the New York/New Jersey offshore areas. The economic impacts of offshore wind activities (including associated energy storage and capacity projects) on energy generation and energy security could be long term, minor, and beneficial.

Lighting: Offshore WTGs require aviation warning lighting that could have economic impacts in certain locations. Aviation hazard lighting from up to 1,211 WTGs could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. 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. As described in Section 3.20, at a height of 531 feet, the navigation light on a WTG would be visible out to 31 miles. A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). In a subsequent study, 1,723 beachgoers were surveyed to determine the impact of WTGs and the conclusion was that the farther away the WTGs, the less of an impact occurred. Nearly 70 percent of beachgoers said that WTGs 15 miles offshore would neither worsen nor increase their experience (Parsons et al. 2020). The vast majority of the WTG positions envisioned offshore of the geographic analysis area would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs, so impacts are anticipated to be negligible. These lights would be incrementally added over the construction period and would be visible for the operating lives of 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 13 offshore wind projects would occur within the New York and New Jersey lease areas between 2023 and 2030, with a maximum of 10 projects under construction concurrently during 2026 (Appendix F, Table F2-1). Vessel lights would be visible from coastal businesses, especially near the ports used to support offshore wind construction (COP Volume II, Section 2.2.5.2.1; Ocean Wind 2023).

Cable emplacement and maintenance: Cable installation for each project could temporarily cause commercial fishing vessels, static gear fishing vessels, and recreational vessels to relocate away from work areas and disrupt fish stocks, thereby reducing income and increasing costs during installation. Fishing vessels are not likely to access affected areas during active construction, as about 5,235 acres (21.2 km^2) of seafloor disturbance would occur associated with offshore cable and inter-array cable installation (Appendix F, Table F2-2). In the long term, concrete mattresses covering cables in hard-bottom areas could hinder commercial trawlers and dredgers (COP Volume II, Section 2.2.6.2.1; Ocean Wind 2023). Assuming similar installation procedures as under the Proposed Action, the duration and range of impacts would be limited, and the disturbance to marine species important to recreational fishing and sightseeing would recover following the disturbance (COP Volume II, Section 2.3.3.2; Ocean Wind 2023). Impacts of onshore cable installation would depend upon the specific location but could temporarily disrupt beaches and other recreational coastal areas. Disruptions may result in conflict over other fishing grounds, increased operating costs for vessels, and lower revenue. Seafood processing and wholesaling businesses could also experience short-term reductions in productivity. Disruptions from new cable emplacement would have localized, short-term, and minor impacts on demographics, employment, and economics. Maintenance is anticipated to have long-term intermittent and negligible impacts on demographics, employment, and economics.

Noise: Noise from O&M, pile driving, cable laying and trenching, and vessel traffic could result in temporary impacts on demographics, employment, and economics due to impacts on commercial/for-hire fishing businesses, recreational businesses, and marine sightseeing activities.

Assuming other offshore wind facilities generate vessel traffic similar to the projected Proposed Action vessel trips, construction of each offshore wind project would generate between 20 and 65 vessels operating at any given time (Section 3.16). Noise from vessel traffic during the maintenance and construction phases could affect species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (COP Volume II, Section 2.3.4.2; Ocean Wind 2023). This noise may also make these facilities less attractive to fishing operators and recreational boaters (COP Volume II, Section 2.3.3.1.2; Ocean Wind 2023). Similarly, noise from pile driving from offshore wind activities would affect fish populations that are crucial to commercial fishing and marine recreational businesses (COP Volume II, Section 2.1.2.2.1; Ocean Wind 2023). These impacts would be greater if multiple construction activities occur in close spatial and temporal proximity. An estimated 2,447 foundations (WTGs and substations) would be installed within the New York and New Jersey lease areas between 2023 and 2030.

Onshore construction noise could possibly result in a short-term reduction of economic activity for businesses near installation sites for onshore cables or substations, temporarily inconveniencing workers, residents, and visitors. Noise would have intermittent, short-term, and negligible impacts on demographics, employment, and economics.

Port utilization: Offshore wind installation would require port facilities for berthing, staging, and loadout. Development activities would bolster port investment and employment while also supporting jobs and businesses in supporting industries. Offshore wind development would also support planned expansions and modifications at ports in the geographic analysis area, including the ports of Atlantic City, New Jersey; Norfolk, Virginia; and Paulsboro and Hope Creek, New Jersey. While simultaneous construction or decommissioning (and, to a lesser degree, operation) activities for multiple offshore wind projects in the geographic analysis area could stress port capacity, it would also generate considerable economic activity and benefit the regional economy and infrastructure investment. The White House 2021 states that investments in ports build up the resilience and sustainability of the economy.

Port utilization would require a trained workforce for the offshore wind industry including additional shore-based and marine workers that would contribute to local and regional economic activity. Improvements to existing ports and channels would be beneficial to other port activity. Port utilization in the geographic analysis area would occur primarily during development and construction projects, anticipated to occur primarily between 2023 and 2030. Ongoing O&M activities would sustain port activity and employment at a lower level after construction.

Offshore wind activities and associated port investment and usage would have long-term, moderate beneficial impacts on employment and economic activity by providing employment and industries such as marine construction, ship construction and servicing, and related manufacturing. The greatest benefits would occur during offshore wind project construction between 2023 and 2030. If offshore wind construction results in competition for scarce berthing space and port service, port usage could potentially have short- to medium-term adverse impacts on commercial shipping.

Presence of structures: Under the No Action Alternative, the addition of up to 2,447 offshore wind structures (WTGs and substations) with 995 acres (4 km^2) of foundation and scour protection and 370 acres (1.5 km^2) of offshore export cable hard protection would increase the risk of gear loss connected with cable mattresses and structures along the East Coast (Appendix F, Table F2-2). Fisheries using bottom gear may be permanently disrupted, which would increase economic impacts on the commercial/for-hire recreational fishing industries (COP Volume II, Section 2.3.4.2.1; Ocean Wind 2023). These offshore facilities would also pose allision and height hazard risks, creating obstructions and navigational complexity for marine vehicles, which would impose fuel costs, time, and risk and require adequate technological aids and trained personnel for safe navigation (Appendix F, Table F2-1 and Table F2-2). In the event of an allision, vessel damage and spills could result in both direct and indirect costs for commercial/for-hire recreational fishing.

Due to the locations of offshore wind lease areas, it is possible that some commercial fishing areas would be displaced. Because of this, fishermen are likely to switch to their next best fishing location. These locations may involve lower catches per unit, catches of alternative species with different prices, or increased congestion, which would have its own effects, such as increased fishing costs among fishing fleets. In a study on the socioeconomic effects of offshore wind off the coast of Rhode Island and Massachusetts, Hoagland et al. (2015) found that losses associated with reduction to commercial fishing may be distributed in unexpected ways across the coastal economy. Regional coastal economies are linked across onshore industry sectors and offshore activities, and impacts on commercial fishing would not just affect fishing fleets and related coastal businesses. The study's authors found that impacts may be most pronounced in areas that are not close to the coastline (Hoagland et al. 2015), highlighting the potential for broad, regional socioeconomic impacts.

The potential for 2,447 offshore wind energy structures within the geographic analysis area could encourage fish aggregation and generate reef effects that attract recreational fishing vessels (COP Volume II, Section 2.2.7.2; Ocean Wind 2023). Fish aggregation could increase human fishing activities, but this attraction would likely be limited to the minority of recreational fishing vessels that already travel as far from the shore as the wind energy facilities. Fish aggregation could potentially result in broad changes in recreational fishing practices if these effects are widespread enough to encourage more participants to travel farther from shore.

The 995 acres (4 km^2) of hard coverage for offshore wind foundations could create foraging opportunities for harbor and gray seals, sea turtles, bats, northern gannets, loons, and peregrine falcons, possibly attracting private or commercial recreational sightseeing vessels. As a result, the presence of new habitat could increase economic activity associated with offshore sightseeing. New structures would be added intermittently between 2023 and 2030 and could benefit structure-oriented species as long as the structures remain (COP Volume II, Section 2.2.3.2.2; Ocean Wind 2023).

As a result of fish aggregation and reef effects associated with the presence of offshore wind structures, there would be long-term impacts on commercial fishing operations and support businesses such as seafood processing. The fishing industry is expected to be able to adapt its fishing practices over time in response to these changes. These effects could simultaneously provide new business opportunities such as fishing and tourism. Overall, the presence of offshore wind structures would have continuous, long-term, moderate impacts on demographics, employment, and economics.

Traffic: Offshore wind construction and decommissioning and, to a lesser extent, offshore wind operations would generate increased vessel traffic. This additional traffic would support increased employment and economic activity for marine transportation and supporting businesses and investment in ports. Assuming other offshore wind facilities generate vessel traffic similar to the projected Proposed Action vessel trips, construction of each offshore wind project would generate between 20 and 65 vessels operating at any given time (Section 3.16). Construction of 13 offshore wind projects could occur within the New York and New Jersey lease areas between 2023 and 2030, with a maximum of 13 projects under construction concurrently during 2026 (Appendix F, Table F2-1). Increased vessel traffic would have continuous, beneficial impacts during all project phases, with moderate impacts during construction and decommissioning.

Impacts of short-term, increased vessel traffic during construction could include increased vessel traffic congestion, delays at ports, and a risk for collisions between vessels. Increased vessel traffic would be localized near affected ports and offshore construction areas. Congestion and delays could increase fuel costs (i.e., for vessels forced to wait for port traffic to pass) and decrease productivity for commercial shipping, fishing, and recreational vessel businesses, whose income depends on the ability to spend time out of port. Collisions could lead to vessel damage and spills, which could have direct costs (i.e., vessel repairs and spill cleanup) as well as indirect costs from damage caused by spills. As a result of potential delays from increased congestion and increased risk of damage from collisions, vessel traffic is anticipated to have continuous, short-term, and minor impacts during construction and negligible impacts during operations.

Vessel traffic would occur among ports (outside the demographics, employment, and economic 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 (COP Volume II, Section 2.3.6.2.2; Ocean Wind 2023).

Land disturbance: Land disturbance could result in localized, temporary disturbances of businesses near cable routes and construction sites for substations and other electrical infrastructure, due to typical construction impacts such as increased noise, traffic, and road disturbances. These impacts would be similar in character and duration to other common construction projects, such as utility installations, road repairs, and industrial site construction. Impacts on employment would be localized, temporary, and both beneficial (jobs and revenues to local businesses that participate in onshore construction) and adverse (lost revenue due to construction disturbances). Land disturbance impacts on demographics, employment, and economics would be minor.

3.11.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, the geographic analysis area would continue to be influenced by regional demographic and economic trends. Ongoing non-offshore wind 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, and Ocean 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 fishing; ongoing port maintenance and upgrades; periodic channel dredging; maintenance of piers, pilings, seawalls, and buoys; and the use of small-scale, onshore renewable energy) would have minor adverse and minor beneficial impacts on demographics, employment, and economics.

The No Action Alternative would result in **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics.

Cumulative Impacts of the No Action Alternative. 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 there would be minor adverse and minor beneficial impacts on demographic, employment, and economics from these planned activities, driven primarily by the continued operation of existing marine industries, especially commercial fishing, recreation/tourism, and shipping; increased pressure for environmental protection of coastal resources; the need for port maintenance and upgrades; and the risks of storm damage and sea level rise. Increased investment in land and marine ports, shipping, and logistics capability is expected to result along with component laydown and assembly facilities, job training, and other services and infrastructure necessary for offshore wind construction and operations. Additional manufacturing and servicing businesses would result either in the geographic analysis area or other locations in the United States if supply chains develop as expected. While it is not possible to estimate the extent of job growth and economic output within the geographic analysis area specifically, there will be notable and measurable benefits to employment, economic output, infrastructure improvements, and community services, especially job training, because of offshore wind development.

Offshore wind activities are expected to affect commercial and for-hire fishing businesses and marine recreational businesses (tour boats, marine suppliers) primarily through cable emplacement, noise and vessel traffic during construction, and the presence of offshore structures during operations. These IPFs would temporarily disturb marine species and displace commercial or for-hire fishing vessels, which could cause conflicts over other fishing grounds, increased operating costs, and lower revenue for marine industries and supporting businesses. The long-term presence of offshore wind structures would also lead to increased navigational constraints and risks and potential gear entanglement and loss. Many jobs generated by offshore wind are temporary construction jobs, lasting for a year or less. The long-term benefit of offshore wind projects is the medium-term (10 to 20 years) job market for offshore wind construction; long-term O&M jobs (25 to 35 years); long-term tax revenues; long-term economic benefits of improved ports and other industrial land areas; diversification of marine industries, especially in areas currently dominated by recreation and tourism; and growth in a skilled marine construction workforce. BOEM anticipates that there will be minor adverse and moderate beneficial impacts from offshore wind activities in the geographic analysis area.

BOEM anticipates that the cumulative impacts of the No Action Alternative would be **minor** adverse and **moderate beneficial** due primarily to the impacts on commercial fishing and marine recreational businesses. Beneficial impacts would result from increased employment and economic activity associated with multiple offshore wind projects being developed and operated in the region.

3.11.4 Relevant Design Parameters & Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; BOEM expects any potential variances in the proposed Project build-out within the range of the PDE to result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix E) would influence the magnitude of the impacts on demographic, employment, or economic characteristics:

- Overall size of project (approximately 1,100 MW) and number of WTGs;
- The extent to which Ocean Wind 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; and

- The design parameters that could affect commercial fishing and recreation and tourism because impacts on these activities affect employment and economic activity.

The size of the 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.

Ocean Wind has committed to measures to minimize impacts on demographics, employment, and economics, which include complying with NJDEP noise regulations (SOC-01), developing a construction schedule to minimize onshore construction activities during the peak summer recreation and tourism season (REC-01), and working cooperatively with commercial/recreational fishing entities and interests to ensure that construction and operation of the Project will minimize potential conflicts with commercial and recreational fishing (CFHFISH-01) (COP Volume II, Table 1.1-2; Ocean Wind 2023).

3.11.5 Impacts of the Proposed Action on Demographics, Employment, and Economics

3.11.5.1. Impacts of the Proposed Action

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park, which is described in Section 3.11.9, *Impacts of Alternative E 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. 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). Ocean Wind's economic impact study estimates that the Proposed Action would support the following employment in New Jersey alone in direct, indirect, and induced job-years[1]: an estimated 663 FTE job-years during development, 6,598 FTE job-years during construction, 6,114 FTE job-years during operations, and 1,202 FTE job-years during decommissioning (COP Volume II, Table 2.3.1-4; Ocean Wind 2023).

The Proposed Action would generate employment during construction and installation, O&M, and decommissioning of the Project. The Proposed Action would support a range of positions for professionals such as engineers, environmental scientists, financial analysts, administrative personnel; trade workers such as electricians, technicians, steel workers, welders, and ship workers; and other construction jobs during construction and installation of the Proposed Action. O&M would create jobs for maintenance crews, substation and turbine technicians, and other support roles. The decommissioning phase would also generate professional and trade jobs and support roles. Therefore, all phases of the Proposed Action would lead to local employment and economic activity.

Most of the Project's employment impacts would occur during the construction and operations phases. The Proposed Action is expected to create 6,598 job-years during construction (3,103 direct, 1,111

[1] Direct employment refers to jobs created by the direct hiring of workers. Indirect employment refers to jobs created through increased demand for materials, equipment, and services. Induced employment refers to jobs created at businesses where offshore wind industry workers would spend their incomes.
Job-years is an economic term that converts dollars spent into job equivalents based upon historical multipliers that consider factors such as salary, overhead, and hours worked.

indirect, and 2,384 induced), 6,114 job-years during operations (2,780 direct, 1,116 indirect, and 2,218 induced), and 1,202 job-years during decommissioning (289 direct, 468 indirect, and 446 induced). The 2,780 O&M direct job-years over the Project lifetime equate to approximately 79 per year over the 35-year operational life for the Proposed Action (COP Volume II, Table 2.3.1-4; Ocean Wind 2023).

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. O&M occupations would consist of turbine technicians, plant managers, water transportation workers, and engineers, with average annual compensation of approximately $99,000 (BOEM 2021a). 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 ships' crew 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 on housing, food, transportation, entertainment, and other goods and services. A large number of seasonal housing units are available in the vicinity of the Project. During the summer, competition for temporary accommodations may arise, leading to higher rents (COP Volume II, Section 2.3.1.2; Ocean Wind 2023). 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 (Table 3.11-3).

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. Ocean Wind's economic impact study estimated total state and local taxes generated would be $39,858,672 during construction and $1,215,506 during operations (COP Volume II, Table 2.3.1-6; Ocean Wind 2023). Once the Project is operational, property taxes would be assessed on the value of the Ocean Wind 1 facilities. The increased tax base during operations would be a long-term, beneficial impact on local governments in the Project area.

The reasonably foreseeable environmental trends and impacts of the Proposed Action in addition to ongoing non-offshore wind activities, planned non-offshore wind activities, and offshore wind activities are described by IPF below.

Energy generation and security: The Proposed Action would produce up to 1,100 MW of electricity, or 3 percent of the estimated 35 GW of reasonably foreseeable offshore wind generation potential for the U.S. East Coast. Based on Ocean Wind's OREC allowance, the expected annual energy production would be up to 4,851 GW-hours per year (Ocean Wind 2021). According to the BPU OREC Award, ratepayers could see an increase in their monthly energy bill of $1.46 for residential customers, $13.05 for commercial customers, and $110.10 for industrial customers (New Jersey Office of the Governor 2019). Offshore wind energy projects could produce energy at long-term fixed costs, which could provide stability against fossil fuel price volatility once built, resulting in a minor beneficial impact.

Lighting: Both onshore and offshore structures emit light that could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. 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. Ocean Wind proposes to implement an ADLS to automatically turn the aviation obstruction lights on and off in response to the presence of aircraft in proximity to the wind farm. Such a system will reduce the amount of time that the lights are on, thereby potentially minimizing the visibility of the WTGs from shore and related effects on the local economy. Impacts related to structure lighting would have localized, long-term, and negligible impacts on demographics, employment, and economics.

The anticipated increase in vessel traffic would result in growth in the nighttime traffic of vessels with lighting. 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.

Cable emplacement and maintenance: The Proposed Action's cable emplacement would generate vessel anchoring and dredging at the worksite, requiring recreational vessels to avoid and navigate around the worksites and resulting in short-term disturbance to species important to recreation and tourism, with potential adverse effects on employment and income. Array cable installation would require a maximum of 18 vessels (3 main laying, 3 burial, and 12 support vessels) (COP Volume I, Table 6.1.2-3; Ocean Wind 2023). Offshore export cable installation would require a maximum of 24 vessels (3 main laying, 3 main cable jointing, 3 burial, and 15 support vessels) (COP Volume I, Table 6.1.2-5; Ocean Wind 2023). While it is not specified how long vessels would be present at a given location, there would be at least one location where cable splicing is necessary, which could require a vessel to remain at the same location for several days (COP Volume I, Table 4.4-1; Ocean Wind 2023).

The approximately 3,785 acres of seafloor disturbance (associated with offshore cable and inter-array cable installation), disruption of fish stocks, and concrete mattresses covering cables in hard-bottom areas could hinder commercial trawlers/dredgers, potentially reducing income and increasing costs for affected businesses over the long term. Cable installation would have localized, short-term, minor impacts on demographics, employment, and economics, while maintenance of the Proposed Action and other existing submarine cables would have intermittent, long-term, negligible impacts.

Noise: Noise from vessel traffic would affect commercial fishing businesses and recreational businesses due to impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (COP Volume II, Section 2.3.4.2; Ocean Wind 2023); and noise from maintenance and repair operations that make the wind energy facilities less attractive to fishing operators and recreational boaters (COP Volume II, Section 2.3.3.1.2; Ocean Wind 2023). Noise from O&M activities would have localized, intermittent, long-term, negligible impacts on demographics, employment, and economics.

The estimated 101 foundations (WTGs and substations) would generate noise from pile driving, one of the most impactful noises on marine species, especially if multiple project construction activities occur in close spatial and temporal proximity (COP Volume III, Appendix R-2; Section C.6; Ocean Wind 2023). These disturbances would be temporary and localized, and extend only a short distance beyond the work area. Pile driving could harm marine species or cause avoidance by commercial fish populations, which would in turn affect commercial and for-hire fishing as well as recreational vessels that depend on these animals (COP Volume II, Section 2.2.7.2.1; Ocean Wind 2023). Pile driving and associated noise would have localized, short-term, and minor impacts on demographics, employment, and economics.

Infrequent trenching from pipeline and 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. Impacts on marine life would also affect onshore recreational businesses due to noise near public beaches, parks, residences, and offices. The use of trenchless technology at natural and sensitive landfall locations where possible would minimize direct impacts (COP Volume II, Section 2.2.2.2.1; Ocean Wind 2023). 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 recreational 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 (COP Volume II, Section 2.3.6.2.2; Ocean Wind 2023). Noise from vessels would have short-term, intermittent, negligible impacts on demographics, employment, and economics.

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. Several ports are indicated as possibly supporting proposed Project construction: the ports of Atlantic City, Hope Creek, Paulsboro, and Port Elizabeth in New Jersey; the port of Norfolk in Virginia; and the port of Charleston in South Carolina (COP Volume II, Section 2.3.6.2.1; Ocean Wind 2023). 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 would be greatest during construction when the most jobs and most economic activity at ports supporting the Proposed Action would occur. During operations, activities would be concentrated in Atlantic City, New Jersey where the Project's onshore O&M facility would be located and in other ports that may support Project-related vessel traffic, including Norfolk, Virginia. Ocean Wind estimated that 69 permanent jobs would support operations in Atlantic City. The O&M facility would help to diversify the local economy by providing a source of skilled, year-round jobs. In addition, the facility would undergo dredging in the marina and at Absecon Inlet, which would benefit multiple marina users (COP Volume II, Section 2.4.1; Ocean Wind 2023). Overall, operation of the Proposed Action would generate 2,780 job-years of skilled permanent labor (direct job-years) and over 6,000 total job-years created (direct job-years plus indirect and induced job creation) (COP Volume II, Section 2.3.1.2.2; Ocean Wind 2023). The Proposed Action would have a moderate 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.

Presence of structures: The Proposed Action would add up to 101 offshore wind structures (98 WTGs and 3 substations), with 84 acres (0.3 km^2) of foundation and scour protection and 94 acres (0.4 km^2) of offshore export cable hard protection, which could affect marine-based businesses (i.e., commercial and for-hire recreational fishing businesses, offshore recreational businesses, and related businesses) through impacts such as entanglement and gear loss/damage, navigational hazard and risk of allisions, fish aggregation, habitat alteration, and 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 disrupted, which would increase economic impacts on the commercial and for-hire recreational fishing industries. Marine-based businesses may be adversely affected due to the possible displacement of mobile species and potential for WTGs to become an exclusion area for fishing. Shoreside support services, such as bait and ice shops, vessels and infrastructure, insurance and maintenance services, processing, markets, and domestic/international shipping services, are anticipated to experience the same impacts as the fishing industry itself (BOEM 2017). As described in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*, considering the small number of vessels and fishing activity that would be affected, the impacts on other fishing industry sectors, including seafood processors and distributers and shoreside support services, would be adverse, with the level of impact depending on the fishery in question. The presence of structures would have continuous, long-term, and negligible to moderate 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. Proposed Action structures could increase economic activity associated with offshore sightseeing because these structures create foraging opportunities for harbor and gray seals, sea turtles, bats, northern gannets, loons, and peregrine falcons. These forms of marine life could attract private or commercial recreational sightseeing vessels (COP Volume II, Section 2.2.3.2.2; Ocean Wind 2023). 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 (COP Volume II, Section 2.3.3.1.2; Ocean Wind 2023). As described in Section 3.18, during construction, viewers on the Jersey Shore would 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 temporary, negligible impact on recreation and tourism. The WTGs would be in open ocean approximately 15 miles east of Atlantic City, New Jersey. At maximum vertical extension, the blade tips of the WTGs would be theoretically visible to a viewer at the ocean surface or at beach elevations at distances up to 39.6 miles with clear-day conditions. Between 39.6 miles and 31 miles, only the WTG blades would be potentially visible above the horizon from the perspective of a beach-elevation viewer. Ocean Wind has voluntarily committed to use ADLS and non-reflective pure white (RAL Number 9010) or light gray (RAL Number 7035) paint colors as described in Appendix H to reduce impacts. Additionally, the lower sections of each WTG would be marked with high-visibility (RAL Number 1023) yellow paint from the water line to a minimum height of 50 feet (15.2 meters). Due to EC, the yellow paint would be below the horizon beyond approximately 11.4 miles (18.3 kilometers) from eye levels of 5 feet (1.5 meters). Portions of 949 WTGs from the Proposed Action combined with offshore wind projects could potentially be visible from coastal and elevated locations in the geographic analysis area. The simulations prepared by Ocean Wind show anticipated views in clear conditions of offshore wind projects associated with the No Action Alternative combined with the Proposed Action (Appendix M). The WTGs would be discernable on a clear day, with the color and irregular forms of the WTGs contrasting with the uninterrupted horizontal horizon line associated with the open ocean. As shown in the simulations, the Proposed Action WTGs would contribute the most from the closest locations, the northernmost coast of Cape May County and the coast of Atlantic County. The Proposed Action would be visually subordinate to offshore wind projects along the shore of Ocean County. Atmospheric conditions could limit the number of WTGs discernable during daylight hours for a significant portion of the year (COP Volume III, Appendix L; Ocean Wind 2023).

Traffic: The Proposed Action would generate vessel traffic in the Project area and to and from the ports supporting project construction, O&M, and decommissioning. Ocean Wind estimates that construction activity would generate between 20 and 65 vessels operating at any given time. During operations, the Proposed Action would generate approximately 10 vessel trips per day (refer to Section 3.16 for additional information regarding anticipated vessel traffic). Increased vessel traffic would increase the use of port and marine businesses, including tug services, dockage, fueling, inspection/repairs, and provisioning. 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 and decommissioning, and negligible beneficial impacts during operations. Vessel traffic associated with the Proposed Action could also result in temporary, periodic congestion within and near ports, leading to potential delays and an increased risk for collisions between vessels, which would result in economic costs for vessel owners. As a result of potential delays from increased congestion and increased risk of damage from collisions, the Proposed Action would have continuous, short-term, and minor impacts during construction and negligible impacts during operations.

Land disturbance: Construction of the Proposed Action would require onshore cable installation and substation construction. Installation of the cables would occur within a 50-foot-wide temporary construction corridor. Based on the landfall options with the longest onshore cable routes, construction of the Oyster Creek onshore export cable could result in up to 32 acres of temporary disturbance, and construction of the BL England onshore export cable could result in up to 48 acres of temporary disturbance (COP Volume I, Table 6.2.1-1; Ocean Wind 2023). The employment and economic impact of the Proposed Action caused by disturbance of businesses near the onshore cable route and substation construction site would result in localized, short-term, minor impacts.

3.11.5.2. Cumulative Impacts of the Proposed Action

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

Energy generation and security: The Proposed Action would contribute a noticeable increment to the combined energy security and resilience impacts from ongoing and planned activities including offshore wind. Impacts related to energy generation and security would have long-term, regional, and minor beneficial impacts on demographics, employment, and economics.

Lighting: Between 2023 and 2030, there may be 12 offshore wind projects within the New York and New Jersey lease areas. WTG lighting in offshore wind activities would be visible from the same locations as the Proposed Action in addition to New Jersey coastal locations. The Proposed Action would contribute a noticeable increment to the combined lighting impacts from ongoing and planned activities including offshore wind, which would be negligible.

Cable emplacement and maintenance: The Proposed Action would contribute a noticeable increment to the combined cable emplacement and maintenance impacts on demographics, employment, and economics from ongoing and planned activities including offshore wind, which would be short term and minor.

Noise: Of the adjacent offshore wind projects, construction of the Proposed Action is anticipated to overlap with construction of the Atlantic Shores South offshore wind project for up to 1 year, potentially contributing to increased noise impacts during simultaneous construction activity (Appendix F, Table F2-1). While operational activity would overlap, noise impacts during operations would be far less than during construction. Therefore, the Proposed Action would contribute a noticeable increment to the combined noise impacts on demographics, employment, and economics from ongoing and planned activities including offshore wind, which would be short term and negligible.

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 would contribute a noticeable increment to the impacts from other ongoing and planned activities, which would be long term, moderate, and beneficial on port utilization and the associated trained and skilled offshore wind workforce that would contribute economic activity in port communities and the region as a whole.

Presence of structures: Across the New York and New Jersey lease areas, up to 2,646 offshore structures, including those of the Proposed Action, would affect employment and economics by affecting marine-based businesses. Presence of structures would have both beneficial impacts, such as by providing sightseeing opportunities and fish aggregation that benefit recreational businesses, and adverse effects, such as by causing fishing gear loss, navigational hazards, and viewshed impacts that could affect business operations and income. The Proposed Action would contribute an undetectable increment to the combined impacts on demographics, employment, and economics from other ongoing and planned activities including offshore wind, which would be long term and moderate due to impacts on commercial and for-hire recreational fishing, for-hire recreational boating, and associated businesses.

Traffic: The Proposed Action would contribute a noticeable increment to the combined impacts from ongoing and planned activities including offshore wind, which would be minor during construction and decommissioning and negligible during operations. Increased vessel traffic would produce demand for supporting marine services, with 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 congestion and collision risk would also have long-term, continuous impacts on marine businesses during all project phases, with minor impacts during construction and decommissioning and negligible impacts during operations.

Land disturbance: The exact extent of land disturbance associated with other projects would depend on the locations of landfall, onshore transmission cable routes, and onshore substations for offshore wind energy projects. Therefore, the incremental impacts contributed by the Proposed Action to the combined land disturbance impacts from ongoing and planned activities including offshore wind would be short term and noticeable due to the short-term and localized disruption of onshore businesses.

3.11.5.3. Conclusions

Impacts of the Proposed Action. BOEM anticipates that the Proposed Action would have negligible impacts on demographics within the analysis area. While it is likely that some workers would relocate to the area due to the Proposed Action, this volume of workers would not be substantial compared to the current population and housing supply. The Proposed Action alone would affect employment and economics through job creation, expenditures on local businesses, tax revenues, grant funds, and support for additional regional offshore wind development, which would have minor beneficial impacts. Construction would have a minor beneficial impact on employment and economics due to jobs and revenue creation over the short duration of the construction period. The beneficial impact of employment and expenditures during O&M would have a modest magnitude over the 35-year duration of the Project. Although tax revenues and grant funds would be modest in magnitude, they also would provide a beneficial impact on public expenditures and local workforce and supply chain development for offshore wind. If the Proposed Action becomes decommissioned, the impacts on demographics, employment, and economics would be minor and beneficial due to the construction activity necessary to remove wind facility structures and equipment. After decommissioning, the Proposed Action would no longer affect employment or produce other offshore wind-related revenues.

While the Proposed 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 impacts on individual businesses and communities would also occur. Short-term increases in noise during construction, cable emplacement, land disturbance, and the long-term presence of offshore lighting and structures would have negligible to minor adverse impacts on demographics, employment, and economics. The commercial fishing industry and other businesses that depend on local seafood production would experience impacts during construction. Overall, the impacts on commercial fishing and onshore seafood businesses would have minor impacts on demographics, employment, and economics for this component of the geographic analysis area's economy. Although commercial fishing is a small component of the regional economy, it is important to the identity of local communities within the region. The IPFs associated with the Proposed Action alone would also result in impacts on certain recreation and tourism businesses that range from negligible to minor, with an overall minor impact on employment and economic activity for this component of the analysis area's economy. In summary, the Proposed Action would have **minor adverse** and **moderate beneficial** impacts on demographics, employment, and economics.

Cumulative Impacts of the Proposed Action. The incremental impacts contributed by the Proposed Action to the overall impacts on demographics, employment, and economics would range from undetectable to noticeable. BOEM anticipates that cumulative impacts on demographics, employment, and economics in the geographic analysis area associated with the Proposed Action would be **minor** adverse and **moderate beneficial**. The moderate beneficial impacts primarily would be associated with the investment in offshore wind, job creation and workforce development, income and tax revenue, and infrastructure improvements, while the minor adverse effects would result from aviation hazard lighting on WTGs, new cable emplacement and maintenance, the presence of structures, vessel traffic and collisions during construction, and land disturbance. Impacts on commercial and for-hire recreational fishing are anticipated to be moderate but only one component of the overall impacts. Because they are not expected to disrupt normal demographic, employment, and economic trends, the overall impacts in the geographical analysis area likely would be minor.

3.11.6 Impacts of Alternative B on Demographics, Employment, and Economics

Impacts of Alternative B. Alternatives B-1 and B-2 would result in a slight reduction in both adverse and beneficial impacts on demographics, employment, and economics compared to the Proposed Action, but the overall impact magnitudes would be the same. Alternatives B-1 and B-2 would install fewer WTGs (up to 9 fewer WTGs for B-1; up to 19 fewer WTGs for B-2) and associated inter-array cables, which would slightly reduce the construction impact footprint and installation period. Construction of fewer WTGs would result in a shorter duration of noise impacts and less vessel traffic, which could reduce impacts on commercial and for-hire recreational fishing. Conversely, the reduced number of WTGs would also mean that the Project would generate less energy—with the removal of 9 WTGs, Alternative B-1 would result in an expected annual energy production of 4,178 GW-hours per year compared to 4,851 GW-hours per year under the Proposed Action (Ocean Wind 2021)—and would therefore result in slightly lower beneficial impacts associated with delivering a reliable supply of energy. The removal of 19 WTGs under Alternative B-2 would result in even less energy generation but selection of the alternative would be contingent on a larger turbine being commercially available, which would offset some of these potential energy losses. Because Alternative B would produce less energy, it would also offset fewer GHG emissions from fossil-fueled power generation compared to the Proposed Action, further reducing beneficial impacts. A reduced number of WTGs would also generate less economic activity, which would reduce port utilization and result in lower expenditures in general. However, the change in these impacts would all be slight and would not change the overall impact rating compared to the Proposed Action.

Alternatives B-1 and B-2 could potentially reduce visual impacts by removing the 9 and 19 WTGs, respectively, closest to the shore, thereby reducing potential impacts on the tourism, recreation, and real estate businesses that are sensitive to viewshed impacts from WTGs. However, because most of the WTGs would still be visible, localized, long-term, minor impacts are still anticipated. Fewer WTGs would reduce reef effects and fish aggregation, which would have unclear impacts on the commercial and for-hire and recreational fisheries that rely on marine species. Fewer WTGs would reduce the risk of allisions and the need for vessels to reroute, which would reduce travel time, fuel costs, and other associated costs.

Cumulative Impacts of Alternative B. The incremental impacts contributed by Alternatives B-1 and B-2 to the impacts from ongoing and planned activities including offshore wind would be similar to those described under the Proposed Action.

3.11.6.1. Conclusions

Impacts of Alternative B. Alternatives B-1 and B-2 would result in slightly lower adverse impacts and slightly lower beneficial impacts compared to the Proposed Action, but would not change the overall impact levels, which are anticipated to range from **minor** adverse impacts and **moderate beneficial** impacts on demographics, employment, and economics.

Cumulative Impacts of Alternative B. The incremental impacts contributed by Alternatives B-1 and B-2 to the overall impacts on demographics, employment, and economics would be the same as under the Proposed Action and would range from undetectable to noticeable. Considering all the IPFs together, BOEM anticipates that the overall impacts on demographics, employment, and economics associated with Alternatives B-1 and B-2 when combined with impacts from ongoing and planned activities including offshore wind would be **minor** adverse and **moderate beneficial**.

3.11.7 Impacts of Alternative C on Demographics, Employment, and Economics

Impacts of Alternative C. Impacts of Alternatives C-1 and C-2 would be similar to those of the Proposed Action for demographics, employment, and economics. The 0.81- to 1.08-nm buffer between WTGs in the Ocean Wind 1 Lease Area and WTGS in the Atlantic Shores South Lease Area, as described in Section 3.16, would allow for the transit of larger fishing vessels or survey vessels through the Wind Farm Area. The buffer could improve safety for commercial and recreational fishing vessels in the Wind Farm Area (Sections 3.9 and 3.18).

Alternative C-1 would relocate eight WTG positions to attain the buffer while Alternative C-2 would compress the WTG layout from 1 nm between rows to no less than 0.99 nm between rows. At the distance of 15.3 miles from the shore, relocation of one row of WTGs under Alternative C-1 and compression of the WTG array under Alternative C-2 may be unnoticeable to the casual viewer and would not change visual-related impacts compared to the Proposed Action. Regarding footprint disturbance, BOEM does not expect relocation of the eight WTGs and compression of the 98 WTGs under Alternatives C-1 and C-2, respectively, to significantly change the potential impacts compared to the Proposed Action, as the number of WTGs would remain the same and the overall footprint would remain the same or slightly less (Section 3.13). All other design parameters and potential variability in the design would be the same as under the Proposed Action.

Cumulative Impacts of Alternative C. The incremental impacts contributed by Alternative C to the impacts from ongoing and planned activities including offshore wind would be similar to those described under the Proposed Action.

3.11.7.1. Conclusions

Impacts of Alternative C. The impacts on demographics, employment, and economics resulting from Alternatives C-1 and C-2 are anticipated to range from **minor** adverse and **moderate beneficial**. The 0.81- to 1.08-nm buffer would marginally improve safety of vessel transit, so the impacts resulting from individual IPFs associated with Alternatives C-1 and C-2 would be slightly less adverse than the Proposed Action's impacts but the overall impact magnitudes would not change.

Cumulative Impacts of Alternative C. The impacts contributed by Alternatives C-1 and C-2 to the overall impacts on demographics, employment, and economics would be the same as under the Proposed Action and would range from undetectable to noticeable. Considering all the IPFs together, BOEM anticipates that the overall impacts on demographics, employment, and economics associated with Alternatives C-1 and C-2 when combined with impacts from ongoing and planned activities including offshore wind would be **minor** adverse and **moderate beneficial**.

3.11.8 Impacts of Alternative D on Demographics, Employment, and Economics

Impacts of Alternative D. Alternative D would install up to 15 fewer WTGs and associated inter-array cables, which would slightly reduce the construction impact footprint and installation period. Alternative D could potentially reduce localized impacts on marine species that local commercial/for-hire and recreational fishing use for seafood production compared to the Proposed Action but the overall impact magnitudes would not change. Alternative D would allow commercial fishing vessels to operate and fish without potential impacts from structures in the locations where the WTGs would be removed. In addition, reduced underwater noise from pile driving and vessels during construction activities, and reduced habitat alteration, vessel strikes, artificial lighting, and decommissioning activities, would lessen the potential for displacement of marine species and associated impacts on commercial and recreational vessels.

Construction of fewer WTGs would result in a shorter duration of noise impacts and less vessel traffic, which could reduce impacts on commercial and for-hire recreational fishing. The reduced number of WTGs would also mean that the Project would generate less energy—with the removal of 15 WTGs, Alternative D would result in an expected annual energy production of 3,922 GW-hours per year compared to 4,851 GW-hours per year under the Proposed Action (Ocean Wind 2021)—and would therefore result in slightly lower beneficial impacts associated with delivering a reliable supply of energy and reduced GHG emissions from offsetting fossil-fueled power generation. However, selection of the alternative would be contingent on a larger turbine being commercially available, which would offset some of these potential energy losses. A reduced number of WTGs would also generate less economic activity, which would reduce port utilization and result in lower expenditures in general. However, the change in these impacts would all be slight and would not change the overall impact rating compared to the Proposed Action.

Cumulative Impacts of Alternative D. The incremental impacts contributed by Alternative D to the impacts from ongoing and planned activities including offshore wind would be similar to those described under the Proposed Action.

3.11.8.1. Conclusions

Impacts of Alternative D. Alternative D would result in slightly reduced impacts on demographics, employment, and economics compared to the Proposed Action, but the overall impact magnitude would not change. The removal of 15 WTGs under Alternative D would result in fewer impacts on marine species and, by extension, fewer impacts on commercial and for-hire recreational fisheries. Energy generation and associated beneficial impacts would be reduced under Alternative D because there would be fewer WTGs. Impacts on demographics, employment, and economics under Alternative D are anticipated to be **minor** adverse and **moderate beneficial**.

Cumulative Impacts of Alternative D. The impacts resulting from individual IPFs would be the same as those of the Proposed Action: **minor** adverse impacts and **moderate beneficial** impacts. Considering all the IPFs together, BOEM anticipates that the overall impacts on demographics, employment, and economics associated with Alternative D when combined with the impacts from ongoing and planned activities including offshore wind would be **minor** adverse and **moderate beneficial**.

3.11.9 Impacts of Alternative E on Demographics, Employment, and Economics

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park.

Impacts of Alternative E. The impacts of Alternative E on demographics, employment, and economics would be the same as those of the Proposed Action. Increased onshore construction activity on Island Beach State Park may potentially disturb and restrict park operations and visitation due to typical construction impacts such as increased noise, traffic, and road disturbances. However, impacts would remain localized and short term while the cables are being installed and BOEM does not anticipate impacts to be materially different than those described under the Proposed Action.

Cumulative Impacts of Alternative E. The incremental impacts resulting from individual IPFs would be similar to those described under the Proposed Action.

3.11.9.1. Conclusions

Impacts of Alternative E. The increased length of the onshore cable route under Alternative E would slightly increase the potential for onshore impacts related to noise and traffic that could affect local businesses. However, the overall impact magnitudes are anticipated to be the same as those of the Proposed Action, ranging from **minor** adverse impacts to **moderate beneficial** impacts on demographics, employment, and economics.

Cumulative Impacts of Alternative E. The incremental impacts contributed by Alternative E to the overall impacts on demographics, employment, and economics would be the same as those of the Proposed Action, ranging from undetectable to noticeable. Considering all the IPFs together, BOEM anticipates that the overall impacts on demographics, employment, and economics associated with Alternative E when combined with the impacts from ongoing and planned activities including offshore wind would be **minor** adverse and **moderate beneficial**.

3.11.10 Proposed Mitigation Measures

No additional measures to mitigate impacts on demographics, employment, and economics have been proposed for analysis.

This page intentionally left blank.

3.14. Land Use and Coastal Infrastructure

This section discusses potential impacts on land use and coastal infrastructure from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown on Figure 3.14-1, includes Ocean City, Upper Township, Berkeley Township, Lacey Township, and Ocean Township, and municipal boundaries surrounding the ports that may be used for the Project. Ocean Wind proposes the use of ports in Paulsboro, Hope Creek, and Port Elizabeth, New Jersey; Charleston, South Carolina; and Norfolk, Virginia. In addition, Ocean Wind proposes to use an O&M facility that would be in Atlantic City, New Jersey. These areas encompass locations where BOEM anticipates impacts associated with proposed onshore facilities and ports.

3.14.1 Description of the Affected Environment for Land Use and Coastal Infrastructure

Within the geographic analysis area, land use is diverse, including water, wetlands, barren land, forest, urban, and agricultural land uses. The proposed Project includes two interconnection points with the PJM electric transmission system at the BL England in Upper Township, New Jersey and at the Oyster Creek onshore substation in Lacey Township, New Jersey. Commercial development in northern Cape May County, which includes Ocean City, Upper Township, and Marmora and Beesley's Point, primarily serves local needs with minimal large manufacturing or production, so has minimal, if any, large distribution facilities, and the county includes a variety of residential development types such as single family, townhouses, and over-55 communities. In Ocean City, New Jersey the dominant land use is urban, while wetlands, forest, and urban uses are found primarily on the mainland in Upper Township, New Jersey (COP, Volume II, Section 2.3.5; Ocean Wind 2023).

The proposed BL England onshore substation would be sited on a former coal, oil, and diesel plant in Upper Township, New Jersey. Land surrounding the proposed BL England onshore substation has an urban land use classification and in the Waterfront Town Center zoning district (NJDEP 2015; Township of Upper 2021). The BL England onshore export cable route has four landfall options within the PDE; three proposed landfall locations on the barrier island of Ocean City and one possible landfall location west of the Garden State Parkway in Upper Township, New Jersey. Based on NJDEP land use cover data, land use is classified as urban at all four landfall sites considered and the area surrounding those sites, with the land bordering the potential landfall location at 35th Street in Ocean City, New Jersey classified as barren land (NJDEP 2015). Along the proposed BL England onshore export cable routes, land use is classified as water, wetlands, barren lands, forest, urban, and agriculture (NJDEP 2015). Land along the proposed BL England onshore export cable route is zoned for residential use, including one-, two-, and multifamily, business, gateway/mixed use, and public use (Ocean City 2014).

The proposed Oyster Creek onshore substation would be sited on the former Oyster Creek nuclear plant in Lacey Township, New Jersey. Land surrounding the proposed Oyster Creek onshore substation has an urban land use classification and is within an industrial zoning district (NJDEP 2015; Township of Lacey 2009). Onshore export cable corridors near Oyster Creek are in Berkeley Township, Lacey Township, and Ocean Township. Land use in the vicinity of the Oyster Creek route is classified into five different land use groups: water, wetlands, barren land, forest, and urban (NJDEP 2015). The primary uses along the Oyster Creek onshore export cable corridor are a combination of wetlands, urban development, and forest land, with urban development primarily east of U.S. Route 9. Portions of the Oyster Creek onshore export cable corridor is within lands approved for acquisition by USFWS as part of the Edwin B. Forsythe National Wildlife Refuge; however, as they have yet to be acquired by USFWS, these lands do not need to be evaluated for impacts relative to the refuge (USFWS 2021).

The Oyster Creek export cable corridor would also cross Island Beach State Park, where there are many tidal rivers, waters, beaches, and wetlands (COP, Volume II, Section 2.3.5; Ocean Wind 2023). Island Beach State Park is managed pursuant to the Coastal Barrier Resources Act, enacted to minimize the loss of human life, wasteful federal expenditures, and damage to natural resources associated with the development of coastal barriers. Under the Coastal Barrier Resources Act, Island Beach State Park is listed as an "Otherwise Protected Area," a categorization used for national wildlife refuges, state and national parks, and local and private conservation areas on coastal barriers that are held for conservation or recreation purposes (USFWS 2014). Because it is listed as an otherwise protected area, Coastal Barrier Resources Act consultation with USFWS is not required and the only federal spending restriction is a prohibition on federal flood insurance.

Important landscape features near BL England and Oyster Creek include a combination of natural views such as beaches, shorelines, and scenic vistas, and man-made views such as unique buildings, landscaping, parks, and other cultural features. The New Jersey Pinelands feature some of the largest unbroken tracts of Atlantic coastal pine forests in the eastern U.S., stretching across more than seven counties of New Jersey. While the entirety of the Onshore Project area is outside of the state-designated Pinelands Area (development in this area is regulated by the State of New Jersey Pinelands Commission), portions of the BL England export cable corridors are within the federally designated Pinelands National Reserve in the Forest Area and Regional Growth area Pineland Management Areas (New Jersey Pinelands Commission 2021). All future land use in Pineland Management Areas is subject to guidelines and regulations established in the Pinelands Comprehensive Management Plan. Proposed onshore export cable corridors in Marmora and Beesley's Point are within the Regional Growth Area Pineland Management Area, where sewered and industrial uses are permitted (New Jersey Pinelands Commission 2022). Within the Forest Area Pineland Management Area, roadside retail within 300 feet of pre-existing commercial uses is permitted, as are low-intensity recreational uses. Proposed onshore export cable corridors on Island Beach State Park do not fall within the Pinelands National Reserve. The Great Egg Harbor River is a 129-mile river system and was designated as a Wild and Scenic River by Congress in 1992 (USNPS 2016). It is almost entirely within the Pinelands National Reserve and drains into wetlands within the reserve.

In addition to the landfall locations and onshore substations, the Project would use various ports for construction and O&M. The ports under consideration include Paulsboro, Hope Creek, and Port Elizabeth, New Jersey; Charleston, South Carolina; and Norfolk, Virginia. The O&M facility would be in Atlantic City on two parcels adjacent to Clam Creek that had previously served as a marine terminal. The area is currently zoned for commercial marine use (Atlantic City 2006). The Port of Paulsboro is surrounded by land zoned as the marina industrial business park (Borough of Paulsboro 2010). Hope Creek and Port Elizabeth are within areas zoned for industrial use (Township of Lower Alloways Creek 2014; City of Elizabeth 2000). Land use surrounding the Port of Charleston includes light industry, where uses compatible with surrounding commercial districts are permitted (City of Charleston 2012). The port in Norfolk, Virginia is within marine industrial land use (City of Norfolk 2021).

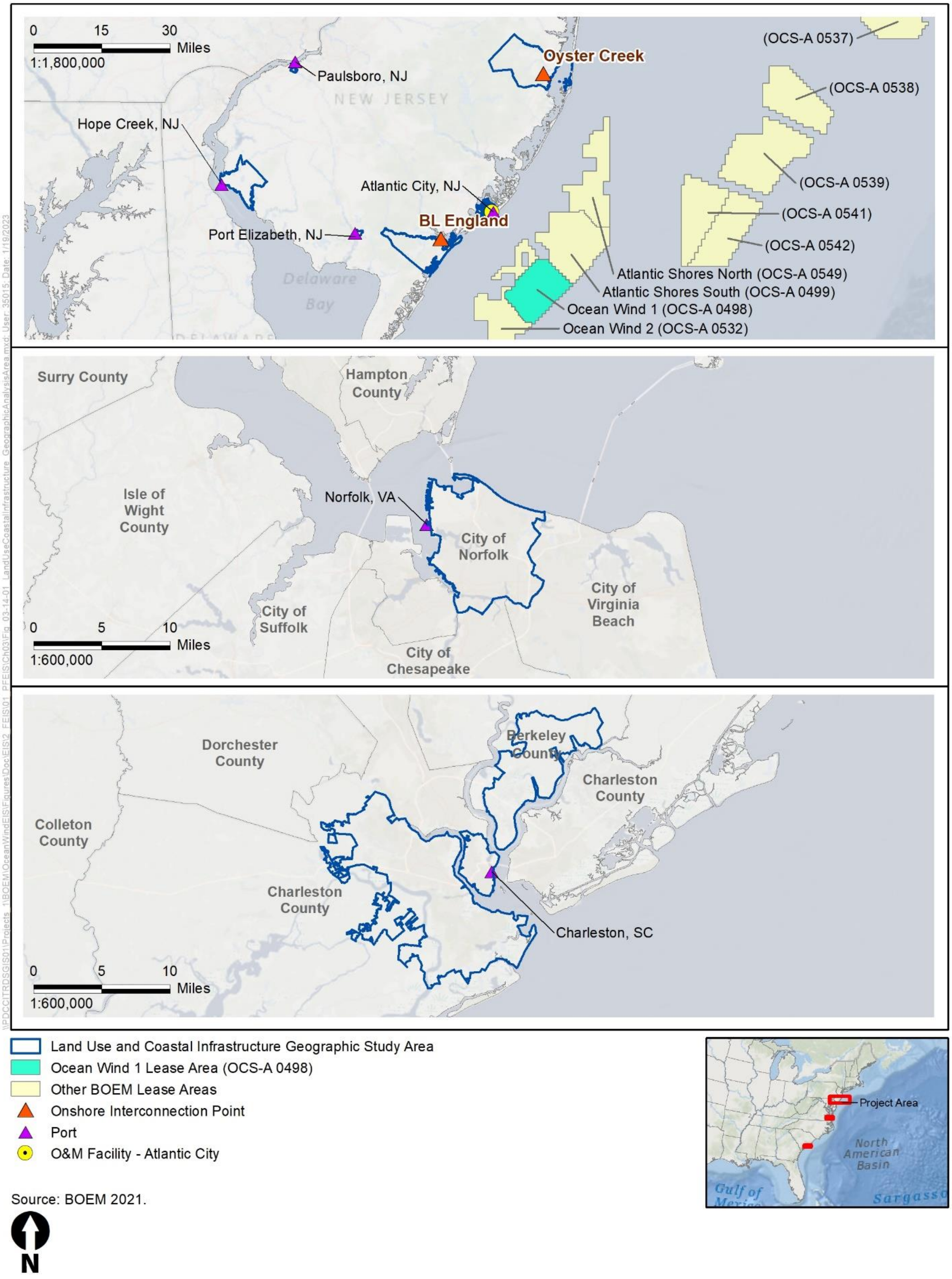


Figure 3.14-1 Land Use and Coastal Infrastructure Geographic Analysis Area

3.14.2 Environmental Consequences

3.14.2.1. Impact Level Definitions for Land Use and Coastal Infrastructure

Definitions of potential impact levels are provided in Table 3.14-1.

Table 3.14-1 Impact Level Definitions for Land Use and Coastal Infrastructure

Impact Level	Impact Type	Definition
Negligible	Adverse	Adverse impacts on area land use would not be detectable.
	Beneficial	Beneficial impacts on area land use would not be detectable.
Minor	Adverse	Adverse impacts would be detectable but would be short term and localized.
	Beneficial	Beneficial impacts would be detectable but would be short term and localized.
Moderate	Adverse	Adverse impacts would be detectable and broad based, affecting a variety of land uses, but would be short term and would not result in long-term change.
	Beneficial	Beneficial impacts would be detectable and broad based, affecting a variety of land uses, but would be short term and would not result in long-term change.
Major	Adverse	Adverse impacts would be detectable, long term, and extensive, and result in permanent land use change.
	Beneficial	Beneficial impacts would be detectable, long term, and extensive, and result in permanent land use change.

3.14.3 Impacts of the No Action Alternative on Land Use and Coastal Infrastructure

Section 3.1 of the Final EIS explains the approach to predicting impacts related to the No Action Alternative. When analyzing the impacts of the No Action Alternative on land use and coastal infrastructure, 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 land use and coastal infrastructure. 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 F, *Planned Activities Scenario*. Separate impact conclusions are presented for both scenarios.

3.14.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, land use and coastal infrastructure in the geographic analysis area described in Section 3.14.1, *Description of the Affected Environment for Land Use and Coastal Infrastructure*, would continue to be affected by ongoing non-offshore wind and offshore wind activities, especially onshore and coastal regional trends, development projects, and port expansion.

The geographic analysis area lies within developed communities that would experience continued commerce and development activity in accordance with established land use patterns and regulations. 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 on undeveloped land may also occur. Ports in the geographic analysis area would continue to serve marine traffic and industries and experience periodic dredging and improvement projects to meet ongoing needs. A channel-deepening project at the Port of Virginia is currently underway and is anticipated to be completed in 2024 (Virginia Port Authority 2021). Dredging and port improvements would allow larger vessels to use the port and may result in increased port use and conversion of surrounding land use if the ports are expanded. See Table F1-12 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for land use and coastal infrastructure. There are no ongoing offshore wind activities within the geographic analysis area for land use and coastal infrastructure.

3.14.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other activities (without the Proposed Action). BOEM has reviewed available information regarding the potential for other offshore wind activities to occur within the geographic analysis area for land use and coastal infrastructure. Atlantic Shores South proposes points of interconnection at the Cardiff Substation and Larrabee Substation (Atlantic Shores 2021). Transmission lines rated at 138 kV and higher have sufficient thermal capability to deliver power from an offshore wind project to the utility’s load center. The *New Jersey Offshore Wind Energy: Feasibility Study* identified existing transmission lines and substations rated at 138 kV and above. These substations would be likely potential points of interconnection for future offshore wind activities but are outside of the geographic analysis area.

The geographic analysis area also includes municipal boundaries surrounding the ports that may be used for the Project. Atlantic Shores South has proposed use of an O&M facility in Atlantic City and identified that the Ports of Paulsboro and Charleston may be used during construction. Furthermore, the potential exists for other offshore wind activities to occur within the municipal boundaries surrounding the ports.

Therefore, 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/hazardous materials may increase due to onshore construction for the landfalls and onshore export cable routes of offshore wind activities. Accidental release risks would be highest during construction, but still pose a risk during operation and decommissioning of offshore wind facilities. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases. Accidental releases could result in temporary restrictions on use of adjacent properties and coastal infrastructure 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 negligible (except in the case of very large spills that affect a large land or coastal area).

Lighting: As described in Section 3.20, aviation hazard lighting on portions of eight offshore wind projects (encompassing 761 WTGs) could potentially be visible from beaches and coastal areas in the geographic analysis area. A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). The majority of the WTG positions associated with other offshore wind activities would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs.

Nighttime lighting from onshore electrical substations could affect the ability to use nearby properties or decisions about where to establish permanent or temporary residences. Nighttime lighting impacts would be localized, constant, and long term. However, it is likely that other offshore wind projects would expand or construct new substations near existing substations, or would construct new substations in areas where land development regulations (i.e., zoning and land use plan designations) allow such uses. For new or expanded substations in business or industrial areas, lighting would have no adverse impacts on land uses. Lighting impacts would depend on the proposed substation locations, but would generally be negligible.

Port utilization: Offshore wind energy projects would make use of port facilities for shipping, berthing, and staging throughout construction, operations, and decommissioning. This use would be similar to existing activities at ports and is consistent with the zoning and land use plan designations of these areas. Offshore wind would likely increase port utilization, and ports would experience beneficial impacts such as greater economic activity and increased employment due to demand for vessel maintenance services and related supplies, vessel berthing, loading and unloading, warehousing and fabrication facilities for offshore wind components, and other business activity related to offshore wind. For larger ports, such as Charleston and Norfolk, offshore wind-related activities would make up a small portion of the total activities at the port; therefore, offshore wind activities are likely to have a negligible impact on land use through port utilization at these ports. However, for smaller ports within the geographic analysis area, such as Paulsboro and Hope Creek, port expansion may be necessary to accommodate the increased activity, resulting in changes to surrounding land use and coastal infrastructure as described below.

Offshore wind activity would make use of planned dredging and improvement projects at ports in the geographic analysis area, including ports in New Jersey and South Carolina. USACE has proposed maintenance dredging of portions of the Newark Bay, New Jersey federal navigation channel, including the removal of material from the Port Elizabeth Channel to occur between July 2021 and February 2022 (USACE 2021). Additionally, in 2017 USACE Charleston District awarded contracts as part of the Charleston Harbor Deepening Project, which will create a 52-foot depth at the entrance channel to Charleston Harbor in South Carolina (USACE n.d.). Dredging at ports is consistent with existing use and would support state strategic plans and local land use goals for the development of waterfront infrastructure. The Atlantic Shores South project would construct an O&M facility in Atlantic City, New Jersey on a shoreside parcel that was formerly used for vessel docking and other port activities. Limited dredging and bulkhead improvements would also be completed for the Atlantic Shores South O&M facility, resulting in minor beneficial impacts on coastal infrastructure (Atlantic Shores 2021). If multiple offshore wind energy projects are constructed at the same time and rely on the same ports, this simultaneous use could stress port resources and could potentially temporarily increase the marine and road traffic, noise, and air pollution in the area during construction activities. Overall, offshore wind projects would have constant, long-term, minor beneficial impacts on port utilization due to the productive use of ports designated for offshore wind activity, as well as localized, short-term, adverse impacts in cases where individual ports are stressed due to simultaneous project activity.

Presence of structures: As described in Section 3.20, portions of eight offshore wind projects (encompassing 761 WTGs) could be visible from some shorelines depending on vegetation, topography, and atmospheric conditions. Visibility would vary with distance from shore, topography, and atmospheric conditions and impacts would generally be localized, constant, and long term. The presence of WTGs would have negligible impacts on land use because while WTGs could be visible from some shoreline locations in the geographic analysis area, WTGs would not result in changes to land use or zoning.

Noise: Noise from offshore wind construction activities is not expected to reach the geographic analysis area, and other offshore wind projects are not anticipated to occur within the geographic analysis area. Therefore, increased noise resulting from other offshore wind activities would not affect land use and coastal infrastructure.

3.14.3.3. Conclusions

Impacts of the No Action Alternative. BOEM expects ongoing non-offshore wind activities to have continuing temporary and permanent impacts on land use and coastal infrastructure. The identified IPFs relevant to land use and coastal infrastructure are accidental releases, nighttime lighting of onshore construction activity and structures, port utilization and expansion, viewshed impacts of offshore structures, presence of onshore infrastructure, and land disturbance, noise, and traffic from construction.

BOEM anticipates that the impacts of ongoing activities, especially onshore and coastal commerce, industry, and construction projects, would have both minor beneficial and negligible adverse impacts in the geographic analysis area. Accidental releases and land disturbance could have temporary adverse impacts on local land uses but, overall, ongoing use and development sustains the region's diverse mix of land uses and provides support for continued maintenance and improvement of coastal infrastructure. Under the No Action Alternative, existing environmental trends and activities would continue, and land use and coastal infrastructure would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **negligible** adverse and **minor beneficial** impacts on land use and coastal infrastructure.

Cumulative Impacts of the No Action Alternative. Planned activities other than offshore wind, primarily increased port maintenance and expansion and construction activity, would have impacts similar to those of ongoing activities, with minor beneficial and negligible adverse impacts. BOEM anticipates that the cumulative impacts of the No Action Alternative would be **minor** adverse and **minor beneficial**. Offshore wind would adversely affect land use through land disturbance (during installation of onshore cable and substations) and accidental releases during onshore construction, as well as through the presence of offshore lighting on wind energy structures and views of the structures themselves that could affect the use and value of onshore properties. Beneficial impacts on land use and coastal infrastructure would result because the development of offshore wind would support the productive use of ports and related infrastructure designed or appropriate for offshore wind activity (including construction and installation, O&M, and decommissioning).

3.14.4 Relevant Design Parameters & Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; BOEM expects any potential variances in the proposed Project build-out within the range of the PDE to result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix E) 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.

Ocean Wind has committed to measures to minimize impacts on land use and coastal infrastructure, which include developing crossing and proximity agreements with utility owners prior to utility crossings (LU-01), complying with NJDEP noise regulations and local noise regulations (SOC-01), and implementing a construction schedule to minimize onshore construction activities during the peak summer recreation and tourism season and to coordinate with local municipalities to minimize impacts on popular events in the area during construction (REC-01 and REC-02) (COP Volume II, Table 1.1-2; Ocean Wind 2023).

3.14.5 Impacts of the Proposed Action on Land Use and Coastal Infrastructure

3.14.5.1. Impacts of the Proposed Action

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park, which is described in Section 3.14.7, *Impacts of Alternative E on Land Use and Coastal Infrastructure*.

The Proposed Action would likely result in localized impacts that would not alter the overall character of land use and coastal infrastructure in the geographic analysis area. The most impactful IPFs would likely include land disturbance during cable installation, the visual impact of offshore WTGs, and the utilization of ports.[1] Other IPFs would likely contribute impacts of lesser intensity and extent and would occur primarily during construction but may also occur during operations and decommissioning.

Accidental releases: Accidental releases from the Proposed Action could include release of fuel/fluids/hazardous materials as a result of port usage, installation of the onshore cables and substation, and substation operation. Potential contamination may occur from unforeseen spills or accidents, and any such occurrence would be reported and addressed in accordance with the local authority. The impact of accidental releases on land use and coastal infrastructure could result in temporary restriction on use of adjacent properties and coastal infrastructure during the cleanup process. Accordingly, accidental releases from the Proposed Action alone would have localized, short-term, negligible to minor impacts on land use.

Lighting: The Proposed Action would include the installation and continuous use of aviation hazard avoidance lighting on WTGs and OSS during low-light and nighttime conditions. During operations, lighting from all the Proposed Action's 98 WTGs could potentially be visible from certain coastal and elevated locations in the geographic analysis area. Ocean Wind proposes to implement an ADLS to automatically turn the aviation obstruction lights on and off in response to the presence of aircraft in proximity of the wind farm. Such a system may reduce the amount of time that the lights are on, thereby potentially minimizing the visibility of the WTGs from shore and related effects on land use. BOEM does not anticipate that intermittent nighttime lighting of the WTGs offshore would affect existing land uses onshore given the use of ADLS and the existing developed areas within the geographic analysis area. At onshore facilities, security lighting would be down shielded to mitigate light pollution (VIS-04; COP Volume II, Table 1.1-2; Ocean Wind 2023). Nighttime lighting from the onshore substations has the potential to affect the use of adjacent properties; however, the proposed onshore substations would be constructed in areas where land development regulations, such as zoning and land use plan designations, allow and would be consistent with such use. As a result, WTG lighting and lighting of onshore infrastructure for the Proposed Action alone would have a long-term, continuous, minor impact on land use and coastal infrastructure in the geographic analysis area.

Port utilization: The Proposed Action does not include port expansion activities, but would use ports that have expanded or would expand to support the wind energy industry generally. For instance, the State of New Jersey is planning to build an offshore wind port on the eastern shore of the Delaware River in Lower Alloways Creek, Salem County, approximately 7.5 miles southwest of the city of Salem (New Jersey Wind Port 2021). Additionally, the State of New Jersey announced a $250 million investment in a

[1] The Proposed Action would not directly require any upgrades to port infrastructure, but would make productive use of existing ports.

manufacturing facility to build steel components for offshore wind turbines at the Port of Paulsboro on the Delaware River in New Jersey (State of New Jersey 2020). Construction on the facility began in January 2021, with production anticipated to begin in 2023. Both of these activities are separate from the Proposed Action and the potential impacts resulting from these port enhancements are evaluated in their own environmental permitting processes.

Land uses and coastal infrastructure affected by construction of offshore components would include temporary construction ports, including Atlantic City, New Jersey for the construction management base; Paulsboro, New Jersey or Europe for foundation scope; Hope Creek, New Jersey or Norfolk, Virginia for WTG scope; and Port Elizabeth, New Jersey, Charleston, South Carolina, or Europe for cable staging. These ports are expected to be used during construction but have independent utility and would not be dedicated to the Project. Proposed uses at existing port facilities would be consistent with the current land uses occurring at these locations and are not expected to result in changes to land use or zoning.

Ocean Wind would use the regional onshore O&M facility in Atlantic City, New Jersey. O&M of the Proposed Action’s offshore components would require daily activity at the O&M facility in Atlantic City. The increased activity within Atlantic City’s port and nearby areas zoned for business and industrial uses would be consistent with the land use character of Atlantic City’s harbor, town center, and business areas, and would provide a source of investment in the coastal infrastructure (COP Volume II, Section 2.4.1; Ocean Wind 2023).

Activities associated with Proposed Action construction would generate noise, vibration, and vehicular traffic at the ports temporarily used for construction described above. These impacts are typical for industrial ports and would not hinder other nearby land uses or use of coastal infrastructure. Overall, the construction and installation of offshore components, O&M, and decommissioning for the Proposed Action alone would have minor beneficial impacts on land use and coastal infrastructure by supporting designated uses and infrastructure improvements at ports.

Presence of structures: Portions of all the Proposed Action WTGs could be visible from certain coastal and elevated areas of the geographic analysis area mainland, depending upon vegetation, topography, and atmospheric conditions. Most WTGs would be approximately 15 miles (24.1 kilometers) from the coastal viewers and the WTGs would not dominate offshore views, even when weather and atmospheric conditions allow views. The Proposed Action alone would have a long-term, continuous, negligible impact on land use and coastal infrastructure in the geographic analysis area because while WTGs would be visible onshore, their presence is not anticipated to result in changes to land use or zoning.

The Proposed Action has two offshore export cable routes, BL England and Oyster Creek, and multiple potential landfall locations in Ocean Township, Lacey Township, Ocean City, and Upper Township. The Oyster Creek export cable is expected to make landfall in either Lacey Township or Ocean Township, and the BL England export cable is expected to make landfall in Ocean City, New Jersey. At the potential landfall sites, the Oyster Creek route would travel west across undeveloped land, taking advantage of previously disturbed areas where possible, before following abandoned roadways associated with an existing confined disposal facility. Land that is currently undeveloped would be permanently affected due to the construction of Project components such as TJBs, duct bank, or substations. These impacts would be minimized by using land zoned for commercial or industrial development, or restoring areas to pre-disturbed conditions following construction and by following existing berms, paths, trails, and roadways where possible (COP Volume II, Section 2.3.5.2; Ocean Wind 2023). After making landfall in Ocean City, the BL England route would follow local roads west, cross Peck Bay at Roosevelt Boulevard Bridge, a currently undeveloped area, via trenchless technology methods, and then continue on existing county road right-of-way to the substation property at the decommissioned BL England Generating Station (COP, Volume III, Appendix L; Ocean Wind 2023). The onshore portion of the Oyster Creek cable route would be up to 5.3 miles, with approximately 200 feet of overhead tie-line to connect into the onshore substation. The onshore portion of the BL England cable route would be up to 8 miles, with approximately 100 feet of overhead tie-line to connect to the onshore substation. Ocean Wind would coordinate and obtain crossing agreements for the crossings of utilities, roadways, bridges, and railroads. Because the export cable routes would follow mostly existing road rights-of-way, there would be minimal impacts on existing land uses. Where the offshore export cables cross currently undeveloped areas, there would be a permanent conversion of land to utility right-of-way or easement.

The proposed Oyster Creek substation would occupy up to 31.5 acres (127,476 m^2) and be sited on the former Oyster Creek nuclear plant in Lacey Township, which was retired in 2018 and is in the process of decommissioning. The proposed BL England substation would occupy up to 13 acres (52,609 m^2) and be sited on a former coal, oil, and diesel plant in Upper Township. Because both Oyster Creek and BL England substations would be sited on previously developed sites, there would be no changes to existing land uses. The new substations would be consistent with the existing industrial uses of the two sites.

Onshore construction is expected to result in temporary or permanent impacts on local residents, businesses, and the community along the proposed onshore export cable routes during the construction period. Landfall construction methods would minimize land use impacts and areas would be restored to their previous condition after construction. Temporarily increased noise levels, lighting, and traffic during construction may affect local sensitive receptors (e.g., schools, medical facilities), but would be minimized through BMPs and would not change existing land uses. Ocean Wind has committed to implementing a construction schedule to minimize activities in the onshore export cable route during the peak summer recreation and tourism season and to coordinate with local municipalities to minimize impacts on popular events in the area during construction, to the extent practicable (REC-01 and REC-02; COP Volume II, Table 1.1-2; Ocean Wind 2023). These APMs would minimize impacts on tourism from construction activities.

Land disturbance: The refined Oyster Creek onshore export cable route is a straightened route that would make landfall and travel west, taking advantage of previously disturbed areas where possible along the Holtec property (Figure 2-2). The crossing of Oyster Creek and Route 9 would be conducted using trenchless technology methods to an existing private road, and the route would continue within the existing private road to the Oyster Creek onshore substation. Additional Oyster Creek onshore export cable route options include a route that would make landfall and travel west across undeveloped land, taking advantage of previously disturbed areas where possible, before following abandoned roadways associated with the existing confined disposal facility and Holtec property. In order to minimize potential impacts on wetlands and vegetation, the route would follow existing berms, paths, and trails where practical; however, where this is not possible and land cannot be returned to previous conditions, permanent conversion from undeveloped land to easement land use would occur. The route would then follow existing roadways, State Route 9, and a private road to the substation parcel. The crossing of Oyster Creek could be conducted using trenchless technology methods or by an independent utility bridge (existing Route 9 bridge or new construction). Under this route option, no impacts on the existing confined disposal facility are expected, as disturbance would be limited to the facility's abandoned roadways.

Depending on the landfall location, the BL England onshore export cable route would follow the existing right-of-way of either 5th Street, 13th Street, or 35th Street in Ocean City to 35th Street, then would travel within existing right-of-way of local roads west, would cross Peck Bay at Roosevelt Boulevard Bridge via trenchless technology methods, then would continue on existing county road right-of-way for Roosevelt Boulevard, turning north on Route 9 to the BL England onshore substation property (Figure 2-3).

The Proposed Action's onshore export cable infrastructure would be installed underground in a duct bank, generally along, under, or adjacent to existing roads or utility right-of-way. Where feasible, trenchless technologies, such as HDD, may be used to minimize impacts on land disturbance, including at the crossing of Island Beach State Park and Route 9 along the Oyster Creek cable route and next to the bridge on Roosevelt Boulevard along the BL England cable route. Installation of the cable landfall sites and underground cable routes would temporarily disturb neighboring land uses through construction noise, vibration, dust, and travel delays along the affected roads. These impacts are anticipated to last for the duration of construction; following construction, the cable route corridors would be returned to their previous condition and use. The corridors would be maintained through regular vegetation trimming and herbicide application. Installation of the cables would occur within a 50-foot-wide temporary construction corridor. Based on the landfall options with the longest onshore cable routes, construction of the Oyster Creek onshore export cable could result in up to 32 acres of temporary disturbance, and construction of the BL England onshore export cable could result in up to 48 acres of temporary disturbance. O&M would not result in land disturbance except in the event that cable maintenance or replacement is required. Land use impacts would be minimized by using existing rights-of-way, co-locating Project components, utilizing land that is primarily zoned for commercial or industrial development, or restoring areas to pre-disturbed conditions following construction (COP Volume II, Section 2.3.5.2.1; Ocean Wind 2023).

The construction of the onshore substations would result in temporary and permanent impacts due to construction and the use of temporary construction workspace. Construction of the onshore substation would require a permanent site, including area for the substation equipment and buildings, equipment yards, energy storage, stormwater management, a parking area, an access road, and landscaping. However, the facilities would be consistent with surrounding land uses. The BL England substation would be in Upper Township, New Jersey in the Waterfront Town Center zoning district. Per the town zoning code, electrical substations are a permitted conditional use, and therefore would be authorized subject to conditions to ensure compatibility of surrounding land uses (Township of Upper 2020, 2021). Oyster Creek substation would be in Lacey Township, New Jersey and would be within an industrial zoning district (Township of Lacey 2009). In combination with federal, state, and local government agencies, academic institutions, non-governmental organizations, and businesses, the Barnegat Bay Partnership has established a Comprehensive Conservation and Management Plan for the Barnegat Bay-Little Egg Harbor Estuary. The plan identifies a land use goal to improve and sustain collaborative regional approaches to responsible land use planning and open space preservation in the watershed that protect and improve soil function(s), water quality, water supply, and living resources. The activities for the Proposed Action are consistent with the plan, as no conversion of open space is anticipated for the Oyster Creek substation. Additional information on potential impacts on water and living resources can be found in Section 3.21, *Water Quality*, and Section 3.8, *Coastal Habitat and Fauna*. Due to the locations and zoning, potential impacts on land use would be minor. Upgrades to the electrical transmission grid may be needed for interconnection; however, those upgrades would be consistent with the existing land use. This would have localized, short-term, minor impacts on land use and coastal infrastructure (COP Volume I, Section 6.2, and Volume II, Section 2.3.5.2.1; Ocean Wind 2023).

Noise: The Proposed Action would comply with NJDEP noise regulations and local noise regulations, to the extent practicable, to minimize impacts on nearby communities (SOC-01; COP Volume II, Table 1.1-2; Ocean Wind 2023). Typical construction equipment ranges from a generator or refrigerator unit at 73 dBA at 50 feet to an impact pile driver at 101 dBA at 50 feet. As the Proposed Action would be built 15 miles offshore, noise effects from offshore construction noise would be temporary and negligible (COP Volume III, Appendix R, Section 2.5; Ocean Wind 2023). 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 (COP Volume II, Table 1.1-2; Ocean Wind 2023). Temporarily increased noise levels during construction may affect local sensitive receptors (such as religious locations, recreational areas, schools, and other places that are particularly sensitive to construction) but would be minimized through BMPs and would not change existing land uses.

3.14.5.2. Cumulative Impacts of the Proposed Action

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

Accidental releases: The Proposed Action would contribute a noticeable increment to the cumulative accidental release impacts on land use and coastal infrastructure. The increased risk of and thus the potential impacts from accidental releases of fuel/fluids/hazardous materials in the geographic analysis area would result in localized, short-term, negligible to minor impacts on land use and coastal infrastructure.

Lighting: As stated in Section 3.20, *Scenic and Visual Resources*, offshore nighttime construction lighting and operational aviation hazard lighting for portions of 859 WTGs associated with the Proposed Action and other offshore wind projects could be visible from some shorelines depending on vegetation, topography, weather, and atmospheric conditions. The land use impacts from the Proposed Action in the context of planned activities (i.e., other offshore wind development) would be similar to, but more extensive than, the impacts for the Proposed Action alone. Nevertheless, the Proposed Action would contribute a noticeable increment to the cumulative WTG lighting impacts on land use and coastal infrastructure, which would be continuous, long term, and negligible to minor.

Port utilization: The cumulative impacts of port utilization from the Proposed Action on land use and coastal infrastructure would be minor beneficial. Offshore wind development, including the Proposed Action, would require port facilities for shipping, berthing, and staging, and development activities would support ongoing or new activity at authorized ports.

Presence of structures: The Proposed Action would contribute a noticeable increment to the cumulative onshore transmission cable infrastructure impacts and the presence of structures on land use and coastal infrastructure, which are anticipated to be minor. Assuming that new substations for offshore wind projects would be in locations designated for industrial or utility uses, and underground cable conduits would primarily be co-located with roads or other utilities, operation of substations and cable conduits would not affect the established and planned land uses for a local area.

Land disturbance: Localized, short-term, and minor cumulative impacts on land use and coastal infrastructure due to construction-related disturbance and access limitations along the export cable routes are expected. Impacts on land use and coastal infrastructure from land disturbance would be additive only if land disturbance associated with one or more other projects occurs in close spatial and temporal proximity.

Noise: Construction of other offshore wind projects is not anticipated to occur within the geographic analysis area. The Proposed Action would contribute a noticeable increment to the cumulative noise impacts on land use and coastal infrastructure, which are anticipated to be localized, short term, and minor.

3.14.5.3. Conclusions

Impacts of the Proposed Action. BOEM anticipates that impacts on land use and coastal infrastructure from the Proposed Action would be **minor** adverse with **minor beneficial** impacts. The Proposed Action would have minor beneficial impacts resulting from port utilization, minor impacts resulting from land disturbance during onshore installation of the cable route and substation, and negligible to minor impacts resulting from accidental spills. Noise and traffic from onshore construction would have localized, short-term, minor impacts on land use and coastal infrastructure.

Cumulative Impacts of the Proposed Action. The incremental contribution by the Proposed Action to the cumulative impacts on land use and coastal infrastructure would be noticeable. BOEM anticipates that the cumulative impacts on land use and coastal infrastructure in the geographic analysis area associated with the Proposed Action would be **minor** adverse and **minor beneficial**. The main drivers for this impact rating are the beneficial impacts of port utilization, minor impacts on the viewshed due to the presence of offshore structures, and minor impacts of land disturbance. The Proposed Action would contribute to the cumulative impact rating primarily through short-term impacts from onshore landfall, cable, and substation installation, as well as beneficial impacts due to the use of port facilities designated for offshore wind activity.

3.14.6 Impacts of Alternatives B, C, and D on Land Use and Coastal Infrastructure

Impacts of Alternatives B, C, and D. The impacts of Alternatives B-1, B-2, C-1, C-2, and D on land use and coastal infrastructure would be the same as those of the Proposed Action for all impacts except for the impact of accidental releases, light, port utilization, and the presence of structures. Alternatives B-1, B-2, and D would install fewer WTGs (up to 9 fewer WTGs for Alternative B-1; up to 19 fewer WTGs for Alternative B-2; up to 15 fewer for Alternative D), which would slightly reduce the construction impact footprint and installation period. Alternative C-1 would relocate eight WTGs, and Alternative C-2 would compress the WTG array layout. Each of these alternatives would slightly modify the visibility of the WTGs from coastal and elevated onshore areas in the geographic analysis area, but there would be an overall negligible difference as compared to the Proposed Action (Section 3.20). Because there would be fewer WTGs under these alternatives, there would be less potential for contamination from unforeseen spills or accidents, less light being omitted from offshore, and less need for port facilities for shipping, berthing, and staging. However, under all of these alternatives, the majority of the WTGs would still be visible and there would be no meaningful difference in impacts on land use and coastal infrastructure.

Cumulative Impacts of Alternatives B, C, and D. The incremental impacts contributed by Alternatives B, C, and D to the cumulative impacts on land use and coastal infrastructure would be similar to those of the Proposed Action and would contribute a noticeable increment.

3.14.6.1. Conclusions

Impacts of Alternatives B, C, and D. Alternatives B-1, B-2, C-1, C-2, and D would result in slightly reduced impacts on land use and coastal infrastructure compared to the Proposed Action, but the overall impact magnitude would remain the same. Alternatives B-1 and B-2 would result in slightly reduced visual impacts of WTGs on coastal communities by removing the WTGs closest to those coastal communities. Alternatives C-1, C-2, and D would relocate and remove WTGs but the visual effects would not be noticeable. Because there would be fewer WTGs constructed, Alternatives, B, C, and D would all result in reduced port utilization compared to the Proposed Action, along with reduced associated noise and traffic impacts, and accidental releases, but there would be no change to the overall impact magnitudes. Impacts on land use and coastal infrastructure would be **minor** adverse with **minor beneficial** impacts. Impact ratings associated with individual IPFs would not change.

Cumulative Impacts of Alternatives B, C, and D. The impacts contributed by Alternatives B-1, B-2, C-1, C-2, and D to the cumulative impacts on land use and coastal infrastructure would be the same as those of the Proposed Action, and would contribute a noticeable increment. BOEM anticipates that the cumulative impacts on land use associated with Alternatives B-1, B-2, C-1, C-2, and D would be very similar to those of the Proposed Action: **minor** adverse impacts and **minor beneficial** impacts. This impact rating is primarily driven by impacts from installation of onshore infrastructure and port utilization, which would not change among alternatives.

3.14.7 Impacts of Alternative E on Land Use and Coastal Infrastructure

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park.

Impacts of Alternative E. The impacts of Alternative E on land use and coastal infrastructure would be the same as those of the Proposed Action for all impacts except for land disturbance, traffic, and noise associated with the modifications made to the Oyster Creek export cable route to minimize impacts on SAV in Barnegat Bay.

Land disturbance: Alternative E would limit the onshore portion of the Oyster Creek export cable route on Island Beach State Park to the northern export cable route option. The export cable would make landfall within an auxiliary parking lot of Swimming Area 2 on Island Beach State Park and then continue north within parking lots, then turn northwest under Shore Road before entering Barnegat Bay. Construction of the northern export cable route option would increase the area of temporary disturbance by 2.2 acres compared to the southern export cable route option under the Proposed Action. The land use in the additional temporary disturbance area is characterized as low-intensity developed (Kleiner 2021). The impact of Alternative E would be limited to Island Beach State Park. Trenching and installation activities to bury the cable would temporarily disturb wetlands and vegetation on the barrier island and potentially interfere with recreational activities in the state park. After construction, the right-of-way would be restored to pre-disturbance conditions and long-term effects would not be anticipated.

Traffic: Cable installation on Island Beach State Park within the roadway would result in temporary traffic impacts such as lane closures, shifted traffic patterns, or closed roadways and parking areas. Central Avenue/Shore Road is the only north-south through road on the barrier island, so road closures would restrict access to the southern portion of the island. Roadways would be returned to pre-construction conditions and would not result in changes to the existing land use.

Noise: Alternative E would involve more onshore construction activities such as open trench excavation and trenchless technologies such as HDD or direct pipe for cable installation as a result of the longer onshore export cable route. Under Alternative E as under the Proposed Action, land use impacts would be minimized through the use of existing rights-of-way, co-locating Project components, and restoring some areas to pre-disturbed conditions following construction. While the northern export cable route option would likely result in extended construction with potentially increased impacts on noise and traffic, the overall impacts of construction would be of the same magnitude as those of the Proposed Action.

Cumulative Impacts of Alternative E. The incremental impacts contributed by Alternative E to the impacts on land use and coastal infrastructure from ongoing and planned activities including offshore wind would be noticeable.

3.14.7.1. Conclusions

Impacts of Alternative E. Alternative E would slightly increase the onshore portion of the Oyster Creek export cable route, resulting in increased impacts on land use associated with temporary construction activity compared to the Proposed Action. The overall impact magnitudes would be the same because the cable corridors would follow existing right-of-way and the primary impacts would be limited to the duration of construction. Impacts on land use and coastal infrastructure would be **minor** adverse with **minor beneficial** impacts. Impact ratings associated with individual IPFs would not change.

Cumulative Impacts of Alternative E. The incremental impacts contributed by Alternative E to the cumulative impacts on land use and coastal infrastructure would be the same as those of the Proposed Action and would be noticeable. BOEM anticipates that the cumulative impacts associated with

Alternative E would be very similar to those of the Proposed Action: **minor** adverse impacts and **minor beneficial** impacts. This impact rating is primarily driven by impacts from installation of onshore infrastructure and port utilization, which would not change among alternatives.

3.14.8 Proposed Mitigation Measures

A measure is proposed to minimize impacts on land use and coastal infrastructure (Appendix H, Table H-3). If the measure analyzed below is adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced.

Table 3.14-2 Additional Proposed Measures (Also Identified in Appendix H, Table H-3): Land Use and Coastal Infrastructure

Measure	Description	Effect
Vibration monitoring/ structure monitoring	Ocean Wind will be required to implement vibration monitoring/structure monitoring for onshore activities including, but not limited to, infrastructure, bridges, businesses, homes, and drainage structures.	While adoption of vibration monitoring would reduce risks to coastal infrastructure and improve accountability under the Proposed Action, it would not alter the impact determination of minor for land disturbance.

3.14.8.1. Measures Incorporated in the Preferred Alternative

BOEM has not identified any additional measures in Table 3.14-2 to be incorporated in the preferred alternative.

This page intentionally left blank.

3.19. 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 sea turtle geographic analysis area, as shown on Figure 3.19-1, encompasses two LMEs, namely the Northeast U.S. OCS and Southeast U.S. OCS LMEs. These LMEs capture most of the movement range of sea turtles within the U.S. Atlantic Ocean waters. Due to the 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).

3.19.1 Description of the Affected Environment for Sea Turtles

Four species of sea turtles are known to occur in or near the Ocean Wind Project area, all of which are protected under the ESA (16 USC 1531 et seq.). These include the leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), Kemp's ridley sea turtle (*Lepidochelys kempii*), and green sea turtle (*Chelonia mydas*). A fifth species, the hawksbill sea turtle (*Eretmochelys imbricata*), occurs in the larger geographic analysis area but is very unlikely to occur in the Project area because it typically inhabits tropical waters. While it has been recorded in New England during the summer (Lazell 1980), there are no sightings of hawksbill sea turtle currently documented within Atlantic coastal waters off New Jersey (Conserve Wildlife Foundation of New Jersey 2021). Therefore, this species is not considered further. Table 3.19-1 lists the four sea turtle species and DPS that could occur in the North Atlantic coastal waters offshore New Jersey, and provides the listing status and likelihood of occurrence in the Project area.

Sea turtles inhabit tropical and subtropical seas throughout the world. In coastal U.S. Atlantic waters, sea turtles are seasonally distributed, migrating to and from habitats extending from Florida to New England, with overwintering concentrations in southern waters and nesting sites on southern beaches from Virginia south through Florida. There is potential for the four sea turtle species to seasonally inhabit offshore waters in the Project area in the spring (March–May), summer (June–August), and fall (September–November), including the area of direct effects during the winter months (December–February). Water temperature is a primary factor influencing sea turtle distribution; sea turtles typically occur in the coastal waters off New Jersey when water temperatures exceed 59°F (NJDEP 2010). Sea turtles in the North Atlantic migrate north from warmer South Atlantic waters in the spring (May and June) to take advantage of abundant prey in warming northeastern waters, including both the OCS and inshore embayments and estuaries. Sea turtles return to southern waters as water temperatures decline in the fall and are unlikely to be present in the Project area after November 30. However, not all sea turtles leave the area during winter and there are occasional strandings of sea turtles that become incapacitated or "cold-stunned" at water temperatures below 50°F (NJDEP 2010 citing Mrosovsky 1980).

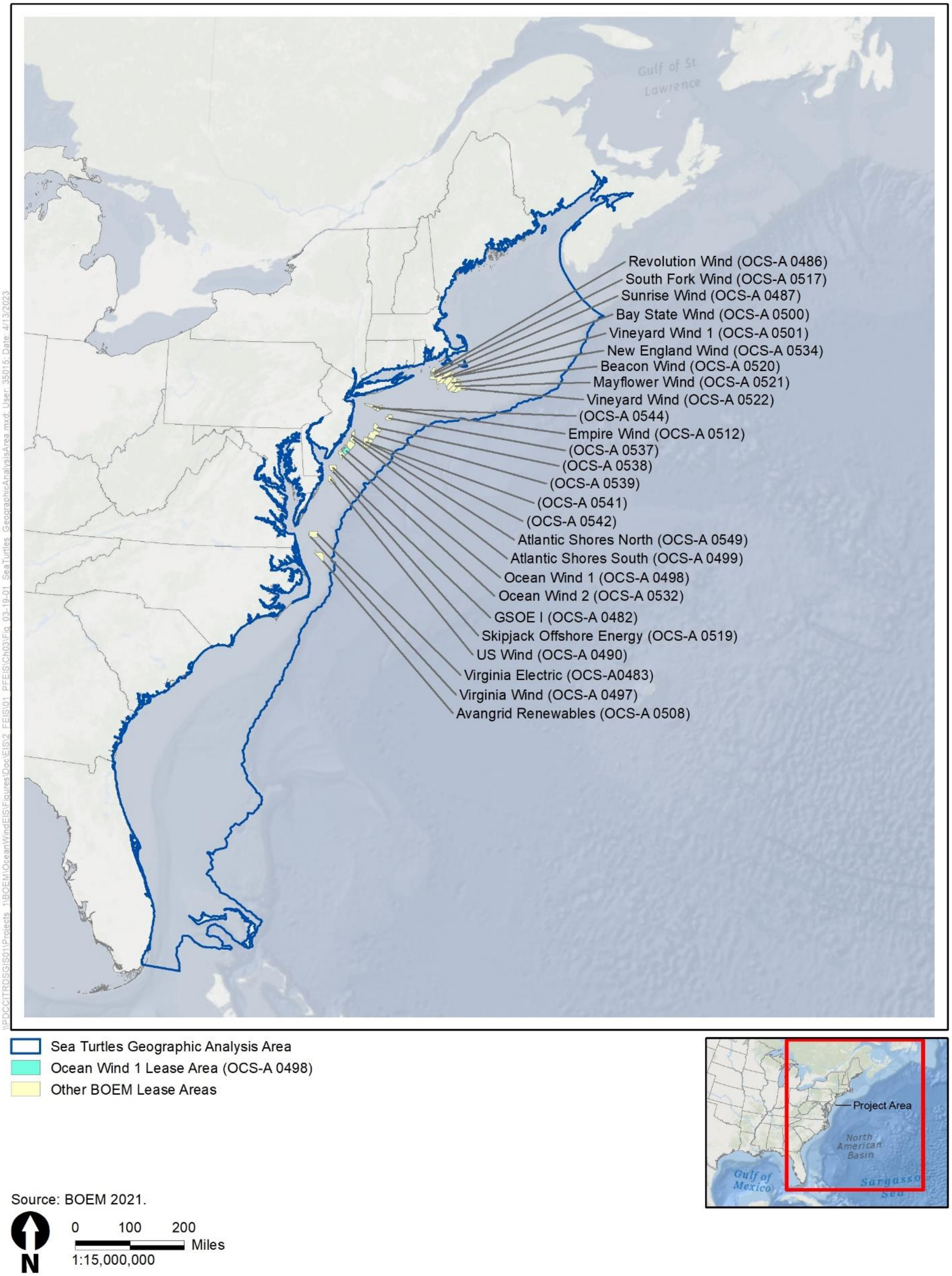


Figure 3.19-1 Sea Turtles Geographic Analysis Area

Table 3.19-1 Sea Turtle Species that May Potentially Occur in the Project Area

Common Name	Scientific Name	DPS	ESA Status[1]	Frequency of Occurrence in New Jersey	Seasonal Occurrence in Project Area	Likelihood of Occurrence in Project Area
Leatherback sea turtle	*Dermochelys coriacea*	Not applicable[2]	E	Common	May to November[3]	Likely
Loggerhead sea turtle	*Caretta caretta*	Northwest Atlantic	T	Common	May to November[3]	Likely
Kemp's ridley sea turtle	*Lepidochelys kempii*	Not applicable	E	Uncommon	May to November[3]	Likely
Green sea turtle	*Chelonia mydas*	North Atlantic	T	Uncommon	May to November[3]	Likely

Sources: NMFS 2021a; NJDEP 2006, 2010
[1] ESA status: E = Endangered, T = Threatened
[2] NMFS and USFWS have not designated DPSs for leatherback sea turtles because the species is listed as endangered throughout its global range (85 *Federal Register* 48332).
[3] May to November is the primary season, but each species can occur beyond these months (see text).

Sea turtle nesting does not occur in New Jersey and there are no nesting beaches or designated critical habitat in the vicinity of the Project (GARFO 2021). Individuals occurring in the Project area are either migrating or foraging, and are likely to spend the majority of time below the surface. Sea turtles can remain underwater for extended periods, ranging from several minutes to several hours, depending on factors such as daily and seasonal environmental conditions and specific behavioral activities associated with dive types (Hochscheid 2014; NSF and USGS 2011). Such physiological traits and behavioral patterns allow them to spend as little as 3 to 6 percent of their time at the water's surface (Lutcavage and Lutz 1997). These adaptations are important because sea turtles often travel long distances between their feeding grounds and nesting beaches (Meylan 1995).

The combination of sightings, strandings, and bycatch data provides the best available information on sea turtle distribution in the Project area. This section summarizes data for each of the four sea turtle species from shipboard and aerial surveys of New Jersey's offshore wind study area (NJDEP 2010), NMFS AMAPPS (Palka et al. 2017, 2021), NMFS Sea Turtle Stranding and Salvage Network (STSSN) (NMFS 2021a), and recent and historic population or density estimates from NMFS, the Department of the Navy, and the New York State Energy Research and Development Authority, where available. A total of 34 sea turtles were recorded in the Project area vicinity during the summer 2017 HRG survey, including 9 loggerhead, 3 green, and 22 unidentified sea turtle species (Alpine 2017), and 4 sea turtles were recorded within the Wind Farm Area during the Geotechnical 1A Survey in winter 2017–2018, including 2 loggerhead and 2 unidentified sea turtles (Smultea Environmental Sciences 2018).

Population dynamics and habitat use of different sea turtle species along the New Jersey shore is still poorly understood. Sea turtles are wide-ranging and long-lived, making population estimates difficult, and survey methods vary depending on species (TEWG 2007; NMFS and USFWS 2013, 2015a, 2015b). Because sea turtles have large ranges and highly migratory behaviors, the current condition and trend of sea turtles are affected by many factors beyond the geographic analysis area.

Sea turtles in the geographic analysis area are subject to a variety of ongoing human-caused impacts, including collisions with vessels, entanglement with fishing gear, fisheries by-catch, dredging, anthropogenic noise, pollution, disturbance of marine and coastal environments, effects on benthic habitat, accidental fuel leaks or spills, waste discharge, and climate change. Sea turtle migrations can cover long distances, and these factors can have impacts on individuals over broad geographical scales. The *Atlantic OCS Proposed Geological and Geophysical Activities: Final Programmatic Environmental Impact Statement* (BOEM 2012), incorporated here by reference, provides further details about each species' range and distribution, population status, ecology and life history, and conservation and management.

Leatherback Sea Turtle: The leatherback sea turtle is the largest and the most widely distributed sea turtle species, ranging broadly from tropical and subtropical to temperate regions of the world's oceans (NMFS and USFWS 1992). Individuals in the Project area belong to the Northwest Atlantic population, which is one of seven leatherback populations globally. The species was listed as endangered under the ESA in 1970 (35 *Federal Register* 8491), inclusive of all populations.[1] Unlike the other three sea turtle species, the leatherback does not use shallow waters to prey on benthic invertebrates or sea grasses. Leatherbacks are highly pelagic in nature, but are also commonly observed in coastal waters along the U.S. OCS (NMFS and USFWS 1992). They feed almost exclusively on jellyfish, siphonophores, and salps (Eckert et al. 2012; NMFS and USFWS 2020). Leatherback sea turtles dive the deepest of all sea turtles to forage and are more tolerant of cooler oceanic temperatures than other sea turtles. In a study tracking 135 leatherbacks fitted with satellite tracking tags, leatherbacks were identified to inhabit waters

[1] NMFS and USFWS have not designated DPSs for leatherback sea turtles because the species is listed as endangered throughout its global range (85 *Federal Register* 48332).

with sea surface temperatures ranging from 52°F to 89°F (Bailey et al. 2012). The study also found that oceanographic features such as mesoscale eddies, convergence zones, and areas of upwelling attracted foraging leatherbacks because these features are often associated with aggregations of jellyfish. In 2007, the population of nesting females in the Northwest Atlantic was estimated at 4,800 to 11,000 (TEWG 2007). NMFS and USFWS (2020) concluded that the Northwest Atlantic population has a total index of nesting female abundance of 20,659 females with a decreasing nest trend at nesting beaches with the greatest known nesting female abundance. During visual aerial and shipboard abundance surveys conducted under AMAPPS I (2010 to 2014) and AMAPPS II (2014 to 2019), approximately 6 percent were positively identified as leatherback sea turtles. Leatherbacks were detected in the vicinity of the Project area during summer and fall (June through November), but not during winter and spring (December through May). The majority of leatherbacks tagged by AMAPPS research have remained in Atlantic OCS waters from North Carolina up the mid-Atlantic shelf and into southern New England and the Gulf of Maine (Palka et al. 2021). From 2010 through 2020, the STSSN reported 12 offshore and six inshore leatherback sea turtle strandings within Zone 39, which encompasses southern New Jersey (NMFS 2021a). During NJDEP (2010) aerial and shipboard surveys for marine mammals and sea turtles, sightings included a total of 12 leatherback sea turtles in waters ranging from 59 to 98 feet deep, with a mean depth of 79 feet. Sightings were recorded from 6.4 to 22.5 miles from shore, with a mean distance of 17.8 miles. The sea surface temperatures associated with leatherback sea turtle sightings ranged from 64.6°F to 68.5°F with a mean temperature of 66.2°F. Leatherback sea turtles undergo extensive migrations in the western North Atlantic and usually start arriving along the New Jersey coast in late spring/early summer (Shoop and Kenney 1992; James et al. 2006). A surrogate density estimate was calculated using the results from New York State Energy Research and Development Authority's surveys across the New York offshore planning area by Normandeau Associates and APEM (2018a, 2018b, 2019a, 2019b, 2020). The estimated leatherback sea turtle density during the fall, the season with the highest density, was 0.789 turtle per 100 km^2, which translates to around three leatherback sea turtles within the Project area (Table 3.19-2). Another density estimate is available from the Navy OPAREA Density Estimates model for the Atlantic Ocean, which estimates sea turtle density each season based on habitat variables (e.g., sea surface temperature, seafloor depth) (Navy 2007) and indicates that the density of leatherback sea turtles in the Project area during fall ranges from 2.675 to 3.745 animals per 100 km^2. That equates to a higher density of approximately 7 to 11 leatherback sea turtles within the 68,450-acre Wind Farm Area. Based on this information, BOEM expects leatherback sea turtles to be common in New Jersey and likely in the Project area from May to November (Table 3.19-1).

Table 3.19-2 Sea Turtle Density Estimates Derived from New York State Energy Research and Development Authority Annual Reports

Common name	Density (animals/100 km^2)			
	Spring (March–May)	Summer (June–August)	Fall (September–November)	Winter (December–February)
Leatherback sea turtle	0	0.331	0.789	0
Loggerhead sea turtle	0.254	26.799	0.19	0.025
Kemp's ridley sea turtle	0.05	0.991	0.19	0
Green sea turtle	0	0.038	0	0

Sources: Normandeau Associates and APEM 2018a, 2018b, 2019a, 2019b, 2020.

Loggerhead Sea Turtle: Loggerhead sea turtles range widely and have been observed along the entire Atlantic Coast as far north as Canada (Brazner and McMillan 2008; Ceriani et al. 2014; Shoop and Kenney 1992). Loggerheads in the Project area belong to the Northwest Atlantic DPS, which is listed as threatened under the ESA (76 *Federal Register* 58868). The regional abundance estimate in the

Northwest Atlantic OCS in 2010 was approximately 588,000 adults and juveniles of sufficient size to be identified during aerial surveys (interquartile range of 382,000 to 817,000 [NEFSC and SEFSC 2011]). The three largest nesting subpopulations responsible for most of the production in the western North Atlantic (peninsular Florida, northern United States, and Quintana Roo, Mexico) have all been declining since at least the late 1990s, thereby indicating a downward trend for this population (TEWG 2009). While some progress has been made since publication of the 2008 Loggerhead Sea Turtle Recovery Plan, the recovery units have not met most of the critical benchmark recovery criteria (Bolten et al. 2019).

The loggerhead sea turtle has a powerful beak and crushing jaws specially adapted to feed on hard-bodied benthic invertebrates, including crustaceans and mollusks. Mollusks and crabs are primary food items for juvenile loggerheads (Burke et al. 1993). Although loggerheads are dietary specialists, the species demonstrates the ability to adjust its diet in response to changes in prey availability in different geographies (Ruckdeschel and Shoop 1988; Plotkin et al. 1993). For example, loggerheads in the Gulf of Mexico feed primarily on crabs, but sea pens are also a major part of the diet. Loggerheads in Chesapeake Bay, Virginia, primarily targeted horseshoe crabs (*Limulus polyphemus*) in the early to mid-1980s but subsequently shifted their diet to blue crabs in the late 1980s, and then to finfish from discarded fishery bycatch in the mid-1990s (Seney and Musick 2007).

Winton et al. (2018) reported that loggerheads tagged within the Northwest Atlantic primarily restrict their summertime distribution to OCS waters and occasionally make excursions inshore to bays and estuaries. Core habitat includes sea surface temperatures from 59.0°F to 82.4°F and at depths between 26.3 and 301.8 feet, and the highest probability of occurrence occurs in regions with sea surface temperatures from 63.9°F to 77.5°F and at depths between 85.6 and 243.5 feet (Patel et al. 2021). Studies have indicated that the Mid-Atlantic Bight of the Atlantic OCS, where the Project area occurs, is an important a seasonal foraging ground for approximately 40,000 to 60,000 juvenile and adult loggerheads during summer months (NEFSC and SEFSC 2011). Satellite telemetry data indicate that potentially 30 to 50 percent of loggerheads that nest and reside along the U.S. eastern seaboard seasonally forage within the Mid-Atlantic Bight (Winton et al. 2018; Patel et al. 2021). Spatial models developed by Winton et al. (2018) based on satellite-tagged turtles demonstrate that the Project occurs within an area of medium to high relative density of loggerheads from May through October; higher densities are predicted to occur farther offshore to the east of the Project (NROC 2023). AMAPPS surveys reported that loggerhead sea turtles are by far the most commonly sighted sea turtles on the Atlantic OCS waters from New Jersey to Nova Scotia, Canada, with 47 percent of all sea turtle observations being positively identified as loggerheads (Palka et al. 2021). Loggerheads were detected in the Project vicinity during spring (March through May) and summer and fall (March through November) but not during winter months (December through February) (Palka et al. 2021).

The NJDEP (2010) aerial and shipboard surveys recorded a total of 615 loggerhead sea turtle sightings between January 2008 and December 2009. The loggerhead sea turtle was the second most frequently sighted species during the survey and the vast majority of sightings were during the summer (NJDEP 2010). From 2010 through 2020, STSSN reported 139 offshore and 74 inshore loggerhead sea turtle strandings within Zone 39, which encompasses southern New Jersey (NMFS 2021a). Loggerheads are stranded far more often than other sea turtles in New Jersey (NMFS 2021a), as they have a higher relative abundance. New York State Energy Research and Development Authority reported that, in the New York offshore planning area, most of the sea turtles recorded were loggerhead sea turtles, by an order of magnitude. The estimated density of loggerhead sea turtles was greatest during summer (26.779 turtles per 100 km^2), followed by fall with approximately 74 animals within the Project area (0.1 turtle per 100 km^2) (Table 3.19-2) (Normandeau Associates and APEM 2018a, 2018b, 2019a, 2019b, 2020). Additionally, the Navy (2007) OPAREA Density Estimates models predict that the density of loggerhead sea turtles in the Project area during summer ranges from 3.608 to 7.955 animals per 100 km^2, which equates to approximately 10 to 22 loggerhead sea turtles within the 68,450-acre Wind Farm Area.

Collectively, available information indicates that loggerhead sea turtles are expected to occur commonly as adults, subadults, and juveniles from the late spring through fall, with the highest probability of occurrence from July through September. Based on this information, BOEM expects loggerhead sea turtles to be common in New Jersey and likely within the Project area from May to November (Table 3.19-1).

Kemp's Ridley Sea Turtle: The Kemp's ridley sea turtle is one of the smallest sea turtle species and is most commonly found in the Gulf of Mexico and along the U.S. Atlantic Coast. Juvenile and subadult Kemp's ridley sea turtles are known to travel as far north as Cape Cod Bay during summer foraging (NMFS et al. 2011). All Kemp's ridley sea turtles belong to a single population that is endangered under the ESA (35 *Federal Register* 183290). The species is primarily associated with habitats on the Atlantic OCS, with preferred habitats consisting of sheltered areas along the coastline, including estuaries, lagoons, and bays (Burke et al. 1994; NMFS 2019) and nearshore waters less than 120 feet deep (Shaver et al. 2005; Shaver and Rubio 2008), although they can also be found in deeper offshore waters. The species is coastally oriented, rarely venturing into waters deeper than 160 feet (50 meters). It is primarily associated with mud sand-bottomed habitats, where primary prey species are found (NMFS and USFWS 2007a). Kemp's ridley sea turtles are generalist feeders that prey on a variety of species, including crustaceans, mollusks, fish, jellyfish, and tunicates, and forage on aquatic vegetation (Carr and Caldwell 1956; Byles 1988; Schmid 1998). However, their preferred diet is crabs (NMFS and USFWS 2007a). The species is also known to ingest natural and anthropogenic debris (Burke et al. 1993, 1994; Witzell and Schmid 2005).

The population was severely reduced prior to 1985 due to intensive egg collection and fishery bycatch, with a low in 1985 of 702 nests counted from an estimated 250 nesting females on three primary nesting beaches in Mexico (NMFS and USFWS 2015a). Recent estimates of the total population of age 2 years and older is 248,307; however, recent models indicate a persistent reduction in survival or recruitment, or both, in the nesting population, suggesting that the population is not recovering to historical levels (NMFS and USFWS 2015a). A total of 20,570 nests were documented in Mexico in 2011. Similar to Mexico, Texas also experienced an increase in the number of nests from 1985 through 2009, but saw a noticeable decline in 2010 when only 141 nests were recorded. The number of nests continues to be low with 199 in 2011, 209 in 2012, 153 in 2013, and 119 in 2014 (NMFS and USFWS 2015a). A record high number of Kemp's ridley sea turtle nests were recorded in 2017 (24,586 in Mexico and 353 in Texas). In 2019 there were 11,090 nests, a 37.61-percent decrease from 2018 and a 54.89-percent decrease from 2017. This decline is typical due to the reproduction biology of the species, as females nest approximately every 2 to 3 years (NPS 2021). Using the standard International Union for Conservation of Nature protocol for sea turtle assessments, the number of mature individuals was recently estimated at 22,341; the assessment concluded the current population trend is unknown (Wibbels and Bevan 2019).

Recent models indicate a persistent reduction in survival or recruitment, or both, in the nesting population, suggesting that the population is not recovering (NMFS and USFWS 2015a). Visual sighting data are limited because this small species is difficult to observe using typical aerial survey methods (Kraus et al. 2016) or because their density is truly low in Atlantic OCS waters. AMAPPS surveys rarely encountered Kemp's ridley sea turtles, with around 1 percent of all sea turtle observations being positively identified as Kemp's ridley. No Kemp's ridley sea turtles were detected in the vicinity of the Project area (Palka et al. 2021). The Marine Mammal Stranding Center in New Jersey rescued an average of 45 Kemp's ridley turtles each year between 1995 and 2005, of which 18 percent had become impinged on power plant grates, 4 percent had been struck by boat propellers, and 20 percent showed signs of other impacts (NJDEP 2006). From 2010 through 2020, STSSN reported 11 offshore and five inshore Kemp's ridley sea turtle strandings within Zone 39, which encompasses southern New Jersey (NMFS 2021a).

Based on surveys by Normandeau Associates and APEM (2018a, 2018b, 2019a, 2019b, 2020) across the New York offshore planning area, the estimated density of Kemp's ridley sea turtles was greatest during the summer (0.991 turtle per 100 km^2) and is approximately three animals within the Project area (see Appendix J, Table J-6). Additionally, the Navy (2007) OPAREA Density Estimates model indicates that the density of Kemp's ridley sea turtles in the Project area during summer ranges from 0 to 0.0186 animal per 100 km^2, which equates to approximately 0 to 1 Kemp's ridley sea turtle within the 68,450-acre Wind Farm Area. Kemp's ridley sea turtles commonly occur in inshore and nearshore New Jersey waters as they migrate to the North Atlantic during May and June and forage for crabs in SAV (Burke et al. 1994). These often are juveniles foraging for food and return to the Gulf of Mexico as coastal waters cool in fall (Ocean Wind 2023). Based on this information, Kemp's ridley sea turtles could occur infrequently as juveniles and subadults from July through September, potentially occurring as late as November. The highest likelihood of occurrence is in coastal nearshore areas adjacent to Ocean City and Barnegat Bay where the offshore export cable is anticipated to make landfall, as they seek protected shallow-water habitats. BOEM expects Kemp's ridley sea turtles to occur in the Project area from May to November.

Green Sea Turtle: Green sea turtles are found in tropical and subtropical waters around the globe. However, juveniles and subadults are occasionally observed in Atlantic coastal waters as far north as Massachusetts (NMFS and USFWS 1991). They are most commonly observed feeding in the shallow waters of reefs, bays, inlets, lagoons, and shoals that are abundant in algae or marine grass (NMFS and USFWS 2007b). They feed on aquatic vegetation and invertebrates, including jellyfish, sponges, sea pens, and pelagic prey (Heithaus et al. 2002; Seminoff et al. 2015). Green turtles do not nest on beaches in the Project area; their primary nesting beaches are in Costa Rica, Mexico, the United States (Florida), and Cuba. Green turtles are commonly associated with drift lines or surface current convergences, which commonly contain floating *Sargassum* capable of providing small turtles with shelter and sufficient buoyancy to raft upon (NMFS and USFWS 1991). They rest underwater in coral recesses, the underside of ledges, and sand-bottom areas that are relatively free of strong currents and disturbance from natural predators and humans.

Green sea turtles in the Project area belong to the North Atlantic DPS, which is listed as threatened under the ESA (81 *Federal Register* 20057). The most recent status review for the North Atlantic DPS estimates the number of female nesting turtles to be approximately 167,424 individuals (NMFS and USFWS 2015b). According to NMFS and USFWS (2015b), nesting trends are generally increasing for this DPS. Because of their association with warm waters, green turtles are uncommonly found in New Jersey waters during the summer, foraging on marine algae and marine grasses (Conserve Wildlife Foundation of New Jersey 2021).

AMAPPS visual aerial and shipboard positively detected low numbers of green sea turtles that displayed similar seasonal migrations as other sea turtles; it reported that green sea turtles composed approximately 4 percent of the 9,455 positively identified sea turtles. Green sea turtles were detected in the vicinity of the Project area during summer and fall (June through November), but not during winter and spring (December through May) (Palka et al. 2021). NMFS STSSN rescued eight green sea turtles between 1995 and 2005, of which six had evidence of human interactions with fishing activities, boat strikes, and impingement on a power plant grate (NJDEP 2006). From 2010 to 2020, STSSN reported seven offshore and two inshore green sea turtle strandings within Zone 39, which encompasses southern New Jersey (NMFS 2021a).

Based on surveys in the New York offshore planning area by Normandeau Associates and APEM (2018a, 2018b, 2019a, 2019b, 2020), the estimated density green sea turtles was greatest during the summer (0.38 turtle per 100 km^2). Fall density estimates were less than one animal within the Project area (see Appendix J, Table J-6). Additionally, the Navy OPAREA Density Estimates data modeled the density of green sea turtles in the Project area during summer with ranges from 0 to 2.338 animals per 100 km^2 (Navy 2007). This translates to approximately 0 to 6 green sea turtles within the 68,450-acre Wind Farm Area. Based on this information, the occurrence of green sea turtles in the Project area is expected to be uncommon and limited to small numbers.

3.19.2 Environmental Consequences

3.19.2.1. Impact Level Definitions for Sea Turtles

Definitions of impact levels are provided in Table 3.19-3.

Table 3.19-3 Impact Level Definitions for Sea Turtles

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
	Beneficial	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
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.

3.19.3 Impacts of the No Action Alternative on Sea Turtles

Section 3.1 of the Final EIS explains the approach to predicting impacts related to the No Action Alternative. When analyzing the impacts of the No Action Alternative on sea turtles, 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 sea turtles. 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 F, *Planned Activities Scenario*. Separate impact conclusions are presented for both scenarios.

3.19.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for sea turtles described in Section 3.19.1, *Description of the Affected Environment for Sea Turtles*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. The ongoing non-offshore wind activities that may affect sea turtles include marine transportation; onshore development activities; dredging and port improvements; marine minerals use and ocean dredged material disposal; commercial and recreational fishing; undersea transmission lines, gas pipelines, and other submarine cables; oil and gas activities; military use; and global climate change (see Section F.2 in Appendix F for a complete description of ongoing and planned activities). Under the No Action Alternative, BOEM expects ongoing activities would continue having temporary to permanent impacts (disturbance, displacement, injury, mortality, and reduced foraging success) on sea turtles, primarily due to lighting associated with coastal development, noise, marine pollution, vessel strikes, entanglement or ingestion of fishing gear, and ongoing climate change.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles include:

- Continued O&M of the Block Island project (five WTGs) installed in state waters;
- Continued O&M of the Coastal Virginia Offshore Wind project (two WTGs) installed in OCS-A 0497; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

The effects of approved projects have been evaluated through previous NEPA review and are incorporated by reference. Ongoing O&M of the Block Island and Coastal Virginia Offshore Wind projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect sea turtles through the primary IPFs of noise, presence of structures, and land disturbance. Ongoing offshore wind activities would have the same type of impacts from noise, presence of structures, and land disturbance that are described in detail in Section 3.19.3.2 for planned offshore wind activities but the impacts would be of lower intensity.

See Table F1-21 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for sea turtles.

Lighting: The impacts of coastal development affects sea turtles primarily through habitat loss from development and artificial lighting near sea turtle nesting areas, which can disorient nesting females and hatchlings. Artificial lighting on the OCS does not appear to have the same potential for effects. In spite of increasing human population growth and associated coastal development, and negative correlation between sea turtle nest numbers and the presence of artificial light (Mazor et al. 2013), Weishampel et al. (2016) found that nighttime light levels decreased for more than two-thirds of Florida’s surveyed sea turtle nesting beaches despite of coastal urbanization trends. It is anticipated that there will be increasing adoption of state and local lighting ordinances in places where sea turtles nest. However, the impacts of lighting on sea turtles resulting from ongoing non-offshore wind activities would be minor because coastal development trends are likely to continue and sea turtle nesting is also affected by light from more distant urban lighting.

Impacts of lighting on sea turtles from ongoing construction and operation of offshore wind projects have been previously analyzed and were found to be negligible because construction vessel activity was unlikely to measurably alter baseline vessel light levels and proposed lighting will be intermittent, and because of the lack of evidence that offshore platform illumination leads to impacts on sea turtles (BOEM 2021a, 2021b).

Noise: Very little data exist on the behavioral responses of sea turtles to noise. Of the available studies, sea turtles typically change their behavior in some way in response to noise. Further information on sea turtle hearing and thresholds for potential impacts (PTS, TTS, or behavioral disturbance) are provided in the analysis of other offshore wind activities (Section 3.19.3.2). In the geographic analysis area, ongoing activities that may produce noise would include site characterization surveys and scientific surveys (i.e., G&G surveys). These would be infrequent and produce high-intensity impulsive noise that has the potential to affect sea turtles, including potential auditory injuries and behavioral responses, which could include short-term displacement of feeding or migrating (NSF and USGS 2011). The potential for PTS and TTS in sea turtles is considered possible if these animals were to occur in close proximity to the G&G survey noise source. Also, noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water or through the seabed can result in high-intensity, low-exposure-level, and long-term but localized intermittent risk to sea turtles. Lastly, noise from infrequent trenching activities for pipeline and cable laying, as well as other cable burial, dredging, and marine minerals extraction, could cause behavioral disturbance to sea turtles, which is expected to be localized and temporary. The impacts of noise on sea turtles resulting from ongoing non-offshore wind activities are expected to be minor. Although there is some risk for permanent injury (PTS), no mortality is expected.

Impacts of noise on sea turtles from ongoing construction and operation of offshore wind projects have been previously analyzed and were found to range from negligible to moderate during construction and would be negligible during operation. Moderate impacts would result from impact pile driving during construction; however, low numbers of sea turtles are expected to be present. WTG operation noise could result in localized behavioral effects (BOEM 2021a, 2021b).

Traffic (vessel strikes): Vessel strike is an increasing concern for sea turtles. Injuries from propellers and collisions resulting from small boats and ships are expected to occur even more frequently as recreational boat activity increases in conjunction with ongoing coastal development. For example, the percentage of loggerhead strandings attributed to vessel strikes has increased from approximately 10 percent in the 1980s to a record high of 20.5 percent in 2004 (NMFS and USFWS 2007c). Sea turtles cannot reliably avoid being struck by vessels exceeding 2 knots (Hazel et al. 2007) and typical vessel speeds in the geographic analysis area may exceed 10 knots. Increased vessel traffic could result in sea turtle injury or mortality (Foley et al. 2019). The impacts of vessel traffic on individual sea turtles resulting from ongoing non-offshore wind activities would be minor. Although population-level impacts from vessel strikes alone have not been demonstrated, marine traffic is increasing and vessel strikes are understood to be a major threat to sea turtles.

Impacts of traffic (vessel strikes) from ongoing construction and operation of offshore wind projects have been previously analyzed and were found to be minor. Vessels would implement the use of protected species observers, vessel speed restrictions, and other measures to minimize vessel strikes (BOEM 2021a, 2021b).

Accidental releases: Marine pollution is an ongoing threat, as sea turtle ingestion of human trash and debris has been observed in all species of sea turtles (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Ingestion often occurs when sea turtles mistake debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Thomás et al. 2002). Although the threat varies among species and life stages due to differing feeding, plastic ingestion is an issue for marine turtles from the earliest stages of life (Eastman et al. 2020) and the volume of debris ingested is related to the size of the turtles (Thomás et al. 2002). Fuel spills have lesser potential impacts on sea turtles due to their low probability of occurrence and relatively limited spatial extent, although impacts of large spills can be significant. However, sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka et al. 2010) or sublethal effects on individual fitness. Sea turtles could also become entangled in lost or abandoned fishing gear, which is a significant source of mortality for both juveniles and adults (National Research Council 1990). The impacts of accidental releases on sea turtles resulting from ongoing non-offshore wind activities would be minor. Marine pollution is believed to be a significant factor limiting the recovery of sea turtles.

Impacts from accidental releases and discharges associated with ongoing construction and operation of offshore wind projects have been previously analyzed and were found to be negligible because of the low probability, short-term duration, and highly localized nature of accidental releases (BOEM 2021a, 2021b). Offshore wind projects will comply with their Oil Spill Response Plan and USCG requirements for the prevention and control of oil and fuel spills.

Gear utilization: A primary threat to sea turtles is their unintended capture in fishing gear, which can result in drowning or cause injuries that lead to injury and mortality (e.g., swallowing hooks). For example, trawl fishing is among the greatest continuing primary threats to the loggerhead turtle (Bolten et al. 2019) and sea turtles are also caught as bycatch in other fishing gear including longlines, gillnets, hook and line, pound nets, pot/traps, and dredge fisheries. A substantial impact of commercial fishing on sea turtles is the entrapment or entanglement that occurs with a variety of fishing gear. Although the requirement for the use of bycatch mitigation measures, such as requirements for "turtle excluder devices" in trawl fishing gear, has reduced sea turtle bycatch, Finkbeiner et al. (2011) compiled data on sea turtle bycatch in U.S. fisheries and found that in the Atlantic, a mean estimate of 137,700 interactions, 4,500 of which were lethal, occurred annually since implementation of bycatch mitigation measures. The impacts of gear utilization associated with fisheries use on sea turtles are expected to be minor. A reduction of sea turtle interactions with fisheries is a priority for sea turtle recovery.

Impacts of gear utilization from ongoing construction and operation of offshore wind are expected to occur at short-term, regular intervals over the lifetime of the projects and are expected to be negligible (BOEM 2021a, 2021b).

Climate change: Global climate change could result in population-level impacts on sea turtle species by displacement, impacts on prey species, altered population dynamics, and increased mortality. It is well established that climate change has the potential to affect the distribution and abundance of sea turtles and their prey due to changing water temperatures, ocean currents, and increased acidity. Furthermore, rising sea levels and increased storm intensity may negatively affect turtle nesting beaches. Increasing air temperatures can affect sea turtle population structure because temperature-dependent sex determination of embryos would result in a shift toward more female-biased sex ratios (Poloczanska et al. 2009). Patel et al. (2021) used global climate models to predict that the future distribution of suitable thermal habitat for loggerheads along the OCS will likely increase in northern regions. Sea turtle nesting could also shift northward on the U.S. Atlantic Coast. Because these changes may affect sea turtle reproduction, survival, and demography, the impacts of climate change on sea turtles are expected to be minor.

3.19.3.2. Cumulative Impacts of the No Action Alternative

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

Planned non-offshore wind activities within the geographic analysis area that contribute to cumulative impacts on sea turtles include but are not limited to various coastal development projects permitted through regional planning commissions, counties, and towns; dredging for the New Jersey Wind Port on the Delaware River in Salem County; the Davisville/Brooklyn/Newark Container-on-Barge Service; the approved liquefied natural gas export terminals in Elba Island, Georgia, and Jacksonville, Florida; the Roosevelt Island Tidal Energy Project; dredging for beach replenishment used for the Long Beach Island Coastal Storm Risk Management Project, Barnegat Inlet to Little Egg Inlet; the Atlantic City marina upgrades; and the Port of Virginia channel deepening. These and other planned non-offshore wind activities may affect sea turtles via the same IPFs listed above and discussed in further detail below. Impacts on sea turtles may be temporary (displacement or behavioral responses) or permanent (e.g., habitat loss or mortality). All activities would be required to comply with federal, state, and local regulations, which would avoid or minimize most potential impacts.

Planned offshore wind activities have the potential to produce impacts resulting from site characterization studies, site assessment data collection activities that involve installation of meteorological towers or buoys, and installation and operation of turbine structures. Other planned offshore wind projects in the geographic analysis area are estimated to collectively:

- Install 3,109 WTG and OSS foundations
- Install 4,988 miles (8,027 kilometers) of offshore export cable and 5,309 miles (8,544 kilometers) of inter-array cable
- Disturb 27,126 acres (110 km^2) of seabed for WTG foundations and scour protection, cable emplacement, and anchoring
- Store 5,300 gallons (19,041 liters) of diesel fuel, oils, lubricants, and coolant per WTG

BOEM expects planned offshore wind activities (without the Proposed Action) to affect the primary IPFs of accidental releases, discharges, EMF, cable placement and maintenance, noise, vessel traffic, port utilization, presence of structures, and gear utilization. This section provides a general description of these activities, recognizing the extent and significance of potential effects on conditions cannot be fully quantified for projects that are in the conceptual or proposal stage and have not been fully designed. Where appropriate, certain potential effects resulting from these actions can be generally characterized by comparison to effects resulting from the Proposed Action that are likely to be similar in nature and significance. The intent of this section is to provide a general overview of how reasonably foreseeable future activities might influence environmental conditions. Should any or all of the activities described in Appendix F proceed, each would be subject to independent NEPA analyses and regulatory approvals, and their environmental effects would be fully considered therein.

Accidental releases: Accidental releases of fuel, fluids, hazardous materials, trash, and debris may increase 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.

Planned offshore wind development would require large quantities of coolant fluids, oils and lubricants, and diesel fuel (see Table F2-3 in Appendix F for specific quantities). In the planned activities scenario (see Table F2-3 in Appendix F), there would be a low risk of a leak of fluids from any single one of approximately 2,946 WTGs, each with approximately 5,300 gallons (19,041 liters) of diesel fuel, oils, lubricants, and coolant stored. According to BOEM's modeling (Bejarano et al. 2013), a release of 128,000 gallons is likely to occur no more often than once per 1,000 years, and a release of 2,000 gallons or less is likely to occur every 5 to 20 years. The likelihood of a spill occurring from multiple WTGs and OSS at the same time is very low and, therefore, the potential impacts from a spill larger than 2,000 gallons are largely discountable. Based on the volumes potentially involved, the likely amount of additional releases associated with planned offshore wind development would fall within the range of accidental releases that already occur on an ongoing basis from non-offshore wind activities. Impacts resulting from accidental releases may pose a long-term risk to sea turtles and could potentially lead to mortality and sublethal impacts on individuals present in the vicinity of the spill, but the potential for exposure would be minor given the isolated nature of these accidental releases and the variable distribution of sea turtles in the geographic analysis area.

The accidental release of trash and debris may occur by vessels during construction, operations, and decommissioning of planned offshore wind facilities. Ingestion of trash or exposure to aquatic contaminants can be lethal to sea turtles. However, sea turtles may also be affected sublethally in a variety of ways, which could include experiencing depressed immune system function, poor body condition, and reduced growth rates, fecundity, and reproductive success (Hoarau et al. 2014). Sea turtles could also become entangled in debris accidentally released by offshore wind project vessels, causing lethal or injurious impacts. Additionally, refueling of primary construction vessels at sea would likely be proposed for planned offshore wind activities, which could affect sea turtles and their prey if spills were to occur. Impacts on individual sea turtles, including decreased fitness, health effects, and mortality, may occur if individuals are present in the vicinity of a spill, but accidental releases are expected to be rare and injury or mortality are not expected to occur. BOEM assumes all vessels will comply with laws and regulations to minimize releases. In the unlikely event of a trash or debris release, it would be an accidental, localized event in the vicinity of an offshore wind lease area.

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.

EMF: The EMFs produced by cables have the potential to affect sea turtle migration because they are known to possess geomagnetic sensitivity and use cues from Earth’s magnetic field for orientation, navigation, and migration. Sea turtles appear to have a detection threshold of magnetosensitivity and behavioral responses to field intensities ranging from 0.0047 to 4,000 microteslas for loggerhead turtles and 29.3 to 200 microteslas for green turtles, with other species likely similar due to anatomical, behavioral, and life history similarities (Normandeau et al. 2011). In the planned activities scenario, up to 4,988 miles (8,027 kilometers) of offshore export cable and 5,309 miles (8,544 kilometers) of inter-array cable would be added in the geographic analysis area for sea turtles, producing EMFs in the vicinity of each cable during operations (Appendix F, Table F2-1). Submarine power cables in the geographic analysis area for sea turtles are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF from cable operation to low levels. Juvenile and adult sea turtles may detect the EMF over relatively small areas near cables (e.g., when resting on the bottom or foraging on benthic organisms near cables or concrete mattresses). There are no data on impacts on sea turtles from EMFs generated by underwater cables, although anthropogenic magnetic fields can influence migratory deviations (Luschi et al. 2007; Snoek et al. 2016). Lohmann et al. (2008) speculated that navigation methods used by adult and juvenile sea turtles were dependent upon the stage of migration, initially relying on magnetic orientation. While the specific mechanisms of leatherback sea turtle navigation are unknown, it is believed that they possess a compass sense similar to hardshell turtle species, possibly related to geomagnetic cues (Eckert et al. 2012; Luschi et al. 2007; NMFS and USFWS 2013). Therefore, although EMF associated with planned offshore wind development cables could cause some deviations to sea turtle routes, these deviations would likely be minor (Normandeau et al. 2011) and biologically insignificant due to the minor energy expenditure they may cause. Furthermore, this IPF would be limited to extremely small portions of the areas used by resident or migrating sea turtles. As such, exposure to EMF planned offshore wind activities would be negligible.

Lighting: All WTGs and OSS associated with planned offshore wind activity would be lit with navigational and FAA hazard lighting. Although lighting on nesting beaches or in nearshore habitats has the potential to result in disorientation to nesting females and hatchling turtles, artificial lighting on the OCS does not appear to have the same effects. Orr et al. (2013) indicated that lights on WTGs that flash intermittently for navigational or safety purposes do not present a continuous light source, and therefore do not appear to have a disorienting influence for any sea turtle life history stages. Additionally, the continuous lighting of construction equipment and wind turbines at night during project construction would not be expected to attract or disorient sea turtles. Salmon and Wyneken (1990) conducted laboratory tests that indicated that hatchlings no longer oriented toward brighter horizons after they began swimming. Therefore, if hatchlings swim in the vicinity of offshore wind facilities with lighting, their behavior should not be affected by the lights. BOEM anticipates that impacts on sea turtles from structure lighting associated with planned offshore wind activity would be negligible. Impacts from lighting from planned non-offshore wind activities would likely be minor because coastal development trends are likely to continue and sea turtle nesting is also affected by light from more distant urban lighting.

Cable emplacement and maintenance: Planned offshore wind development would require the placement and maintenance of cabling to bring generated electricity onshore and would result in seafloor disturbance and elevated levels of suspended sediment. This could affect 32,346 acres (131 km^2) of seabed while associated undersea cables are installed, causing an increase in suspended sediment (see Appendix F, Table F2-2). Cable emplacement may occur from a variety of methods that include trenching devices, plows, and jetting and are dependent upon seabed sediments. The impacts from these cable emplacement methods are variable but typically include suspension of seabed sediments that vary in extent and intensity depending on the project and site-specific conditions. Impacts from cable burial would be spatially and temporally localized, with the main impacts occurring within a few feet vertically and a few hundred feet horizontally from the point of disturbance. Suspended sediment concentrations due to jet plow would be within the range of natural variability. Potential impacts from construction activities on sea turtles would be short term and involve increased turbidity for 1 to 6 hours in the immediate vicinity of the cable emplacement corridor. If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary. Sea turtles would be expected to swim away from the sediment plume and return to the area once turbidity has returned to background levels. Elevated turbidity could temporarily affect the foraging behavior of sea turtles by attracting prey to feed on detritus or interfering with visual prey detection, but no impacts due to swimming through the plume would be expected (NMFS 2020). It is expected that mitigation measures would be implemented to minimize and reduce the potential for adverse effects from water quality changes on sea turtles.

Dredging for sand wave clearance may be necessary in places to ensure cable burial below mobile seabed sediments, which could result in additional impacts on sea turtles related to impingement, entrainment, and capture associated with mechanical and hydraulic dredging techniques. Sea turtles have been known to become entrained in trailing suction hopper dredge or trapped beneath the draghead as it moves across the seabed. Direct impacts, especially for entrainment, typically results in severe injury or mortality (Dickerson et al. 2004; USACE 2020). About 69 projects have recorded sea turtle takes within channels in New Jersey, Delaware, and Virginia and there have likely been numerous other instances not officially recorded (Ramirez et al. 2017). However, the risk of interactions between hopper dredges and individual sea turtles is expected to be lower in the open ocean areas where dredging may occur compared to nearshore navigational channels where sea turtles are more concentrated in a constrained operating environment (Michel et al. 2013; USACE 2020). This may be due to the lower density of sea turtles in these areas as well as differences in behavior and other risk factors.

Dredging within nearshore areas could affect green sea turtle habitat by directly removing SAV or creating suspended sediments that may be deposited on top of seagrass (see Section 3.6, *Benthic Resources*). To mitigate that risk, it is anticipated that planned offshore wind projects would perform SAV surveys and avoid these areas during construction, to the extent practicable. Changes in turbidity and suspended sediments could temporarily disrupt normal sea turtle behaviors, especially if turtles rely on vision to forage. Sea turtles may experience behavioral effects upon exposure to turbidity or suspended sediments and become more susceptible to other threats like vessel strikes, but this has not been studied or measured. There are also no studies that evaluate the behavioral effects of suspended sediments on mobile prey species and Johnson (2018) suggested that any effects on sea turtle prey species from suspended sediments, sediment deposition, or turbidity may cause turtles to move to other areas and then return to the affected areas at some time in the future. It is not believed that dredging would permanently change the sea turtle prey base (Michel et al. 2013) and planned wind projects would implement turbidity reduction measures to contain the silt and sediment stirred up by dredging.

Lastly, while there would be a loss of existing benthic habitat, the presence of scour protection and hard protection on top of cables could create a more complex habitat and increase the abundance of associated organisms like mussels and crustaceans on and around the cables (Hutchison et al. 2020), providing a prey resource for loggerhead and Kemp's ridley sea turtles. The hard substrate may increase the abundance of jellyfish, an important prey species for leatherback sea turtles (Janßen et al. 2013). It is anticipated that offshore wind cables may cause long-term to permanent impacts on some areas with SAV, adversely affecting green sea turtles' forage availability, although cable routes for planned projects have not been fully determined at this time. Studies on the effects of dredging on green sea turtles in Florida found that they utilized adjacent unaffected habitats and returned to the dredged area within 2 years (Michel et al. 2013).

Given the available information, the risk of injury or mortality of individual sea turtles resulting from dredging necessary to support planned offshore wind projects would be minor and population-level effects are unlikely to occur.

Noise: In the geographic analysis area, planned offshore wind activities that could cause underwater noise are impact pile driving (installation of WTGs and OSS), vibratory pile driving (installation and removal of cofferdams), HRG surveys, detonations of UXO, vessel traffic, aircraft, cable laying or trenching, and turbine operation.

The installation of ongoing WTG foundations into the seabed involves pile driving and other construction activities that could cause underwater noise in the geographic analysis area and result in short-term behavioral disturbance and impacts on sea turtle hearing that may recover over time (i.e., TTS) as well as long-term impacts on sea turtle hearing (i.e., PTS). Noise from pile driving would occur during installation of foundations for offshore structures. The potential for underwater noise to result in adverse impacts on a sea turtle depends on the received sound level and the frequency content of the sound relative to the hearing ability of the animal. The limited data available on sea turtle hearing abilities are summarized in Table 3.19-4. Sea turtles appear to hear frequencies from 30 Hz to 2 kilohertz, with a range of best hearing sensitivity between 100 and 700 Hz; however, there is some sensitivity to frequencies as low as 60 Hz and possibly as low as 30 Hz (Ridgway et al. 1969). Therefore, there is substantial overlap in the frequencies that sea turtles can detect and the dominant frequencies produced by offshore wind activities, including pile driving, impulsive sources used for HRG surveys, and UXO.

Table 3.19-4 Hearing Capabilities of Sea Turtles

Sea Turtle Species	Hearing		Source
	Range (Hertz)	Highest Sensitivity (Hertz)	
Green Sea Turtle (*Chelonia mydas*)	60–1,000	300–500	Ridgway et al. 1969
	100–800	600–700 (juveniles) 200–400 (subadults)	Bartol and Ketten 2006; Ketten and Bartol 2006
	50–1,600	50–400	Piniak et al. 2012a, 2016
Loggerhead Sea Turtle (*Caretta caretta*)	250–1,000	250	Bartol et al. 1999
	50–1,100	100–400	Martin et al. 2012; Lavender et al. 2014
Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)	100–500	100–200	Bartol and Ketten 2006; Ketten and Bartol 2006

Sea Turtle Species	Hearing Range (Hertz)	Hearing Highest Sensitivity (Hertz)	Source
Leatherback Sea Turtle (*Dermochelys coriacea*)	50–1,600	100–400	Piniak et al. 2012b

Given the high energy levels of offshore wind energy survey and installation noise sources, it can be concluded that sea turtles could be affected by associated noise. However, there are no available empirical data regarding threshold levels for impacts on sea turtle hearing from sound exposure. As a result, there have been no regulatory threshold criteria established for sea turtles. There are limited data pertaining to behavioral responses of sea turtles and none specifically to sounds generated by offshore wind activities. McCauley et al. (2000) observed that one green turtle and one loggerhead sea turtle in an open water pen increased swimming behaviors in response to a single seismic airgun at received levels of 166 dB re 1 µPa and exhibited erratic behavior at received levels greater than 175 dB re 1 µPa. Moein et al. (1994) documented similar avoidance reactions to similar levels of seismic signals, although both studies were done in a caged environment, so the extent of avoidance could not be monitored. DeRuiter and Larbi Doukara (2012) observed that 57 percent of loggerhead sea turtles exhibited a diving response after seismic airgun array firing at received levels between 175 and 191 dB re 1 µPa. Moein et al. (1994) did observe a habituation effect to the airguns; the animals stopped responding to the signal after three presentations. Sea turtles can become habituated to repeated noise exposure over time and not suffer long-term consequences (O'Hara and Wilcox 1990). This type of noise habituation has been demonstrated even when the repeated exposures were separated by several days (Bartol and Bartol 2011; Navy 2018).

In the absence of NMFS acoustic thresholds, the U.S. Navy has adopted PTS and TTS thresholds for sea turtles as presented in Finneran et al. (2017) (see Table 3.19-5). Table 3.19-5 outlines the acoustic thresholds for the onset of PTS, TTS, and behavioral disturbance for sea turtles for impulsive noise sources. NMFS has considered behavioral response beginning at 175 dB re 1 µPa SPL_{RMS} for impulsive and non-impulsive noise sources (Navy 2017). These thresholds apply to juvenile, subadult, and adult life stages.

Table 3.19-5 Acoustic Thresholds for Onset of Acoustic Impacts (PTS, TTS, or Behavioral Disturbance) for Sea Turtles

Injury (PTS)		TTS		Behavioral Disturbance
SPL_{peak} (dB re 1 µPa) Impulsive	SEL_{cum} (dB re 1 µPa^{2}s) Impulsive	SPL_{peak} (dB re 1 µPa) Impulsive	SEL_{cum} (dB re 1 µPa^{2}s) Impulsive	SPL_{RMS} (dB re 1 µPa) Impulsive/Non-Impulsive
232	204	226	189	175

dB re 1 µPa = decibels relative to 1 micropascal; dB re 1 µPa^{2}s = decibels relative to 1 micropascal squared second; SEL_{cum} = cumulative sound exposure level

In the planned activities scenario (see Appendix F), the construction of 3,109 WTG and OSS foundations would create underwater noise and may temporarily affect sea turtles if they are present in the ensonified area. While these potential effects are acknowledged, their potential significance is unclear.

Impact pile driving noise: Impulsive underwater noise from impact pile driving during planned offshore wind development, due to the anticipated frequency and spatial extent of effects, represents the IPF with the highest likelihood for effects on individual sea turtles. Sea turtles migrating through the area when pile driving occurs are expected to adjust their course to avoid the area where noise is elevated above 175 dB re 1 µPa SPL_{RMS}. Such behavioral alterations could cause turtles to cease foraging or expend additional effort and energy avoiding the area. Presumably, sea turtles could continue foraging activities outside the area of elevated noise levels as adjacent habitat provides similar foraging opportunities. Although information is lacking, some sea turtles could be temporarily displaced into areas that have a lower foraging quality or result in higher risk of interactions with ships or fishing gear. Sea turtles may experience physiological stress during this avoidance behavior, but this stressed state would be anticipated to dissipate over time once the sea turtle is outside the ensonified area. Furthermore, this displacement would result in a relatively small energetic consequence that would not be expected to have long-term impacts on sea turtles.

While there have been no documented sea turtle mortalities associated with pile driving and no direct evidence of PTS occurring in sea turtles, TTS has been demonstrated in many species from exposure to impulsive and non-impulsive noise (a full review is provided in Southall et al. 2007 and NOAA 2013). Prolonged or repeated exposure to sound levels sufficient to induce TTS without recovery time can lead to PTS (Southall et al. 2007). The accumulated stress and energetic costs of avoiding repeated exposure to pile-driving noise over a season or a life stage could have long-term impacts on survival and fitness (Navy 2018). Conversely, sea turtles could become habituated to repeated noise exposure over time, ignore a stimulus that was not accompanied by an overt threat, and not suffer long-term consequences (O’Hara and Wilcox 1990; Hazel et al. 2007). This type of noise habituation has been demonstrated even when the repeated exposures were separated by several days (Bartol and Bartol 2011; Navy 2018). The magnitude of potential impacts on sea turtles would be dependent upon the locations of concurrent construction operations, as well as the number of hours per day, the number of days that pile driving would occur, and the time of year in which pile driving occurs. Reduced hearing sensitivity because of pile driving could limit the ability to detect predators, prey, or potential mates and reduce the survival and fitness of affected individuals; however, the role and importance of sound in these biological functions for sea turtles remain poorly understood (Lavender et al. 2014).

HRG survey noise: Planned offshore wind energy projects perform HRG surveys that use a combination of sonar-based methods to map shallow geophysical features and can be classified as impulsive or non-pulsive noise sources. The equipment is towed behind a moving survey vessel and generates a short-duration pulse in the 1.1- to 200-kilohertz range, with the interval between pulses ranging from 0.2 to 1 second, depending on the specific type of equipment used. The equipment only operates when the vessel is moving along a survey transect, meaning that the ensonified area is intermittent and constantly moving. HRG surveys that use non-impulsive sources are not expected to affect sea turtles because they operate at frequencies above the sea turtle hearing range.

BOEM (2018) and NMFS (2021b) evaluated potential underwater noise effects on sea turtles from HRG surveys using impulsive sources (boomers/airguns/sparkers/sub-bottom profilers) and concluded that for an individual sea turtle to experience PTS (204 dB re 1 $\mu Pa^2 s$ SEL_{cum}; 232 dB re 1 $\mu Pa^2 \cdot s$ SPL [0–pk] impulsive sources), it would have to be within 1 meter of the loudest possible noise source. In fact, NMFS (2021b) states that none of the equipment being operated for HRG surveys with hearing overlap for sea turtles has source levels loud enough to result in PTS or TTS. However, noise from impulsive sources used during HRG surveys could exceed the behavioral effects threshold (175 dB) up to 90 meters from the source, depending on the type of equipment used. Given the limited extent of potential noise effects, injury-level exposures (PTS/TTS) are unlikely to occur. As stated above and based on the loudest impulsive noise source, it is highly unlikely that noise from HRG survey sound sources would cause PTS or TTS in sea turtles (NMFS 2021b). While low-level behavioral exposures could occur, these disruptions would be limited in extent and short term in duration given the movement of the survey vessel and the mobility of the animals. Therefore, underwater noise impacts from HRG surveys are expected to be minor.

UXO detonation noise: 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 as well as the Proposed Action are relatively unknown. Impacts associated with UXO detonations for other projects would be similar to those described and modeled for the Proposed Action in Section 3.19.5.

Vessel noise: Due to the large number of vessels required for planned offshore wind development, vessel noise could potentially result in impacts on individual sea turtles. The use of ocean vessels could potentially result in long-term but infrequent impacts on sea turtles, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes, especially their submergence patterns (NSF and USGS 2011; Samuel et al. 2005). However, Hazel et al. (2007) suggest that sea turtles' ability to detect approaching vessels is primarily vision-dependent, not acoustic. Sea turtles may respond to vessel approach, noise, or both, with a startle response (diving or swimming away) and a temporary stress response (NSF and USGS 2011). Samuel et al. (2005) indicated that vessel noise can have an effect on sea turtle behavior, especially their submergence patterns. BOEM anticipates that the potential effects of noise from construction and installation vessels would elicit brief responses to the passing vessel that would dissipate once the vessel or the turtle left the area.

Turbine operational noise: Sound is generated by operating WTGs due to pressure differentials across the airfoils of moving turbine blades and from mechanical noise of bearings and the generator converting kinetic energy to electricity. Sound generated by the airfoils, like aircraft, is produced in the air and enters the water through the air-water interface. Mechanical noise associated with the operating WTG is transmitted into the water as vibration through the foundation and subsea cable. Both airfoil sound and mechanical vibration may result in long-term, continuous noise in the offshore environment. Measured underwater sound levels in the literature are limited to geared smaller wind turbines (less than 6.15 MW), as summarized by Tougaard et al. (2020). Tougaard et al. 2009 measured SPLs ranging between 109 and 127 dB re 1 μPa underwater 45 and 65 feet (14 and 20 meters) from the foundations at frequencies below 315 Hz up to 500 Hz. Wind turbine acoustic signals above ambient background noise were detected up to 2,066 feet (630 meters) from the source (Tougaard et al. 2009). Noise levels were shown to increase with higher wind speeds (Tougaard et al. 2009). Operational noise from larger, current-generation WTGs on the order of 10 MW would generate higher source levels than the range noted above, at around 170 dB re 1 μPa SPL_{RMS} (Stöber and Thomsen 2021). However, the shift from using gear boxes to direct-drive technology is expected to reduce the sound level by around 10 dB and, based on available data, the sound levels produced during the operation of planned offshore wind projects would be less than the injurious thresholds defined by NMFS for sea turtles. While it may cause behavioral effects, these effects would be at relatively short distances from the foundations and would reach ambient underwater noise levels within 50 meters of the foundations (Miller and Potty 2017; Tougaard et al. 2009). Sea turtles may respond to underwater noise generated by WTG operation through avoidance or behavioral alteration for some sea turtles. Such localized behavioral effects would be negligible and sea turtles could be expected to become habituated to the sound. In contrast, the decommissioning of a project would reverse any sea turtle displacement effects caused by operational noise. Also, underwater noise from offshore wind project operation is unlikely to result in significant effects on the forage base for sea turtles. These species are primarily invertivores or, in the case of green sea turtles, omnivorous vegetarians. The sound sensitivity of invertebrates like crabs, jellyfish, and mollusks is restricted to particle motion and the affect dissipates rapidly such that any effects are highly localized to the immediate proximity (i.e., less than 3.3 feet [1 meter]) of the noise source (Edmonds et al. 2016). Although loggerhead and Kemp's ridley sea turtles may periodically prey on fish, fish represent a minor component of a flexible and adaptable diet. Underwater noise could temporarily reduce the availability of fish prey species, but these effects would be limited in extent and duration.

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.

Traffic (vessel strikes): Planned offshore wind projects on the OCS would be constructed between 2023 and 2030, contributing to increases in vessel traffic and associated noise impacts within the sea turtle geographic analysis area. Based on the current vessel traffic generated by ongoing activities, it is assumed that vessel traffic associated with planned offshore wind development poses a high-frequency, high-exposure collision risk for sea turtles in coastal waters when transiting through offshore wind lease areas during construction, operations, and decommissioning. Construction of each individual offshore wind project would generate approximately 20 to 65 simultaneous construction vessels (refer to Section 3.16 for additional information regarding vessel traffic). This vessel traffic increase would be expected to result in a small incremental increase in overall vessel traffic within the geographic analysis area for sea turtles. Sea turtles are likely to be most susceptible to vessel strikes in coastal waters, where they forage from May through November. Vessel speed may exceed 10 knots in such waters, and those vessels traveling at greater than 10 knots would pose the greatest threat to sea turtles (Hazel et al. 2007).

The relative risk of vessel strikes with sea turtles from wind industry vessels would depend upon the density of sea turtles within the area, stage of project development, time of year, number of vessels, and speed of vessels during each stage. Planned offshore wind projects may also cause shifts in vessel traffic, including temporary restrictions of fishing vessels during construction due to implementation of safety zones, potential increases in vessel traffic within the offshore wind lease areas after construction due to an influx of recreational fishing vessels targeting species associated with an artificial reef effect, and likely shifts in commercial fishing vessels from the offshore wind lease areas to areas not routinely fished due to recreation vessel congestion and gear-conflict concerns. Collision risk for sea turtles would be expected to occur primarily when vessels transit to and from the offshore wind lease areas from ports. Once within the offshore wind lease areas, vessels would typically be stationary and no collision risk would be expected, but some transits between locations may also occur. The increased collision risk from transiting vessels has the potential to result in injury to or mortality of individual sea turtles, but impacts would be minor given the broad distribution and low densities of most sea turtle species. Population-level impacts would also be expected to be unlikely due to the low densities of each species and their extensive distribution within the geographic analysis area. Therefore, BOEM anticipates that the impacts of vessel strikes on sea turtles from ongoing and planned offshore wind activities would be minor. Impacts from traffic (vessel strikes) 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.

Port utilization: Offshore wind on the mid-Atlantic OCS may require the expansion or improvement of regional ports to support planned projects. The State of New Jersey is planning to build an offshore wind port on the eastern shore of the Delaware River in Lower Alloways Creek (Appendix F). Port improvements could lead to an increase in vessel traffic during construction, O&M, and decommissioning. The resulting change in vessel traffic in the geographic analysis area cannot be predicted, however, because only locations for port expansion are identified and no specific project plans have been proposed. Any future port expansion and associated increase in vessel traffic would be subject to independent NEPA analysis and regulatory approvals requiring full consideration of potential effects on sea turtles regionwide. 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.

Presence of structures: Development of offshore wind projects in the planned activities scenario would install more buoys, meteorological towers, foundations, and hard protection. Up to 3,109 new WTG and OSS foundations would be installed, which could create a reef effect. Foundations and armoring create biological hotspots that support species range shifts and expansions, and changes in biological community structure (Raoux et al. 2017; Methratta and Dardick 2019; Degraer et al. 2020). Around the base of the monopiles, colonizing organisms on the surface of the pile would likely enhance food availability and food web complexity through an accumulation of organic matter (Degraer et al. 2020; Mavraki et al. 2020). The accumulation could lead to an increased importance of the detritus-based food web but is unlikely to result in significant broad-scale changes to the local trophic structure (Raoux et al. 2017). The available information suggests that the prey base for leatherback, loggerhead, and Kemp’s ridley sea turtles may increase in the geographic analysis area due to the reef effect of the WTGs and associated scour protection and an increase in crustaceans and other forage species. These structures would affect ocean mixing and alter thermal stratification, which although small compared to other naturally occurring mixing mechanisms (Schultze et al. 2020) could influence sea turtle dive behavior and thermoregulation. This effect would also influence primary and secondary productivity, the distribution and abundance of fish and invertebrates, and overall community structure within and in proximity to project footprints. Depending on proximity and extent, hydrodynamic and reef effects from future actions could influence the availability of prey and forage resources for sea turtles.

As discussed above regarding scour protection for cable emplacement, the presence of new, hard surfaces, including WTG foundations, would provide habitat that could be colonized by an abundance of organisms that are sea turtle prey, like mussels, crustaceans, and jellyfish. In the Gulf of Mexico, loggerhead, leatherback, green, Kemp’s ridley, and hawksbill sea turtles have been documented in the vicinity of offshore oil and gas platforms, with the probability of occupation increasing with the age of the structures (Gitschlag and Herczeg 1994; Hastings et al. 1976). Sea turtles would be expected to use habitat in between the WTGs as well as around structures for feeding, breeding, resting, and migrating for short periods, but residency times around structures may increase with the age of structures if communities develop on and around foundations.

Project-specific effects would vary, recognizing that larger and contiguous projects could have more significant effects on prey and forage resources, but the extent and significance of these effects cannot be predicted based on currently available information. The ultimate effects of planned offshore wind structures on ocean productivity, sea turtle prey species, and thereby sea turtles are difficult to predict with certainty and are expected to vary by location, season, and year, depending on broader atmospheric conditions and ecosystem processes. Impacts would also be highly localized and unlikely to have biologically meaningful effects on individual sea turtles. Project decommissioning, including the removal of the monopile foundations and scour and cable protection, would reverse the artificial reef effect provided by these structures and remove or disperse the associated biological community. Sea turtle species accustomed to the foraging opportunities provided in this community would have to adapt.

While the anticipated reef effect would result in long-term beneficial impacts on sea turtles, some potential exists for increased exposure to fishing gear that could lead to entanglement, ingestion, injury, and death. The presence of structures may concentrate recreational fishing around foundations and would also increase the risk of gear loss or damage. This could cause entanglement, especially with monofilament line, and increase the potential for entanglement in both lines and nets leading to injury and mortality due to abrasions, loss of limbs, and increased drag, resulting in reduced foraging efficiency and ability to avoid predators (Barnette 2017; Berreiros and Raykov 2014; Foley et al. 2008). The reef effect may attract recreational fishing effort from inshore areas and attract sea turtles for foraging opportunities, resulting in a small increased risk of sea turtle entanglement and hooking or ingestion of marine debris where fishermen and turtles are concentrated around the same foundations.

Given the available information, the risk of injury to or mortality of individual sea turtles due to the presence of structures 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.

Gear utilization (biological/fisheries monitoring surveys): Sea turtles could be affected by monitoring surveys of planned offshore wind activities due to vessel traffic and associated underwater vessel noise and potential for vessel strikes. These effects would be similar to those discussed above under *Noise* and *Traffic*. Additional impacts on sea turtles could result from trawl and trap surveys and the use of acoustic survey technologies. Offshore wind projects are expected to use trawl surveys, among other methods, for project monitoring. The capture and mortality of sea turtles in bottom-trawl fisheries are well documented (Henwood and Stuntz 1987; NMFS and USFWS 1991, 1992; National Research Council 1990). While sea turtles are capable of remaining submerged for long periods of time, they appear to rapidly consume oxygen stores when entangled and forcibly submerged in fishing gear (Lutcavage and Lutz 1997). The preponderance of available research (Epperly et al. 2002; Sasso and Epperly 2006) and anecdotal information from past trawl surveys indicates that limiting tow times to less than 30 minutes would likely eliminate the risk of death for incidentally captured sea turtles. It is anticipated that the proposed trawls for offshore wind project monitoring would be limited to 20 minutes, indicating that this activity poses a negligible risk of mortality and 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.

Other fisheries resource surveys using stationary gear like Chevron traps or baited remote underwater video could pose a risk of entanglement for sea turtle species due to buoy and anchor lines. While there is a theoretical risk of sea turtle entanglement, particularly for leatherbacks, in trap and pot gear (NMFS 2016), the likelihood would be discountable given the limited, patchy distribution of sea turtles, the small number of vertical lines used in the surveys, and the limited duration of each survey event. Efforts would also be taken to reduce sea turtle interactions during fisheries surveys. Sea turtle prey items such as horseshoe crabs, other crabs, whelks, and fish may be removed from the marine environment as bycatch in trap gear. However, all bycatch is expected to be returned to the water alive, dead, or injured to the extent that the organisms would shortly die. Injured or deceased bycatch would still be available as prey for sea turtles, particularly loggerhead sea turtles, which are known to eat a variety of live prey as well as scavenge dead organisms. Given this information, any effects on sea turtles from the collection of potential sea turtle prey in trap gear would be so small that it cannot be meaningfully measured, detected, or evaluated and, therefore, effects would be insignificant.

The equipment used in the clam, oceanography, and pelagic fish surveys pose minimal risk to sea turtles. Tows for the clam survey have a very short duration of 120 seconds, and the vessels would be subject to mitigation measures similar to those for the trawl survey. Both the oceanography and pelagic fish surveys are non-extractive and would also be subject to mitigation measures that would avoid minimize potential impacts on sea turtles. Therefore, the effects of the equipment used in clam, oceanography, and pelagic fish surveys on sea turtles would insignificant or discountable. Lastly, the passive acoustic monitoring surveys would not have any direct impacts on sea turtles; as with all other monitoring surveys, impacts on sea turtles could arise from vessel noise and the potential for vessel strike as discussed above. Mooring lines for such surveys pose a theoretical entanglement risk to sea turtles but BOEM anticipates requiring that moored systems would use the best available technology to reduce any potential risks of entanglement and that they would pose a discountable risk of entanglement to sea turtles.

Monitoring surveys are expected to occur at short-term, regular intervals over the lifetime of a project and therefore impacts of this IPF on sea turtles from planned offshore wind projects would be negligible even though the potential extent and number of animals potentially exposed cannot be determined without project-specific information. Impacts from gear utilization from planned non-offshore wind activities would likely be minor because although the requirement for bycatch mitigation measures has reduced sea turtle bycatch, interactions with fisheries gear would continue.

3.19.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, baseline conditions for sea turtles would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities, including other offshore wind activities. BOEM expects ongoing activities would have temporary to permanent impacts on sea turtles (disturbance, displacement, injury, mortality, and reduced foraging success), primarily due to lighting associated with coastal development, noise, marine pollution, vessel strikes, entanglement or ingestion of fishing gear, and ongoing climate change. The No Action Alternative, including ongoing non-offshore wind and offshore wind activities, would result in **minor** impacts on sea turtles because impacts on sea turtles would be detectable and measurable but of low intensity, localized, and temporary or short term in duration.

Cumulative Impacts of the No Action Alternative. Construction of planned offshore wind projects in the geographic analysis area could affect migration, feeding, breeding, and individual fitness of sea turtles through the primary IPFs. Most impacts on sea turtles would be localized and temporary or short term. Intermittent, temporary impacts from underwater noise may be of high intensity and result in a high exposure level but impacts on sea turtles are not expected to result in population-level effects. Although there would be a loss of existing benthic habitat, WTG and OSS foundations may provide foraging and sheltering opportunities for sea turtles. The significance of this reef effect is unknown, however, and is not expected to result in biologically significant impacts on sea turtles and the presence of structures would result in negligible beneficial impacts. BOEM anticipates that the No Action Alternative combined with all ongoing and planned activities (including other offshore wind activities) would result in **minor** impacts, because potential impacts may include injury or loss of individuals, but these impacts would not result in population-level effects.

3.19.4 Relevant Design Parameters and Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; BOEM expects any potential variances in the proposed Project build-out within the range of the PDE to result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix E) would influence the magnitude of the impacts on sea turtles:

- Noise associated with the construction, operation, and decommissioning of Project structures (e.g., pile driving and construction vessels), which could have behavioral and physiological effects, or cause auditory injury to sea turtles;
- Vessel traffic, which could increase collision risk for sea turtles due to vessels transiting to and from the Wind Farm Area during construction, operations, and decommissioning, and increased recreational fishing vessels; and
- The presence of structures, which could cause both beneficial and adverse impacts on sea turtles through localized changes to hydrodynamic disturbance, prey aggregation and associated increase in foraging opportunities, incidental hooking from recreational fishing around foundations, entanglement in lost and discarded fishing gear, migration disturbances, and displacement.

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

- Foundation Type. The potential acoustic impacts on sea turtles differ among the foundation types that Ocean Wind would use, which is up to three pin-piled jacket foundations or monopile foundations for OSS and up to 98 monopile foundations for WTGs. Construction of the jacket-type foundation would have a higher acoustic impact than construction of the monopile foundation due to the increased risk of exposure because of the longer time required to install more piles (up to four 9.8-foot [3-meter] pin piles per jacket).
- Monopile diameter. The potential acoustic impacts on sea turtles differ among the WTG monopile diameters that may be used. Ocean Wind would use monopiles with a maximum outer diameter at seabed of 34 feet (11 meters) that taper to a maximum top diameter of 25 feet (8 meters). The acoustic impacts of a monopile with a smaller diameter would differ.
- The WTG number. All potential impacts would be lessened with a decrease in number of WTGs built.
- Onshore export cable routes: The route chosen (including variants within the general route) would determine the amount of habitat affected.
- Season of construction: The active season for sea turtles in New Jersey is from May through November. Construction outside of this window would have a lesser impact on sea turtles than construction during the active season.

Although some variation is expected in the design parameters, the impact assessment on sea turtles in this section analyzes the maximum-case scenario.

Ocean Wind has committed to measures to minimize impacts on sea turtles. The APMs are considered part of the Proposed Action and applicable action alternatives and are assessed within each IPF. The measures outlined in the COP include maintaining reasonable distances from sea turtles (MMST-01), adhering to NMFS Regional Viewing Guidelines to minimize the risk of vessel collision (MMST-02), posting protected species observers as required by NMFS during construction activities (MMST-04), obtaining necessary permits and establishing appropriate and practicable mitigation and monitoring measures (MMST-05), and developing and implementing a Protected Species Mitigation and Monitoring Plan (MMST-06) (COP Volume II, Table 1.1-2; Ocean Wind 2023).

As part of its COP, Ocean Wind has also developed a Protected Species Mitigation and Monitoring Plan for marine mammals, sea turtles, and ESA-listed fish species (COP Volume III, Appendix AA; Ocean Wind 2023). Measures proposed in the Protected Species Mitigation and Monitoring Plan include but are not limited to protected species observers, vessel avoidance measures such as separation distances and speed restrictions, pile driving time-of-year restrictions, visual monitoring for HRG surveys, UXO detonation monitoring, marine debris awareness training, and monitoring and reporting of sea turtle observations during activities with potential impacts. Appendix H, Table H-1 provides a full list of the committed measures in greater detail.

3.19.5 Impacts of the Proposed Action on Sea Turtles

3.19.5.1. Impacts of the Proposed Action

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park, which is described in Section 3.19.8, *Impacts of Alternative E on Sea Turtles*.

This section summarizes the potential impacts of the Proposed Action on sea turtles during the various phases of the proposed Project. Routine activities would include construction, O&M, and decommissioning of the proposed Project, as described in Chapter 2, *Alternatives*. BOEM prepared a BA for the potential effects on ESA-listed species under NMFS' jurisdiction, which found that the Proposed Action *may affect and is likely to adversely affect* ESA-listed sea turtles (BOEM 2022). The BA concluded that auditory effects due to the Proposed Action may affect, but are not likely to adversely affect, ESA-listed sea turtles. Non-auditory effects from UXO detonations due to the Proposed Action could include mortality and therefore may adversely affect ESA-listed sea turtles. Also, trawl surveys could lead to the capture and minor injury of small numbers of individual sea turtles, which may adversely affect small numbers of sea turtles as detailed in the BA (BOEM 2022).

The analysis of impacts under the No Action Alternative (see Section 3.19.3.2), and references therein, applies to the following discussion of impacts under the Proposed Action. The most impactful IPFs associated with the Proposed Action, discussed below, include underwater noise during pile driving, which could cause temporary impacts; increased vessel traffic, which could lead to injury or mortality from vessel strikes; the presence of structures, which would lead to permanent impacts that may be either adverse or beneficial; and cable emplacement and maintenance, which could affect sea turtles from mechanical and hydraulic dredging techniques and via water quality effects.

Accidental releases: Accidental release of trash and debris may occur from Project vessels during construction, operations, and decommissioning. BOEM assumes operator compliance with federal and international requirements for managing shipboard trash; such events also have a relatively limited spatial impact. While precautions to prevent accidental releases would be employed by vessels and port operations associated with the Project, it is likely that some debris could be lost overboard during construction, maintenance, and routine vessel activities. However, the amount would likely be miniscule compared to other inputs. In the event of a release, it would be an accidental, localized event in the vicinity of the Project area, likely resulting in non-measurable impacts, if any. However, because sea turtle ingestion of trash can be fatal, the overall impact would be minor. Proposed mitigation and monitoring for waste management, including marine debris awareness and elimination training for Project personnel, would be required, reducing the likelihood of an accidental release.

EMF: The Project would install up to 190 miles of 8-inch 170-kV array cable among the WTGs. Up to 175 miles of up to three 13-inch 275-kV export cables would be added in the Project area, buried to a depth of 4 to 6 feet (1.2 to 1.8 meters) depending on site conditions (Ocean Wind 2023). Normandeau et al. (2011) concluded that sea turtles are unlikely to detect magnetic field intensities below 50 milligauss, suggesting that these species would be insensitive to EMF effects from the Project's electrical cables. Furthermore, the proposed shielding and burial depths would minimize EMF intensity and extent. Given the extremely small area where exposure to this IPF would occur and the proposed burial depth of the submarine cable, no measurable impacts such as changes in swimming direction and altered migration routes would be expected. These effects on sea turtles are more likely to occur with direct current cables than with alternating current cables (Normandeau et al. 2011). Because alternating current cables have been proposed for the Project and the Project area represents an extremely small area within the coastal waters used by sea turtles, BOEM expects non-measurable, minor impacts, if any, on sea turtle behavior.

Cable emplacement and maintenance: The Proposed Action would include up to 390 acres (1.6 km^2) of seafloor disturbance by cable installation, which would mostly be done by jet or mechanical plow. The predicted concentrations of suspended sediment for various cable emplacement activities are described in Section 3.15.5, *Impacts of the Proposed Action on Marine Mammals*. Sediment within the Wind Farm Area is generally fine and medium-grained sand with areas of gravelly sand and gravel deposits near the Wind Farm Area. Based on the grain sizes evaluated by the studies in Massachusetts, Rhode Island, and Virginia, the gravelly sand and gravel deposits near the Wind Farm Area are likely to settle to the bottom of the water column quickly and sand re-deposition would be minimal and close to the trench centerline.

For grain sizes that are fine and medium-grained sand within the Wind Farm Area, sediments would settle on the seafloor within minutes and potentially extend laterally up to 160 meters. Although turbidity is likely to be high in the affected areas, the sediment would no longer affect water quality once it has settled. Elevated turbidity levels would be localized, short term, and temporary in duration. Physical or lethal effects are unlikely to occur because sea turtles are air-breathing and lay eggs on land, and therefore do not share the physiological sensitivities of susceptible organisms like fish and invertebrates. If elevated turbidity caused any behavioral responses in sea turtles such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary (Michel et al. 2013). Furthermore, sea turtles are migratory species that forage over wide areas and would likely be able to avoid short-term suspended sediment impacts that are limited in severity and extent without consequence. Because the effect of sediment suspension would be short term and localized and the use of dredging would be restricted, negligible impacts, if any, would be expected.

Dredging could contribute additional impacts on sea turtles related to impingement, entrainment, and capture associated with mechanical and hydraulic dredging techniques. Dredging may be used for cable installation in areas for sand wave clearance and for HDD in-water exit pits. The area of potential dredging is currently unknown due to the dynamic nature of sand waves. Dredging would also likely be required in shallow areas in Barnegat Bay to allow vessel access for the export cable installation, which may include the prior access channel on the western side of Island Beach State Park and the western side of Barnegat Bay at the export cable landfall. The duration of inshore dredging is proposed for less than 1 month. Locations include the prior channel (west side of Island Beach State Park/east side of Barnegat Bay), the west side of Barnegat Bay at the export cable landfall, and the Oyster Creek section of the federal channel in Barnegat Bay. Ocean Wind proposes to conduct maintenance dredging of the Oyster Creek channel if USACE is unable to conduct dredging in this area as part of the federal channel dredging that is currently under contract. Dredging for the Project is anticipated to be less than 1 acre/7,000 cubic yards (5,352 m^2). Approximately 18,000 cubic yards (13,762 cubic meters) of sediment would be removed from a 3.7-acre (0.015-km^2) area to maintain the Oyster Creek federal navigation channel to its authorized 200-foot width and 8-foot depth (61-meter width and 2.4-meter depth). Ocean Wind proposes to use a hydraulic cutterhead or closed-clamshell dredge and will evaluate use of previously permitted and available confined disposal locations or other upland facilities using either a pipeline system or a barge to transport the dredged material.

As noted in Section 3.19.3.2 under cable emplacement and maintenance, considerations should be taken for the dredge type used in evaluating the potential impacts on sea turtles. Mechanical dredging would consist of lowering an open clamshell bucket through the water column and, once the bucket contacts the seafloor, closing the bucket jaws to trap and scoop the sediment that is then brought to the surface. Based on all available evidence, sea turtles being captured in a mechanical dredge is extremely unlikely to occur. Hydraulic dredging uses dragheads that trail along the seafloor removing sediment. Sea turtles are most often able to escape from the oncoming draghead of a hydraulic dredge due to the slow speed that the draghead advances (up to 3 miles per hour or 4.4 feet per second [1.4 m/s]) (NMFS 2020). During swimming and surfacing, sea turtles are highly unlikely to interact with the draghead and are most vulnerable when foraging or resting on the seafloor. The Project would employ protected species observers on landfall dredges, inshore where sea turtles are known to be more vulnerable to dredging, like in the Barnegat Bay, which would decrease the risk of impingement or entrainment of sea turtles during dredging activities. Also, there are no known large aggregation areas or areas where sea turtles would be expected to spend large amounts of time stationary on the bottom where they would be likely affected by dredging, and the potential capture of sea turtles is most likely in areas like channels, SAV beds, and areas that otherwise have relatively high densities of sea turtles. Because there is a low risk of interactions with dredges and Ocean Wind would implement mitigation and monitoring measures, the likelihood of a sea turtle becoming entrained in a dredge associated with the Proposed Action, if it were to occur, would be considered minor.

Dredging would increase turbidity and temporarily affect an overall very small area that may be used as foraging habitat by sea turtles. During ultrashallow dredging in proximity to SAV beds, Ocean Wind would consider installing silt curtains parallel to the SAV beds to reduce sediment deposition in these sensitive areas. Also, to avoid impacts on adjacent SAV beds, Ocean Wind is performing geotechnical investigations and will use that data to determine whether HDD is the installation technique with the least environmental impact or whether the risk of inadvertent return is such that open cut would result in the least impact. This method would limit the impacts on SAV to approximately 2.92 acres (0.012 km^2) and make the likelihood of impacts on green sea turtle foraging from Project dredging activities so small it cannot be meaningfully measured, detected, or evaluated. Impacts would be reduced because Ocean Wind would implement a SAV monitoring and mitigation plan to ensure that any impacts on SAV during construction and installation of the export cable are monitored and reasonable actions are taken to avoid and minimize seabed disturbance and sediment dispersion, consistent with permit conditions. Because SAV restoration is likely to have poor success, Ocean Wind is proposing a 3:1 mitigation ratio, consisting of mapping efforts, monitoring activities, restoration of documented impacts at an in-situ 1:1 ratio, and additional research to improve SAV mitigation in the future. Pelagic prey items are extremely unlikely to be affected due to the operation of both dredges on the seafloor; therefore, leatherback sea turtle prey items are extremely unlikely to be affected. The benthic organisms preyed upon by Kemp's ridley and loggerhead sea turtles may survive entrainment and motile organisms, such as crabs, may avoid the dredge. However, entrainment of crabs does occur (Reine and Clarke 1998) and BOEM expects that most small benthic invertebrates in the path of the dredge would be entrained. Given the size of the area where dredging will occur and the short duration of dredging, the loss of benthic invertebrates would be small, temporary, and localized. Based on this analysis, BOEM expects any impact on foraging for sea turtles from the loss of prey items due to dredging to be negligible.

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 population-level effects are unlikely to occur.

Noise: Project noise transmitted through water, through the seabed, or both can result in high-intensity, low-exposure-level, and long-term but localized intermittent risk to sea turtles. Data regarding sea turtle hearing abilities were summarized in Table 3.19-4. The acoustic thresholds for the onset of PTS, TTS, and behavioral disruptions for sea turtles for impulsive and non-impulsive noise sources were detailed in Table 3.19-5. Underwater noise generated by impact installation of monopiles and pin piles, vibratory installation and removal of sheet piles for cofferdams, detonations of UXO, vessel activity, and WTG operation would increase sound levels in the marine receiving environment and may result in potential adverse effects on sea turtles in the Project area including PTS, TTS, or behavioral disturbance.

Impact pile-driving noise: Noise from pile driving, which would occur during the installation of Project structures, would result in a potential risk of behavioral disturbance or TTS in sea turtles. Pile driving would involve two pile types: monopiles and pin piles. For the WTGs, a single (8-meter-diameter at top, 11-meter-diameter at bottom) vertical hollow steel monopile would be installed for each location using an impact hammer (IHC-4000 or IHC-S-2500 kilojoule impact hammer or similar) to an expected penetration depth of 50 meters. Installation of a single monopile is expected to take 9 hours (1 hour pre-clearance period, 4 hours piling, 4 hours moving to next location). Up to two piles are expected to be installed per 24-hour period. Concurrent monopile installation at more than one location is not planned. For the OSS, a piled jacket foundation is being considered. This would involve installing 16- by 2.44-meter-diameter pin piles as a foundation for each OSS foundation using an impact hammer (IHC-S-2500 kilojoule impact hammer or similar) to an expected penetration depth of 70 meters. Alternatively, a single monopile like the ones used for WTGs may be used for each OSS. Each pin pile takes approximately 4 hours to install, and a single OSS foundation is expected to take 6 days to install.

For installation of both the WTG and OSS monopile foundations, 24-hour-per-day pile driving is expected to occur. A total of 98 monopiles would be installed for WTGs and 48 pin piles (or three monopiles) would be installed for OSS, constituting about 584 hours of active pile driving (404 if monopiles are used, assuming OSS monopile installation is identical to WTG). Sea turtle hearing sensitivity is within the frequency range of sound produced by impact pile driving, although their rigid external anatomy may make sea turtles highly protected from such impulsive sound effects (for a summary, see Popper et al. 2014). Any sea turtle present in the area could be exposed to the noise from one pile-driving event per day, repeated over a period of days.

As described in Section 3.15, Ocean Wind has committed to using a noise mitigation system during installation of both monopiles and pin piles that achieves a performance of 10 dB broadband attenuation during pile-driving activities. Accordingly, the modeled isopleths for potential behavioral disturbance to sea turtles for one monopile per day ranged from 0.76 to 1.18 kilometers during summer. The number of sea turtles predicted to receive sound levels above exposure criteria during pile driving for WTGs and OSS is summarized in Tables J-12 through J-14 in Appendix J. The number of individual sea turtles predicted to receive sound levels above PTS (e.g., injury) with 10-dB attenuation during impact pile driving for WTG and OSS installation is discountable for Kemp's ridley, leatherback, and green sea turtles, as fewer than one individual sea turtle is predicted to be affected.

Potential PTS effects on loggerhead sea turtles are considered possible, and up to eight individuals may be exposed to underwater noise in excess of PTS thresholds during WTG monopile installation. Up to 16 Kemp's ridley, seven leatherback, and 175 loggerhead sea turtles could be exposed to underwater noise exceeding behavioral thresholds from impact pile-driving of WTG and OSS monopiles. Acoustic modeling of pile driving for pin piles supporting OSS jacket foundations predicted that an additional 15 loggerheads could be exposed to underwater noise exceeding behavioral thresholds. With the use of APMs such as soft-start procedures, noise-attenuating systems, and implementation of monitoring zones and clearance zones (Table H-1), mortality or injury (PTS) would not be expected and pile-driving noise would therefore not be expected to affect the population level of any of the sea turtle species.

Vibratory pile driving noise: Temporary sheet pile cofferdams may be installed at the following four locations and would likely involve vibratory pile driving:

- Oyster Creek HDD, two cofferdams (Atlantic Ocean to Island Beach State Park; sea-to-shore)
- Island Beach State Park Barnegat Bay HDD, two cofferdams (Barnegat Bay onshore; bay-to-shore)
- Oyster Creek HDD, two cofferdams (bayside of Oyster Creek; shore-to-bay)
- BL England HDD, one cofferdam (sea-to-shore)

Selection of a preferred design for cofferdams and landfall works is pending additional design and coordination. Ocean Wind anticipates that impacts relating to cofferdam installation and removal would eclipse any potential impacts of alternative methods, and therefore cofferdam estimates represent the most conservative values and are carried forward in this EIS. It is possible that some injury (TTS or PTS) and behavioral disturbance effects could occur on green and Kemp's ridley sea turtles, but the installation and removal is only expected to occur over a 4-day period. Given the low density of sea turtles within inshore areas of New Jersey, impacts from vibratory pile driving on sea turtles would be negligible to minor.

In summary, pile-driving noise (impact and vibratory) associated with the Proposed Action may result in temporary impacts, including behavioral effects and minor auditory injury to individual turtles activities. Given that pile-driving activities would be conducted with mitigation measures such as the use of noise-attenuating systems, soft-start procedures, and protected species observers, impacts on individual sea turtles through this sub-IPF would be expected to be reduced. Once pile driving stops, this sub-IPF would be removed from the environment and sea turtle behavior would be expected to return to normal. If exposed to noise that leads to PTS, individuals would experience permanent effects. Impacts at the population level are not anticipated given the low density of turtles in the Project area and the spacing between individual work areas.

HRG survey noise: Ocean Wind expects that there would be an estimated 19,496 miles (31,375 kilometers) of HRG surveys required in the Offshore Project area (including the export cable routes), with a single vessel being able to cover 43.5 miles (70 kilometers) per day. Specific details of these surveys can be found in Section 2.1.2.2.1, *Site Preparation Activities.*

As discussed above under the No Action Alternative, HRG surveys used in the Project area can use a combination of sonar-based methods to map shallow geophysical features and can be classified as impulsive or non-pulsive noise sources. HRG surveys that use non-impulsive sources are not expected to affect sea turtles because they operate at frequencies above the sea turtle hearing range.

Previously, BOEM (2018) and NMFS (2021b) evaluated potential underwater noise effects on sea turtles from HRG surveys using impulsive sources (boomers, airguns, sparkers, sub-bottom profilers) and concluded that for an individual sea turtle to experience PTS, it would have to be within 3.3 feet (1 meter) of the loudest possible noise source. Furthermore, it was determined that none of the equipment being operated for HRG surveys with hearing overlap for sea turtles has source levels loud enough to result in PTS or TTS.

The only potential effects on sea turtles may be the noise from impulsive sources used during HRG surveys that exceed the behavioral effects threshold (175 dB). For sea turtles to experience behavioral disturbance they would have to be within 295 feet (90 meters) of the sound source (maximum sound levels). Ocean Wind estimates that the number of sea turtles exposed to sound levels eliciting behavioral changes would be low given the large monitoring and shutdown zone monitored. Activities would be stopped if an animal entered the 295-foot (90-meter) shutdown zone. While low-level behavioral exposures could occur, these disruptions would be limited in extent and short term in duration given the movement of the survey vessel and the mobility of the animals and would have limited effects on both the individual and population. Therefore, underwater noise impacts from HRG surveys are expected to be minor.

UXO detonation noise: UXO detonations could generate high pressure levels that could cause disturbance and injury to sea turtles. Ocean Wind conducted modeling of acoustic ranges for UXO, which included three sound pressure metrics (peak pressure level, SEL, and acoustic impulse), four different depths at four different sites, and five charge weight bins (ranging from 2.3 kilograms [bin E4] up to 454 kilograms [bin E12]). The modeling of acoustic fields was performed using a combination of semi-empirical and physics-based computational models. The modeling assumed that the full weights of UXO explosive charges are detonated together with their donor charges and that no shielding by sediments occurs. It also assumed that only one UXO would be detonated within a 24-hour period. Both unmitigated and mitigated (10-dB reduction) detonations were included in the model. For UXO detonations, auditory PTS thresholds for all sea turtles would be exceeded up to 1,549 feet (472 meters) from the source, and for behavioral thresholds this distance increases to 7,382 feet (2,250 meters). Potential non-auditory effects on sea turtles from UXO could be expected up to 1,273 feet (388 meters) from the source. UXO detonations could thus result in mortality of sea turtles in spite of pre-clearance efforts because surveys for small species in clearance zones can be difficult. However, impacts would be minor given the relatively low number of potential UXO anticipated to be encountered within the Project area and Ocean Wind’s commitment to using a dual noise mitigation system. Additional details about impacts of UXO detonations and other underwater noise on sea turtles are also presented in the BA (BOEM 2022).

Vessel noise: The frequency range for vessel noise (10 to 1,000 Hz; MMS 2007) overlaps with sea turtles’ known hearing range (less than 1,000 Hz with maximum sensitivity between 200 to 700 Hz;

Bartol and Ketten 2006) and, therefore, the vessel noise would be audible. The broadband source level of a modern commercial container ship traveling at 21.7 knots is up to 188 dB re 1 µPa (McKenna et al. 2012). This source level is below the non-impulsive acoustic injury threshold of 204 dB re 1 µPa for sea turtles (Finneran et al. 2017), meaning that only behavioral responses could be expected for sea turtles exposed to Project vessel noise. The increase in vessel traffic associated with the Project would be greatest during construction, with an estimated 20 to 65 vessels operating at any given time. In total, the Proposed Action would generate approximately 3,847 vessel trips during the construction and installation phase (COP Volume I, Section 6.1, Tables 6.1.2-1 through 6.1.2-5; Ocean Wind 2023). The construction vessels used for Project construction are described in the COP Volume 1, Section 6.1.2.4.2 and Tables 6.1.2-1 to 6.1.2-4 (Ocean Wind 2023). Typical large construction vessels used in this type of project range from 325 to 350 feet in length, from 60 to 100 feet in beam, and draft from 16 to 20 feet (Denes et al. 2021). The noise from these smaller, slower vessels may be below the behavioral response thresholds of sea turtles or limited to the area immediately adjacent to the vessel. Sea turtles are regularly subjected to commercial shipping traffic and other vessel noise and may be habituated to vessel noise as a result of this exposure. Given the lower sound levels associated with vessel transit and operation and the limited ensonified area produced by this source, the risk of impacts on sea turtles is expected to be negligible to minor.

Turbine operational noise: Sound generated by WTGs aerodynamics and mechanical vibration may result in long-term, continuous underwater noise in the offshore environment. Noise generated by offshore WTGs less than 6.15 MW range from around 80 to 135 dB re 1 µPa SPL_{RMS} underwater, with frequencies between 10 Hz and 8 kilohertz (Tougaard et al. 2020). Recent studies conducted by Stöber and Thomsen (2021) have suggested that operational noise from larger, current-generation WTGs on the order of 10 MW would generate higher source levels than the range noted above, at around 170 dB re 1 µPa SPL_{RMS}. However, the shift from using gear boxes to direct-drive technology is expected to reduce the sound level by 10 dB. Based on the current available data, as discussed above under the No Action Alternative, underwater noise from turbine operations is unlikely to cause PTS or TTS in sea turtles but could cause behavioral effects. It is expected that these effects would be at relatively short distances from the foundations and would reach ambient underwater noise levels within 50 meters of the foundations (Miller and Potty 2017; Tougaard et al. 2009) and sea turtles would be expected to habituate to the noise.

Summary of Noise Impacts: Noise generated from Project activities would include impulsive (e.g., impact pile driving, UXO detonations, 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, UXO detonations, and, to a lesser extent, vibratory pile driving could cause injury-level effects (i.e., PTS) in sea turtles. UXO detonation may also cause non-auditory mortality at close range. All noise sources have the potential to cause behavior-level effects and some may also cause TTS. The APMs proposed to reduce the effects of underwater noise on sea turtles are expected to be effective in limiting the potential for PTS and non-auditory injury and mortality; however, the potential for some PTS, TTS, and behavioral effects remains. The intensity of this IPF is considered medium for impact and vibratory pile driving, as PTS thresholds would be exceeded; severe for UXO detonations, as mortality thresholds would be exceeded; and low for all other activities, as TTS and behavioral thresholds would be exceeded. The predicted effects would be permanent in the case of some PTS effects and non-auditory injury/mortality resulting from UXO detonations and short term with respect to TTS, behavioral effects, and masking. The geographic extent is considered localized for PTS effects and extensive for behavioral disturbance effects. The frequency of the activity causing the effect is considered infrequent for impact pile driving, vibratory pile driving, UXO detonations, aircraft, cable-laying, and trenching and dredging noise; frequent for HRG survey noise; and continuous for WTG operational noise. With the APMs in place for UXO detonations such as pre-clearance surveys and the relatively small areas where mortality is possible, the likelihood of mortality of a sea turtle from UXO detonations is considered low. With implementation of effective APMs such as a noise mitigation system (for 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.

Traffic (vessel strikes): Vessels would occur during the pre-construction, construction, O&M, and decommissioning phases. Based on information provided by Ocean Wind, construction activities would require several types of vessels transiting between the various ports and the Project area, totaling an estimated 2,859 vessel trips over the 20-month construction period, or approximately 143 trips per month (COP Table 1-6; Ocean Wind 2023). Increased vessel traffic associated with the Project may increase the potential for high-intensity impacts from vessel strikes traveling between the Wind Farm Area and the following ports that are expected to be used during construction: Atlantic City, New Jersey, as a construction management base; Paulsboro, New Jersey, or from Europe directly for foundation fabrication and load out; Norfolk, Virginia, or Hope Creek, New Jersey, for WTG pre-assembly and load out; and Port Elizabeth, New Jersey, or Charleston, South Carolina, or directly from Europe for cable staging. All O&M transits would occur from Atlantic City, New Jersey, to the Offshore Project area. Construction would generate between 20 and 65 vessels operating in the Wind Farm Area or over the offshore export cable route at any given time. The regions of greatest risk for sea turtles from vessel strike are beyond the Project area where high densities of sea turtles and high concentrations of recreational-boat traffic occur, such as the eastern Florida coast, Florida Keys, and the shallow coastal bays in the Gulf of Mexico (National Research Council 1990). The lack of nesting beaches in the Project area where vessels may be close to shore makes this factor irrelevant for this analysis, with the exception of boats transiting from Charleston, South Carolina. However, these would be large, slow-moving cargo vessels that will be operating offshore where sea turtles are more dispersed. Also, due to the small number of proposed vessel transits in otherwise heavily traveled waters, Project vessels transiting south of the Project area would not result in a measurable increased risk to sea turtles. It is possible that some vessels would transit from Europe, although the number and port locations are unknown. These vessels would be specialized construction vessels and cargo vessels that may travel up to around 12 knots (6.1 m/s). They would represent an extremely small portion of the vessel traffic to and from ports in western Europe and the Atlantic coast. It is extremely unlikely that any sea turtles would occur along the vessel transit route at the same time one of these Project vessels is moving through the area due to the dispersed nature of sea turtles in the open ocean and the intermittent presence of such vessels. Together, these factors make it extremely unlikely that any sea turtle would be struck by a Project vessel transiting from Europe.

Sea turtle exposure to vessel traffic would be expected to be concentrated in nearshore habitats during Project construction, which is estimated to occur between 2023 to 2025. This is because nearshore areas would be most regularly traversed by high volumes of Project vessels and shallow foraging habitat may be particularly dangerous for turtles because of their tendency to flee toward deeper water and use deeper water to rest between foraging bouts during the day as well as overnight (Hazel et al. 2007). The collision risk for turtles in all areas is likely to be further exacerbated if water clarity is low and if vessel traffic continues at night, because both turbid water and darkness would impede turtles' visual detection of danger areas. Several other factors contribute to the probability of vessel strikes, including sea turtle density, time of year, sea turtle submergence rates, vessel type and speed, vessel trip numbers, and vessel trip distances. While not available for this analysis, a risk model was developed by BOEM (Barkaszi et al. 2021) for assessing vessel strike risk associated with offshore wind development, which incorporates information from databases and reports to obtain sea turtle density, distribution, and swim depth data. Information about sea turtle density considerations is discussed in Section 3.19.1 and summarized in Table 3.19-2. Sea turtles, with the exception of hatchlings and pre-recruitment juveniles, spend a majority of their time submerged, during which time they may not be susceptible to vessel strikes. Sea turtles spend less than 6 percent of their time at the water's surface (Lutcavage and Lutz 1997), during which they would be most vulnerable to being struck by vessels or propellers. Information on swim depth is provided in the U.S. Navy Undersea Warfare Center's dive distribution and group size parameter reports (Watwood and Buonantony 2012; Borcuk et al. 2017); these data suggest that loggerhead and green sea turtles spend 60 to 75 percent of the time within 32 feet (10 meters) of the surface, leatherback sea turtles spend about 20 percent of the time within 32 feet (10 meters) of the water surface, and there are insufficient data to quantify Kemp's ridley sea turtle activity. Any sea turtle found in the geographic analysis area could thus occur at or near the surface, whether resting, feeding, or periodically surfacing to breathe.

Based on information provided by Ocean Wind, construction activities (including offshore installation of WTGs, substations, array cables, interconnection cable, and export cable) would require up to 20 to 65 simultaneous construction vessels (COP Volume I Tables 6.1.2-1 to 6.1.2-4; Ocean Wind 2023). Over 80 percent of the vessels and vessel trips would transit between the Wind Farm Area and Atlantic City, New Jersey. For this transit, vessels would traverse waters with sea turtle densities similar to those described above. At this relatively low density, vessel strikes would be statistically unlikely. Vessels transiting from Norfolk and Charleston could potentially traverse waters where sea turtle abundance may be almost three times higher, with the highest densities of sea turtles predicted to occur for loggerheads near the mouth of the Chesapeake Bay, approximately 20 to 30 miles (32 to 48 kilometers) offshore (Navy 2007). When considered relative to existing vessel traffic, these vessel transits would have a low risk of vessel strikes with sea turtles.

Project construction would also cause shifts in commercial fishing vessel traffic, which includes over 1,000 annual vessel trips in the Lease Area (see Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*). These vessels would be displaced during Project construction and might decide to avoid the Lease Area during Project operation. This reduction in commercial fishing within the Wind Farm Area could lead to a reduced risk of vessel strikes with sea turtles, but collision risk could increase in those areas where fishing vessels relocate. Conversely, recreational fishing vessel traffic in and around the Wind Farm Area could increase as a result of the reef effect generated by the monopile foundations. This assumes similar densities of sea turtles occur in both areas; however, the future distribution of commercial and recreational fishing vessels in response to the Project cannot be predicted. The increased collision risk in some areas is anticipated to be commensurate with the decreased risk within the Wind Farm Area, so changes in collision risk from relocated commercial and for-hire fishing vessels during Project construction would not be measurable from baseline. At most, impacts of relocation of fishing vessel traffic would be considered minor on sea turtles.

Given the mobility of sea turtles and the use of trained, dedicated protected species observers, vessel speed restrictions, and protected species identification training and implementation of monitoring/ clearance zones and shutdown zones, interactions between Project vessels and sea turtles would be reduced. However, sea turtles are not fast swimmers and have difficulty detecting vessels traveling more than 4 kilometers per hour (Hazel et al. 2007). Also, sea turtles are hard to detect in the open ocean and collision risk for turtles in all areas is likely to be further exacerbated if water clarity is low and if vessel traffic continues at night, because both turbid water and darkness would impede sea turtles ability to detect approaching boats. When monitoring at night or in low-visibility conditions, protected species observers would use night-vision goggles with thermal clip-ons, a hand-held spotlight, or a mounted thermal camera system. Although sea turtles are ectothermic, because they do have some capacity to retain heat and are able to maintain body temperatures that are slightly higher than the surrounding environment, the use of thermal imaging is fact capable of detecting sea turtles (Snyder 2017). This was demonstrated by the summer 2017 HRG surveys for the Project, which documented three sea turtle sightings using night vision binoculars, all within 50 meters of a vessel; however, the narrow field of view and low-resolution monochrome image reduces the ability of the observer to discern animals with small surface presence, particularly at greater distances, and also to determine fine-scale features for species identification (Alpine 2017). While these mitigation measures would reduce the probability of a Project-related vessel strike, they would not result in complete avoidance. The Project would have a period of peak vessel activity lasting approximately 1 year (during construction and installation of offshore export cables, WTGs, OSS, and inter-array cables). However, avoidance measures would be designed to avoid vessel strikes on sea turtles by reducing vessel speed and avoiding sighted turtles. The additional measure of training personnel to watch for and report sea turtles would further increase vigilance to avoid striking sea turtles.

Presence of structures: Impacts on sea turtles could result from the reef effect created by the presence of up to 101 foundations and 131 acres (0.53 km^2) of scour/cable protection. Studies have found increased biomass for benthic fish and invertebrates (Pezy et al. 2018; Raoux et al. 2017; Wang et al. 2019), indicating that offshore wind facilities can generate beneficial permanent impacts on local ecosystems, translating to increased foraging opportunities for sea turtles. The WTG and OSS foundations would provide some level of reef effect and may result in long-term, minor beneficial impacts on sea turtle foraging and sheltering; however, long-term, minor adverse impacts could occur as a result of increased interaction with fishing gear. The reef effect and associated increase in fish biomass could increase recreational fishing effort in and around turbine foundations, which may increase marine debris from fouled fishing gear in the area. Sea turtle entanglement in fishing gear is not considered a new IPF, however, but a change in the distribution of fishing effort from other locations.

Gear utilization (biological/fisheries monitoring surveys): The presence of gear used for fisheries and benthic monitoring surveys under the Proposed Action could affect sea turtles by entrapment or entanglement as described for other offshore wind projects in Section 3.19.3. Surveys are expected to occur at short-term, regular intervals over the lifetime of the Project. Trawl surveys for fisheries monitoring could result in small numbers of sea turtle captures, but serious injuries or mortalities would mostly be avoided because the bottom time for proposed trawls would be limited to 20 minutes and available research indicates that limiting tow times to less than 30 minutes likely eliminates the risk of death for incidentally captured sea turtles (Epperly et al. 2002; Sasso and Epperly 2006). As noted previously, further details about this impact are provided in the BA. Because trawl surveys for Project monitoring could lead to potential capture or minor injury or mortality of small numbers of loggerhead and Kemp’s ridley sea turtles, impacts on sea turtles would likely be minor.

3.19.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with past, ongoing, and planned activities. Ongoing and planned non-offshore wind activities within the geographic analysis area that contribute to cumulative impacts on sea turtles include but are not limited to various coastal development projects permitted through regional planning commissions, counties, and towns; dredging for the New Jersey Wind Port on the Delaware River in Salem County; the Davisville/Brooklyn/Newark Container-on-Barge Service; the approved liquefied natural gas export terminals in Elba Island, Georgia, and Jacksonville, Florida; the Roosevelt Island Tidal Energy Project; dredging for beach replenishment used for the Long Beach Island Coastal Storm Risk Management Project, Barnegat Inlet to Little Egg Inlet; the Atlantic City marina upgrades; and the Port of Virginia channel deepening. Ongoing and planned offshore wind activities in combination with the Proposed Action would result in an estimated 3,044 WTGs, to which the Proposed Action would contribute 98 WTGs, or 3 percent.

Accidental releases: The Proposed Action would contribute an undetectable increment to the cumulative accidental release impacts on sea turtles, which are expected to be minor.

EMF: The Proposed Action would contribute an undetectable increment to the cumulative EMF impacts on sea turtles, which are expected to be negligible.

Cable emplacement and maintenance: The Proposed Action would contribute an undetectable increment to the cumulative cable emplacement and maintenance impacts on sea turtles, which are expected to be minor.

Noise Impacts: The Proposed Action would contribute a noticeable increment to the cumulative noise impacts on sea turtles, which are expected to be minor.

Traffic (vessel strikes): The Proposed Action would contribute a noticeable increment to the cumulative vessel traffic impacts on sea turtles, which are expected to be minor.

Presence of structures: The Proposed Action would contribute a noticeable increment to the cumulative impacts of structures on sea turtles, which are expected to be minor.

Gear utilization (biological/fisheries monitoring surveys): The Proposed Action would contribute a noticeable increment to the cumulative impacts of gear utilization, which are expected to be negligible.

3.19.5.3. Conclusions

Impacts of the Proposed Action. Project construction and installation, O&M, and conceptual decommissioning would result in habitat disturbance, entrainment and impingement, underwater and airborne noise, water quality degradation, vessel traffic (strikes and noise), artificial lighting, and potential discharges/spills and trash. BOEM anticipates the impacts resulting from the Proposed Action would range from **negligible** to **minor** adverse impacts and could include potentially **minor beneficial** impacts. Adverse impacts are expected to result mainly from pile-driving noise and increased vessel traffic. Beneficial impacts are expected to result from the presence of structures. Beneficial impacts; however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Cumulative Impacts of the Proposed Action. The incremental impacts contributed by the Proposed Action to the cumulative impacts on sea turtles would range from undetectable to noticeable. BOEM anticipates that the cumulative impacts on sea turtles associated with the Proposed Action would be **minor**. The main drivers for these impact ratings are pile-driving noise and associated potential for auditory injury, the presence of structures, ongoing climate change, and ongoing vessel traffic posing a risk of collision. The Proposed Action would contribute to the cumulative impacts primarily through pile-driving noise and the presence of structures. BOEM made this decision because the overall effect would be detectable and measurable, but these impacts would not result in population-level effects.

3.19.6 Impacts of Alternatives B-1, B-2, C-1, and D on Sea Turtles

Impacts of Alternatives B-1, B-2, C-1, and D. Alternatives B-1, B-2, C-1, and D would include exclusion of proposed WTGs and would lead to the same types of impacts on sea turtles from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action. Alternatives B-1, B-2, C-1, and D would exclude up to 9, 19, 8, and 15 turbines, respectively; this is equivalent to an approximately 10- to 20-percent reduction in the size of the Project. Table 3.19-6 summarizes the differences in the number of monopiles as they related to each alternative. The corresponding reduction in the number or duration of construction vessels in the Offshore Project area is unknown; therefore, the discussion regarding a reduction in vessels during construction is qualitative.

Table 3.19-6 Summary of Changes to Impact Pile-Driving Requirements Among Alternatives

Alternative	WTGs	Reduction in Monopiles	Total Number of Monopiles	Total Hours of Impact Pile Driving (4 to 6 hrs/pile)	Number of days
Proposed Action	98	98	98	392 to 588 hours	98
Alternative B-1	exclusion of up to 9 WTG positions	Up to 9 fewer	89	356 to 534 hours	89
Alternative B-2	exclusion of up to 19 WTG positions	Up to 19 fewer	79	316 to 474 hours	79
Alternative C-1	exclusion of 8 WTG positions	Up to 8 fewer	90	360 to 540 hours	90
Alternative D	exclusion of up to 15 WTG positions	Up to 15 fewer	83	332 to 498 hours	83

Notes: Assumes each pile would require 4 to 6 hours of impact pile driving per pile, with a maximum-case scenario of one pile per day.
hrs/pile = hours per pile

These alternatives may change the duration for the IPFs in comparison to that described for the Proposed Action in Section 3.19.5, as described in following paragraphs.

Noise: The 10- to 20-percent reduction in the number of monopiles for Alternatives B-1, B-2, C-1, and D would reduce the overall number of impact pile-driving hours required for installation. This would limit the duration of the effect by the days outlined in Table 3.19-6. However, the overall effects would remain the same (e.g., PTS, TTS, disturbance, and masking) as described in Section 3.19.5. Limiting the duration of the effect could reduce the number of sea turtles exposed to underwater sound. However, the overall sound levels resulting from construction and decommissioning activities would still have temporary, minor impacts on sea turtles due to potential auditory injuries and behavioral effects as described previously; no mortality or injury (PTS) would be expected. Likewise, a reduction in the number of WTGs would result in a reduction in the number or duration of construction vessels used and may reduce the probability of UXO detonations during Project construction. The magnitude of the effects of underwater noise from Project vessels during construction would remain the same (e.g., disturbance, masking) as described in Section 3.19.5; however, the duration of the effects would be reduced.

Presence of structures: The 10- to 20-percent reduction in the number of monopiles would reduce the overall footprint of the alternatives on the seafloor as compared to the Proposed Action. The beneficial impact of the reef effect on sea turtle resting and foraging and the potential adverse effects of sea turtle entanglement with fisheries gear on WTG foundations would both be proportionally reduced by 10 to 20 percent.

Cable emplacement and maintenance: Alternatives B-1, B-2, C-1, and D would have short-term and localized water quality impacts from inter-array and export cable installation via jet or mechanical plow, and dredging if necessary for sand wave clearance and installation of HDD in-water exit pits, which would produce undetectable, negligible impacts on sea turtles due to increased turbidity. Compared to the Proposed Action, there would be a smaller area of seabed disturbance and water column disturbance and a shorter duration of associated water quality degradation. The area of seabed disturbed by scour protection would be reduced by 0.82 acre per WTG foundation; thus, the 80 acres of total seabed scour protection under the Proposed Action would be reduced by 7 to 12 acres under Alternatives B-1, B-2, C-1, and D. Alternatives that reduce the number of WTGs would also reduce the risk of interactions between hopper dredges and individual sea turtles due to the reduced length of dredging for installation of inter-array cables.

Traffic (vessel strikes): A reduction in the number of monopiles would result in a reduction in the number of construction vessels or the duration of vessels in the Offshore Project area during construction activities that would be required for installation. While unquantifiable, the 10- to 20-percent reduction in the number of monopiles could reduce the probability of a vessel strike on a sea turtle proportionally by 10 to 20 percent during Project construction, operation, and decommissioning. A decrease in Project vessels would also slightly reduce the risk of accidental releases (e.g., fuel spills, trash, debris) that could potentially affect sea turtles.

Cumulative Impacts of Alternatives B-1, B-2, C-1, and D. The incremental impacts contributed by Alternatives B-1, B-2, C-1, and D to the cumulative impacts on sea turtles would be similar to those described under the Proposed Action.

3.19.6.1. Conclusions

Impacts of Alternatives B-1, B-2, C-1, and D. Alternatives B-1, B-2, C-1, and D would reduce the number of WTGs and their associated inter-array cables, which would result in an incremental reduction in effects on sea turtles from certain construction and installation, O&M, and conceptual decommissioning impacts. BOEM expects that the impacts resulting from the alternatives individually would be similar to those of the Proposed Action and would range from **negligible** to **minor** adverse and could include potentially **minor beneficial** impacts.

Cumulative Impacts of Alternatives B-1, B-2, C-1, and D. The incremental impacts contributed by Alternatives B-1, B-2, C-1, and D to the cumulative impacts on sea turtles would range from undetectable to noticeable. BOEM anticipates that the cumulative impacts of Alternatives B-1, B-2, C-1, and D would be the same level as under the Proposed Action: **minor**.

3.19.7 Impacts of Alternative C-2 on Sea Turtles

Impacts of Alternative C-2. Under Alternative C-2, the compressed layout would have the same types of impacts on sea turtles from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action within a smaller construction and operational footprint. Although the area affected by noise, turbidity, and use of construction and operational vessels would be decreased, the number of vessels and monopiles would stay the same. BOEM expects that the impacts resulting from Alternative C-2 would be similar to those of the Proposed Action and would range from negligible to minor adverse and could include potentially minor beneficial impacts.

Cumulative Impacts of Alternative C-2. The incremental impacts contributed by Alternative C-2 to the cumulative impacts on sea turtles would range from undetectable to noticeable. The cumulative impacts of Alternative C-2 would be the same level as under the Proposed Action: minor.

3.19.7.1. Conclusions

Impacts of Alternative C-2. Although Alternative C-2 would result in a decreased construction and operational footprint, BOEM expects that the impacts resulting from the alternative would be similar to those of the Proposed Action and range from **negligible** to **minor** and could include potentially **minor beneficial** impacts.

Cumulative Impacts of Alternative C-2. The incremental impacts contributed by Alternative C-2 would be similar to those of the Proposed Action and range from undetectable to noticeable. BOEM anticipates that the cumulative impacts of Alternative C-2 would be the same level as under the Proposed Action: **minor**.

3.19.8 Impacts of Alternative E on Sea Turtles

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park.

Impacts of Alternative E. Alternative E would lead to the same types of impacts on sea turtles from construction and installation, O&M, and conceptual decommissioning activities in the Offshore Project Area as described for the Proposed Action. The reduced acreage of SAV affected by the Oyster Creek export cable emplacement within Barnegat Bay under Alternative E (0.89 acre) compared to the northernmost export cable route under the Proposed Action (15.25 acres) would reduce potential impacts on adult green sea turtles, as they are the only sea turtles that forage exclusively on aquatic vegetation such as eelgrass. While the number of green sea turtles that would potentially benefit is not quantifiable, the species regularly occurs in Barnegat Bay (Excelon Generation 2012); therefore, minimizing impacts on SAV in Barnegat Bay would avoid the destruction of important green sea turtle foraging habitat. Additionally, SAV provides important nursery habitat for sea turtle prey and is a rich foraging ground. Loggerheads prey on the abundant shellfish found in SAV, especially horseshoe crabs and blue crabs. However, Alternative E would still require trenching activities and would not significantly change potential impacts. It would therefore produce the same types of direct impacts on sea turtles from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action. Impacts within the Offshore Project area would stay the same as under the Proposed Action. Therefore, Alternative E would result in negligible to minor adverse and potentially minor beneficial impacts.

Cumulative Impacts of Alternative E. The incremental impacts contributed by Alternative E to the cumulative impacts on sea turtles would be similar to those described under the Proposed Action: minor.

3.19.8.1. Conclusions

Impacts of Alternative E. Although Alternative E would result in reduced acreage of SAV affected by cable emplacement, BOEM expects that the impacts resulting from the alternative alone would be similar to those of the Proposed Action and range from **negligible** to **minor** and could include potentially **minor beneficial** impacts.

Cumulative Impacts of Alternative E. The incremental impacts contributed by Alternative E would be similar to those of the Proposed Action and range from undetectable to noticeable. BOEM anticipates that the cumulative impacts of Alternative E would be the same level as under the Proposed Action: **minor**.

3.19.9 Proposed Mitigation Measures

Several measures are proposed to minimize impacts on sea turtles (Appendix H, Table H-2 and H-3, as well as Table 1-11 in the BA). If one or more of the measures analyzed below are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced.

Table 3.19-7 Measures Resulting from Consultations (Also Identified in Appendix H, Table H-2): Sea Turtles

Measure	Description	Effect
Passive Acoustic Monitoring (PAM) Plan	BOEM, BSEE, and USACE would ensure that Ocean Wind prepares a PAM Plan that describes all proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the required use of PAM for monitoring. This plan would be submitted to NMFS, BOEM and BSEE (at OSWsubmittals@bsee.gov) for review and concurrence at least 120 days prior to the planned start of pile driving.	Ocean Wind has committed to implementing passive acoustic monitoring, pile-driving monitoring, protected species observer coverage, sound field verification, and shutdown zones as part of the Proposed Action. Compliance with these APMs would be enforced by BOEM, BSEE, and NMFS as indicated in Table H-1. Implementation and enforcement of these APMs would minimize the potential for underwater noise exposure to sea turtles during the conduct of impact pile driving, vibratory pile driving, HRG surveys, and UXO detonation, as disclosed in the analysis of the Proposed Action. Agency-proposed mitigation measures would further define how the effectiveness and enforcement of APMs would be ensured by requiring that Ocean Wind submit passive acoustic monitoring and pile-driving monitoring plans for approval by BOEM, BSEE, and NMFS and a sound field verification plan for approval by BOEM and BSEE; by ensuring that protected species observer coverage is sufficient and requiring deployment of additional protected species observers or platforms if found insufficient or in the event that clearance or shutdown zones are expanded beyond the distances modeled prior to verification. While adoption of these measures would increase accountability and ensure the effectiveness of APMs, it would not alter the impact determination of minor for the underwater noise IPF for sea turtles, because analysis of the
Pile driving monitoring plan	BOEM would ensure that Ocean Wind prepare and submit a *Pile Driving Monitoring Plan* to NMFS and BSEE (at OSWsubmittals@bsee.gov) for review and concurrence at least 90 days before the start of pile driving. The plan would detail all plans and procedures for sound attenuation as well as for monitoring ESA-listed whales and sea turtles during all impact and vibratory pile driving. The plan would also describe how BOEM, BSEE, and Ocean Wind would determine the number of whales exposed to noise above the Level B harassment threshold during pile driving with the vibratory hammer to install the cofferdam at the sea to shore transition. Ocean Wind would obtain NMFS' concurrence with this plan prior to starting any pile driving.	
PSO Coverage	BOEM, BSEE, and USACE would ensure that PSO coverage is sufficient to reliably detect whales and sea turtles at the surface in clearance and shutdown zones to execute any pile driving delays or shutdown requirements. If, at any point prior to or during construction, the PSO coverage that is included as part of the proposed action is determined not to be sufficient to reliably detect ESA-listed whales and sea turtles within the clearance and shutdown zones, additional PSOs and/or platforms would be deployed. Determinations prior to construction would be based on review of the *Pile Driving Monitoring Plan*. Determinations during construction would be based on review of the weekly pile driving reports and other information, as appropriate.	
Sound field verification	BOEM, BSEE, and USACE would ensure that if the clearance and/or shutdown zones are expanded, PSO coverage is sufficient to reliably monitor the expanded clearance and/or shutdown zones. Additional observers would be deployed on additional platforms for every 1,500 m that a clearance or shutdown zone is	

Measure	Description	Effect
	expanded beyond the distances modeled prior to verification.	Proposed Action already includes analysis of the APMs outlined in Table H-1.
Shutdown zones	BOEM, BSEE, and USACE may consider reductions in the pre-start clearance and/or shutdown zones based on the sound field verification measurements. BOEM and BSEE would ensure that Ocean Wind submits a Sound Field Verification Plan for review and approval at least 90 days prior to the planned start of pile driving.	
Look out for sea turtles and reporting	Between June 1 and November 30, Ocean Wind would have trained lookouts posted on all vessel transits during all phases of the project to observe for sea turtles within a 500-meter vessel strike avoidance zone and communicate any sightings in real time to the boat captain. If a sea turtle is sighted within 100 m or less of the operating vessel's forward path, the vessel operator would slow down to 4 knots (unless unsafe to do so) and then proceed away from the turtle at a speed of 4 knots or less until there is a separation distance of at least 100 m at which time the vessel may resume normal operations. If a sea turtle is sighted within 50 m of the forward path of the operating vessel, the vessel operator would shift to neutral when safe to do so and then proceed away from the turtle at a speed of 4 knots. The vessel may resume normal operations once it has passed the turtle.	Measures to minimize vessel interactions would reduce risk of vessel strike. While adoption of this measure would reduce risk to sea turtles under the Proposed Action, it would not alter the impact determination of minor for vessel traffic.
Sampling gear	All sampling gear would be hauled at least once every 30 days, and all gear would be removed from the water and stored on land between survey seasons to minimize risk of entanglement.	The regular hauling of sampling gear, recovery of lost survey gear, sea turtle disentanglement, and handling and resuscitation guidelines would reduce risk of entanglement or effects of entanglement in fisheries survey gear. Gear identification, sea turtle identification, and data collection would improve accountability in the case of gear loss or gear entanglement. While adoption of these measures would reduce risk to sea turtles and improve accountability under the Proposed Action, it would not alter the impact determination of minor for gear utilization.
Gear identification	To facilitate identification of gear on any entangled animals, all trap/pot gear used in the surveys would be uniquely marked to distinguish it from other commercial or recreational gear. Using yellow and black striped duct tape, place a 3-foot-long mark within 2 fathoms of a buoy. In addition, using black and white paint or duct tape, place 3 additional marks on the top, middle and bottom of the line. These gear marking colors are proposed as they are not gear markings used in other fisheries and are therefore distinct. Any changes in marking would not be made without notification and approval from NMFS.	
Lost survey gear	If any survey gear is lost, all reasonable efforts that do not compromise human safety would be undertaken to recover the gear. All lost gear would be reported to NMFS	

Measure	Description	Effect
	(nmfs.gar.incidental-take@noaa.gov) and BSEE (OSWIncidentReporting@bsee.gov) within 24 hours of the documented time of missing or lost gear. This report would include information on any markings on the gear and any efforts undertaken or planned to recover the gear.	
Sea turtle disentanglement	Vessels deploying fixed gear (e.g., pots/traps) would have adequate disentanglement equipment (i.e., knife and boathook) onboard. Any disentanglement would occur consistent with the Northeast Atlantic Coast STDN Disentanglement Guidelines at https://www.reginfo.gov/public/do/DownloadDocument?objectID=102486501 and the procedures described in "Careful Release Protocols for Sea Turtle Release with Minimal Injury" (NOAA Technical Memorandum 580; https://repository.library.noaa.gov/view/noaa/3773).	
Sea turtle/Atlantic sturgeon identification and data collection	Any sea turtles or Atlantic sturgeon caught and/or retrieved in any fisheries survey gear would first be identified to species or species group. Each ESA-listed species caught and/or retrieved would then be properly documented using appropriate equipment and data collection forms. Biological data, samples, and tagging would occur as outlined below. Live, uninjured animals should be returned to the water as quickly as possible after completing the required handling and documentation.	
Sea turtle/Atlantic sturgeon handling and resuscitation guidelines	Any sea turtles or Atlantic sturgeon caught and retrieved in gear used in fisheries surveys would be handled and resuscitated (if unresponsive) according to established protocols and whenever at-sea conditions are safe for those handling and resuscitating the animal(s) to do so.	
Marine debris awareness training	The Lessee would ensure that vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP complete marine trash and debris awareness training annually. By January 31 of each year, the Lessee would submit to DOI an annual report that describes its marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year.	Marine debris and trash awareness training would minimize the risk of sea turtle ingestion of or entanglement in marine debris. While adoption of this measure would reduce risk to sea turtles under the Proposed Action, it would not alter the impact determination of minor for accidental releases.
Take notification, monthly/annual reporting requirements, BOEM/NMFS	GARFO PRD would be notified as soon as possible of all observed takes of sea turtles, occurring as a result of any fisheries survey. At the end of each survey season, a report would be sent to NMFS that compiles all information	Reporting requirements to document take would improve accountability for documenting sea turtle take associated with the Proposed Action. While

Measure	Description	Effect
meeting requirements for sea turtle take documentation	on any observations and interactions with ESA-listed species. BOEM and BSEE would ensure that Ocean Wind submits regular reports (in consultation with NMFS) necessary to document the amount or extent of take that occurs during all phases of the proposed action. To facilitate monitoring of the incidental take exemption for sea turtles, through the first year of operations, BOEM and NMFS would meet twice annually to review sea turtle observation records.	adoption of these measures would improve accountability, it would not alter the overall impact determination for the Proposed Action.
Data Collection BA BMPs	BOEM would ensure that 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 Ocean Wind project as applicable.	Compliance with Project Design Criteria and best management practices for protected species would minimize risk to sea turtles during HRG surveys. While adoption of this measure would decrease risk to sea turtles under the Proposed Action, it would not alter the impact determination of negligible for HRG activities.
Alternative Monitoring Plan (AMP) for pile driving	BOEM would require Ocean Wind to submit an alternative monitoring plan for nighttime pile driving at least 6 months prior to initiating nighttime impact pile-driving activities. The purpose of the plan is to demonstrate that Ocean Wind can meet the visual monitoring criteria with the technologies Ocean Wind is proposing to use for monitoring during nighttime impact pile driving. This plan may include deploying additional observers; alternative monitoring technologies such as night vision, thermal, and infrared technologies; or use of passive acoustic monitoring and must demonstrate the ability and effectiveness to maintain all clearance and shutdown zones during daytime and nighttime to BOEM's and NMFS's satisfaction.	Adoption of this measure could increase the ability of Ocean Wind to detect sea turtles during pile driving but, given the small amount of time that sea turtles spend at the surface, these measures would not eliminate the minor impacts of pile-driving noise on sea turtles.
Periodic underwater surveys, reporting of monofilament and other fishing gear around WTGs	The Lessee must monitor indirect impacts associated with charter and recreational fishing gear lost from expected increases in fishing around WTG foundations by surveying at least 10 of the WTGs located closest to shore in the Ocean Wind 1 Lease Area (OCS-A 0498) annually and report the results of the surveys to BOEM and BSEE in an annual report.	Periodic underwater surveys and reporting of monofilament and other fishing gear around WTG foundations would reduce the risk of entanglement associated with the presence of structures. While adoption of this measure would reduce risk to sea turtles under the Proposed Action, it would not alter the impact determination associated with the presence of structures.

Measure	Description	Effect
PDC minimize vessel interactions with listed species	All vessels associated with survey activities must comply with vessel strike avoidance measures to reduce interaction with listed species.	Ocean Wind has committed to implementing a vessel strike avoidance policy, vessel separation distances, and vessel speed restrictions as part of the Proposed Action and as described in Table H-1. These measures include maintaining a separation distance of greater than 50 meters for sea turtles (see Table H-1). Compliance with Project Design Criteria to minimize vessel interactions with listed species would reduce risk of vessel strike. While adoption of these measures would reduce risk of vessel strike under the Proposed Action, it would not result in complete avoidance and negligible to minor impacts on sea turtles would still be expected.
Operational sound field verification plan	BOEM would require Ocean Wind to develop an operational sound field verification plan to determine the operational noises emitted from the offshore wind area. The plan would be reviewed and approved by BOEM and NMFS.	The development of an operational sound field verification plan would allow BOEM to confirm that impacts of operating WTG noise do not exceed predicted impacts based on existing monitoring data and modeling efforts. While adoption of this measure would improve accountability of WTG operational noise under the Proposed Action, it would not alter the impact determination for WTG noise.
Biological Opinion Reasonable and Prudent Measures and Terms and Conditions	Reasonable and Prudent Measures and Terms and Conditions to minimize the impact of incidental take of ESA-listed species were documented in the NMFS Biological Opinion dated April 3, 2023. These measures include adherence to mitigation measures specified in the final MMPA ITA to minimize impacts during pile driving and UXO detonation; compliance with requirements for vessel operations within the Delaware River and Delaware Bay included in the Incidental Take Statements provided with the Paulsboro Marine Terminal Biological Opinion (dated July 19, 2022) and the New Jersey Wind Port Biological Opinion (dated February 25, 2022); reporting requirements	These Reasonable and Prudent Measures and Terms would minimize the exposure of ESA-listed species to pile-driving noise and the effects of UXO detonation. These Reasonable and Prudent Measures and Terms would also ensure that all incidental take that occurs is documented and reported to NMFS in a timely manner and that any incidentally taken individual specimens are properly handled, resuscitated if necessary, transported for

Measure	Description	Effect
	related to effects to, or interactions with, ESA-listed species; submittal of required plans (e.g., PSO Training Plan for Trawl Surveys, Passive Acoustic Monitoring Plan, Marine Mammal and Sea Turtle Monitoring Plan, Cofferdam Installation and Removal Monitoring Plan, Alternative Monitoring Plan/Night Time Pile Driving Monitoring Plan, Sound Field Verification Plan, North Atlantic Right Whale Vessel Strike Avoidance Plan) to NMFS GARFO with sufficient time for review, comment and approval; and conducting on-site observation and inspection to gather information on the effectiveness and implementation of measures to minimize and monitor incidental take.	additional care or reporting, or returned to the sea. Reporting requirements to document take would improve accountability for documenting take associated with the Proposed Action. In some cases, these Reasonable and Prudent Measures and Terms provide additional detail or clarification of measures that are included as part of the proposed action. Implementation of these Reasonable and Prudent Measures and Terms would provide incremental reductions in impacts on sea turtles and would improve accountability but would not alter the overall impact determination of the Proposed Action.

GARFO = Greater Atlantic Regional Fisheries Office; ITA = incidental take authorization; m = meter; PAM = passive acoustic monitoring; PRD = Protected Resources Division; PSO = protected species observer

Table 3.19-8 Additional Proposed Measures (Also Identified in Appendix H, Table H-3): Sea Turtles

Measure	Description	Effect
Vessel speed restriction	All vessels, regardless of size, would comply with a 10-knot speed restriction in any SMA, DMA, or Slow Zone.	Sea turtles are not fast swimmers and have difficulty detecting vessels traveling more than 4 kilometers per hour (2.16 knots) (Hazel et al. 2007). Therefore vessel speed restrictions would not substantially reduce the risk of vessel strike for sea turtles under the Proposed Action and would not reduce the negligible to minor impact determination for sea turtles.

DMA = Dynamic Management Area; SMA = Seasonal Management Area

3.19.9.1. Measures Incorporated in the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.19-7 and Table H-2 in Appendix H, *Mitigation and Monitoring*, are incorporated in the Preferred Alternative. BOEM has identified the following additional measures in Table 3.19-8 as incorporated in the Preferred Alternative: vessel speed restriction. These measures, if adopted, would further define how the effectiveness and enforcement of APMs would be ensured and improve accountability for compliance with APMs by requiring the submittal of plans for approval by the enforcing agency(ies) and by defining reporting requirements. Because these measures ensure the effectiveness of and compliance with APMs that are already analyzed as part of the Proposed Action, implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.19.2, *Environmental Consequences*. Agency-proposed measures to minimize vessel interactions with sea turtles would reduce risk of vessel strike. While adoption of these measures would reduce risk to sea turtles under the Proposed Action, it would not alter the impact determination of minor for vessel traffic. The regular hauling of sampling gear, recovery of lost survey gear, sea turtle disentanglement, and handling and resuscitation guidelines would reduce risk of entanglement or effects of entanglement in fisheries survey gear. While adoption of these measures would reduce risk to sea turtles under the Proposed Action, it would not alter the impact determination of minor for gear utilization.

3.21. Water Quality

This section discusses potential impacts on water quality from the proposed Project, alternatives, and ongoing and planned activities in the water quality geographic analysis area. The water quality geographic analysis area, as shown on Figure 3.21-1, includes coastal waters within a 10-mile (16-kilometer) buffer around the Offshore Project area and a 15.5-mile (25-kilometer) buffer around the ports that may be used by the Project. In addition, the geographic analysis area includes an onshore component that includes any 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 operational activities of the proposed Project.

3.21.1 Description of the Affected Environment for Water Quality

Surface waters in the geographic analysis area include: (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 Barnegat Bay, Manahawkin Bay, Delaware Bay, Delaware River, Charleston Harbor, Chesapeake Bay, James 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.
- *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 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.

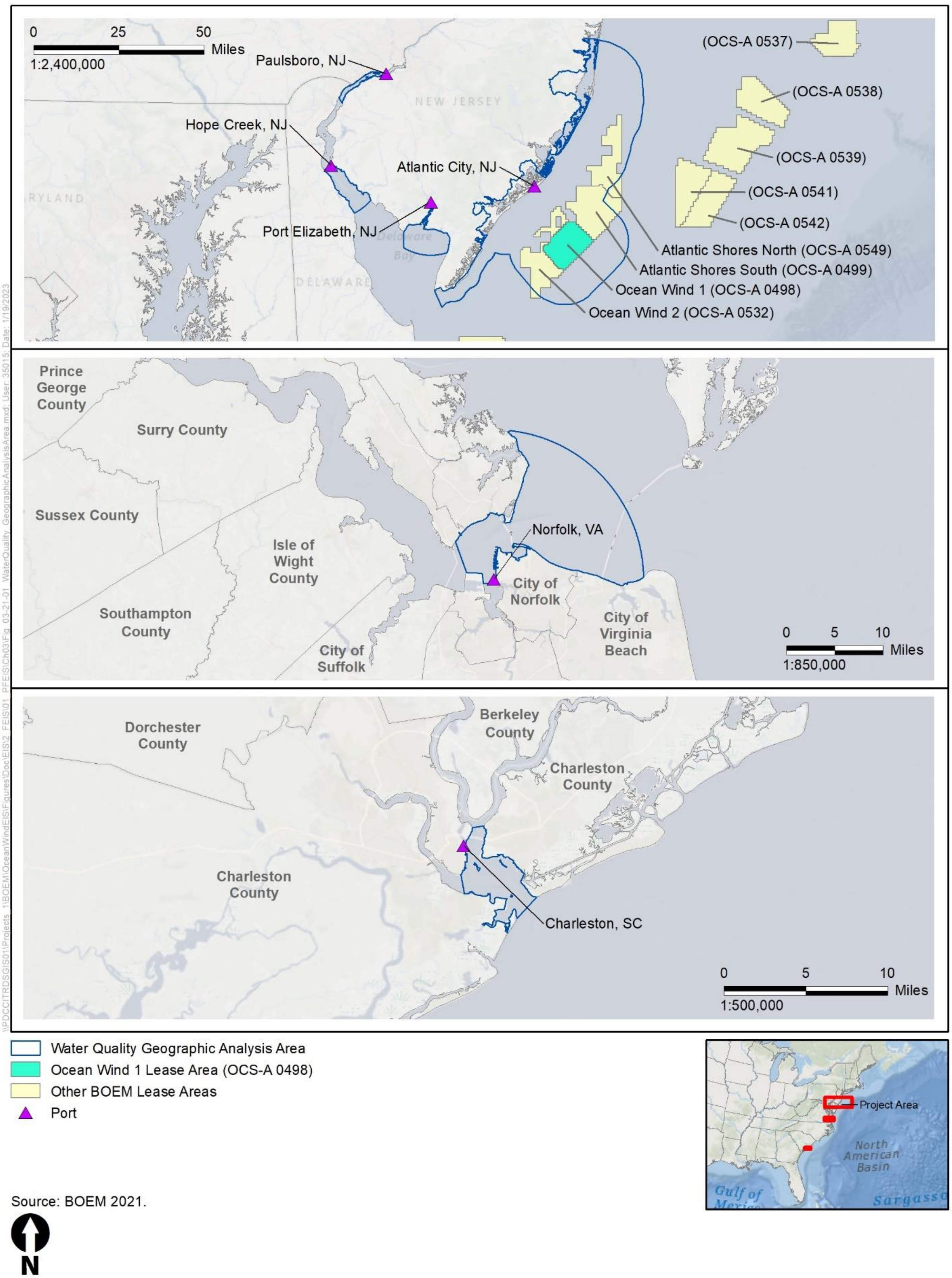


Figure 3.21-1 Water Quality Geographic Analysis Area

- *Turbidity*: Turbidity is a measure of water clarity, which is typically expressed as a concentration of total suspended solids 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, 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: Coastal Marine Waters

Nutrients, DO, Chlorophyll *a*: Table 3.21-1 summarizes water quality parameters for coastal waters at specific point locations in the water quality geographic analysis area, including nutrients, chlorophyll *a*, and DO, for the Atlantic Ocean and various locations in the coastal marine waters between the barrier islands and the mainland around the Proposed project. Nutrient concentrations, as approximated by phytoplankton concentration as chlorophyll *a*, have also been measured via remote sensing techniques. In water closer to the shore, chlorophyll *a* and nutrient values are higher compared to the offshore areas due to input of nutrients from anthropogenic sources. The most recent phytoplankton blooms occur during the fall and winter seasons when stratification decreases due to frequent storms and seasonal overturn. Phytoplankton blooms are also common during the summer months when winds blow surface waters away from the coast and the deeper, cooler, nutrient-rich waters well up from the depths, a phenomenon known as upwelling. When upwelling occurs, these nutrients combined with sunlight lead to phytoplankton blooms along the shorelines in New Jersey (Ocean Wind 2023).

NJDEP conducts annual assessments of the state’s waterways for water quality parameters. Two sites within Barnegat Bay were non-attaining for DO. For Manahawkin Bay and Upper Little Egg Harbor, 50 percent of the 18 sampling stations were below the higher-than-5-mg/L DO target. For samples taken from 15 stations in Lower Little Egg Harbor, 44 percent were below the higher-than-5-mg/L DO target (Ocean Wind 2023).

Table 3.21-1 Water Quality of Coastal Waters in the Geographic Analysis Area

Water Quality Parameter	Unit	Mean	Maximum	Number of Samples
Great Egg Harbor Bay				
Ammonia	µg/L	61	385	188
Nitrate	µg/L	48	2288	194
Total Nitrogen	µg/L	344	2471	192
Total Phosphorus	µg/L	41	96	95
Chlorophyll a	µg/L	2	19	124
DO	mg/L	7	9	190
Little Egg Harbor				
Ammonia	µg/L	--	--	--
Nitrate	µg/L	21	369	409
Total Nitrogen	µg/L	413	1981	434

Water Quality Parameter	Unit	Mean	Maximum	Number of Samples
Total Phosphorus	µg/L	44	140	271
Chlorophyll a	µg/L	4	27	311
DO	mg/L	8	10.9	448
Great Bay				
Ammonia	µg/L	50	535	407
Nitrate	µg/L	37	396	409
Total Nitrogen	µg/L	375	1815	402
Total Phosphorus	µg/L	46	304	217
Chlorophyll a	µg/L	3	27	255
DO	mg/L	7.5	11.3	404
Manahawkin Bay				
Ammonia	µg/L	26	131	146
Nitrate	µg/L	20	214	148
Total Nitrogen	µg/L	544	1896	148
Total Phosphorus	µg/L	50	144	94
Chlorophyll a	µg/L	6	260	108
DO	mg/L	7.8	9	152
Atlantic Ocean				
Ammonia	µg/L	27	504	1188
Nitrate	µg/L	38	259	1218
Total Nitrogen	µg/L	314	8457	1201
Total Phosphorus	µg/L	39	286	803
Chlorophyll a	µg/L	3	50	1021
DO	mg/L	7.7	15.1	1188

Source: Connell 2010.

Salinity: BOEM and NOAA funded an assessment of benthic communities within offshore lease areas, including the Ocean Wind 1 Lease Area. Salinity measured in the Lease Area for the period of 2003–2016 was 32.2 practical salinity units, with a full range spanning 29.4 to 34.4 practical salinity units (n=4,205). This range is within the euhaline range (30–40 practical salinity units), which is the typical salinity range for seawater (Venice salinity classification system). In general, the average salinity increases in the offshore direction off New Jersey, with lower-salinity waters near the shoreline due to the seasonal river discharge and wind variations (Ocean Wind 2023).

Water temperature: Boat-based surveys were conducted to collect various water quality parameters, including temperature, within the Lease Area and surrounding Atlantic Ocean. The minimum sea surface temperature value collected was 36°F (2°C) during winter and the maximum sea surface temperature value collected was 79°F (26°C) during summer. Within the water column, data collected in the New Jersey OCS WEAs over the period of 2003 to 2016 showed seasonal fluctuations spanned as much as 68°F (20°C) at the surface and 59°F (15°C) at the bottom, with thermal stratification beginning in April and increasing into August. Actual surface and bottom temperatures varied substantially from year to year, particularly during the fall. Surface to bottom temperature gradients were warmer at the surface and cooler at the bottom, with a stratified condition in spring and summer and isothermal condition following the fall turnover during winter (Ocean Wind 2023).

Turbidity: Waters along the Northeast Coast, which includes the geographic analysis area around the Project, average 5.6 mg/L of total suspended solids, which is considered low. There are notable exceptions, including estuaries, which averaged 27.4 mg/L, although total suspended solids sampling throughout nine assessment units in and around Barnegat Bay did not record total suspended solids levels above 16 mg/L (USEPA 2012; Ocean Wind 2023). While most ocean waters had total suspended solids concentrations under 10 mg/L, which is the 90th percentile of all measured values, most estuarine waters (65.7 percent of the Northeast Coast area) had total suspended solids concentrations above this level. Near-bottom total suspended solids concentrations were similar to those near the water surface, averaging 6.9 mg/L. With the exception of the entrance to Delaware Bay, all other coastal ocean stations had near-bottom levels of total suspended solids less than or equal to 16.3 mg/L (USEPA 2012).

NJDEP conducts annual assessments of the state's waterways for water quality parameters. Five sampling sites within Barnegat Bay were non-attaining for turbidity. Manahawkin Bay, Upper Little Egg Harbor, and Lower Little Egg Harbor Bay water quality was designated as fully supporting recreation and shellfish, but not supporting wildlife due, in part, to increased turbidity (Ocean Wind 2023).

303(d) listed impaired waters: Nearly all water quality assessment units of Barnegat Bay and associated tidal tributaries in the geographic analysis area are listed as 303(d) impaired (see Appendix I, Figure I-4) (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).

Water Quality Specific to Proposed Ports

Four areas in the water quality analysis area are not in the immediate vicinity of the Project and generally include the Delaware River/Bay up to Philadelphia; the Maurice River up to Port Elizabeth; the confluence of the James River with Chesapeake Bay around Norfolk, Virginia; and Charleston Harbor, South Carolina.

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 (total suspended solids or turbidity), and DO. The overall water quality condition of the Northeast Coast, which includes the Delaware River/Bay and Chesapeake Bay/James River, is considered fair. Phosphorus, chlorophyll *a*, DO, and water clarity ratings are all considered fair, while nitrogen rating is considered good (USEPA 2012). Delaware Bay has a water quality index of fair to poor, with poor water quality indices on the northern side of the bay and fair on the southern side of the bay. The Delaware River has a mostly poor water quality index all the way upstream to Philadelphia. Delaware Bay also has naturally high turbidity compared to most other waters in the Northeast Coast area. The water quality index around Norfolk, Virginia where the James River empties into Chesapeake Bay is generally considered fair for all five water quality parameters, with just a few sample locations considered poor, where two or more of the parameters did not meet standards. The overall water quality condition of the Southeast Coast, which includes Charleston Harbor, is generally considered fair; phosphorus, chlorophyll *a*, and DO water quality ratings are all considered fair, while nitrogen is considered good and water clarity is considered poor. Charleston Harbor has a water quality index of generally fair for all five parameters.

The Delaware River/Bay up to Philadelphia, Maurice River (to Port Elizabeth), James River, Chesapeake Bay, and associated waters around Norfolk, Virginia, and Charleston Harbor, South Carolina are all listed as impaired 303(d) waters that are non-attaining for at least one use with causes that vary including, but not limited to, mercury, PCBs, dioxins, oxygen depletion, noxious aquatic plants, pathogens, and copper (see Appendix I, Figure I-4) (USEPA 2020; South Carolina Department of Health and Environmental Control 2018).

Water Quality Geographic Analysis Area: Coastal Onshore Waters

As previously stated, surface waters within most of the geographic analysis area and all of the Onshore Project area are coastal marine waters. Coastal onshore waters in the geographic analysis area generally occur west of the Oyster Creek Onshore Project area and include Oyster Creek, Waretown Creek, Lochiel Creek, Long Branch, Cave Cabin Branch, Forked River (south, middle and north branch), and associated tributaries to these waters. The assessment units listed as impaired and 303(d) listed by NJDEP cover Waretown/Lochiel Creek, North Forked River (above old railroad grade), and associated tributaries (see Appendix I, Figure I-4). The Waretown/Lochiel Creek assessment unit is non-attaining for drinking water use caused by mercury and other metals. The North Forked River assessment unit is non-attaining for ecological use and recreation use caused by oxygen depletion, pathogens, and unknown causes. There are no coastal onshore waters around the BL England Onshore Project area, as all waters in and around the Project area include saline or tidal/estuarine waters.

Groundwater Quality

The Onshore Project area is within a sole-source aquifer known as the New Jersey Coastal Plain Aquifer. A sole-source aquifer is an aquifer that supplies at least 50 percent of the drinking water for its service area and is the only reasonable drinking water source for that area. Several aquifers compose this larger aquifer system and include the Kirkwood-Cohansey aquifer system, the Atlantic City 800-foot sand, the Wenonah-Mount Laurel aquifer, the Englishtown aquifer, and the Potomac-Raritan-Magothy aquifer system. Depth to groundwater in the aquifer system at several groundwater wells in the vicinity of the Onshore Project area range from 39.9 feet to 102.8 feet below the ground surface (COP Volume II, Table 2.1.2-12; Ocean Wind 2023). The New Jersey Ambient Ground Water Quality Monitoring Network program utilizes 150 wells throughout northern and southern New Jersey to evaluate shallow groundwater quality. The chemical and physical characteristics measured in each well-water sample include pH, specific conductivity, DO, temperature, alkalinity, major ions, trace elements, nutrients, gross-alpha particle activity, VOCs, total dissolved solids, and pesticides. In southern New Jersey, shallow groundwater has a more acidic pH and lower total dissolved solids levels, reflecting the coastal plain origin. In the urbanized areas of southern New Jersey, lower DO levels are detected due to large proportions of impervious surface area. Specific conductivity increases in southern New Jersey have been attributed to application of road salt during the winter. Urban areas in New Jersey have high concentrations of nutrients, such as nitrate and nitrite, in groundwater due to possible leakage from septic and sewer systems. Pesticides, VOCs, trace elements, and major ion concentrations are all higher in the urban areas of Southern New Jersey compared to undeveloped areas (Ocean Wind 2023).

The Onshore Project area does not overlap with any NJDEP-designated wellhead protection areas (NJDEP 2018).

3.21.2 Environmental Consequences

3.21.2.1. Impact Level Definitions for Water Quality

Definitions of impact levels are provided in Table 3.21-2. There are no beneficial impacts on water quality.

Table 3.21-2 Impact Level Definitions for Water Quality

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

3.21.3 Impacts of the No Action Alternative on Water Quality

Section 3.1 of the Final EIS explains the approach to predicting impacts related to the No Action Alternative. When analyzing the impacts of the No Action Alternative on water quality, 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 water quality. 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 F, *Planned Activities Scenario*. Separate impact conclusions are presented for both scenarios.

3.21.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for water quality described in Section 3.21.1, *Description of the Affected Environment for Water Quality*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on water quality generally relate to or include terrestrial runoff, ground disturbance (e.g., construction) and erosion, terrestrial point- and nonpoint-source discharges, 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. The deposition of contaminated runoff into surface waters and groundwater can result in exceedances of water quality standards that can affect the beneficial uses of the water (e.g., drinking water, aquatic life, recreation). While water quality impacts may be temporary and localized (e.g., construction, dredging) and state and federal statutes, regulations, and permitting requirements (e.g., CWA Section 402) avoid or minimize these impacts, issues with water quality can still persist. There are no ongoing offshore wind activities within the geographic analysis area for water quality.

3.21.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned 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 F.2 in Appendix F for a description of ongoing and planned activities). Water quality impacts from these activities, especially from dredging and harbor, port, and terminal operations, are expected to be localized and temporary to permanent, depending on the nature of the activities and associated IPFs. Similar to under ongoing activities, the deposition of contaminated runoff into surface waters and groundwater can result in exceedances of water quality standards that can affect the beneficial uses of the water (e.g., drinking water, aquatic life, recreation). State and federal water quality protection requirements and permitting would result in avoiding and minimizing these impacts. See Table F1-23 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 overlaps with most, but not all, of the Atlantic Shores South (OCS-A 0499) and Atlantic Shores North (OCS-A 0549) lease area and the Ocean Wind 2 (OCS-A 0532) lease areas. BOEM conservatively assumed in its analysis of water quality impacts that all 468 WTGs estimated for the Atlantic Shores South, Atlantic Shores North, and Ocean Wind 2 lease areas would be sited within the water quality geographic analysis area. BOEM anticipates that the Atlantic Shores South, Atlantic Shores North, and Ocean Wind 2 offshore project components would be constructed during years that would have some overlap with each other (Table F2-1).

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

Accidental releases: Other 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. Offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. Vessel activity associated with construction is expected to occur regularly in the New York and New Jersey lease areas beginning in 2023 and continuing through 2030 and then lessen to near-baseline levels during operational activities. Increased vessel traffic would be localized near affected ports and offshore construction areas. Increased vessel traffic in the region associated with offshore wind construction could increase the probability of collisions and allisions, which could result in oil or chemical spills.

Based on the estimated construction schedules (see Table F2-1), offshore wind projects could occur with some overlapping construction schedules between 2023 and 2030. This EIS estimates that up to approximately 1,527,193 gallons of coolants, 2,121,777 gallons of oils, and 471,492 gallons of diesel fuel could be stored within WTG foundations and the OSS within the water quality geographic analysis area. Other chemicals, including grease, paints, and sulfur hexafluoride, 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 OSS 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/OSS, or incidents such as toppling during a storm or earthquake.

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

Accidental releases of trash and debris would be infrequent and negligible because operators would comply with federal and international requirements for management of shipboard trash. All vessels would also need to comply with the USCG ballast water management requirements outlined in 33 CFR 151 and 46 CFR 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; however, due to the very low likelihood of a maximum-case scenario release occurring, the expected size of the most likely spill to be small, and the expected occurrence to be of low frequency, the cumulative impact of accidental releases is anticipated to be short term, localized, and minor, resulting in little change to water quality. As such, accidental releases from 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 284 acres (1.15 km^2) of seabed could be affected by anchoring within the water quality geographic analysis area. Disturbances to the seabed during anchoring would temporarily increase suspended sediment and turbidity levels in and immediately adjacent to the anchorage area. The intensity and extent of the additional sediment suspension effects would be less than that of new cable emplacement (see new 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 adverse, localized, and short term, resulting in a minor impact on ambient water quality. Anchoring would not be expected to appreciably contribute to cumulative 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 F2-2, offshore wind development in the water quality geographic analysis area would result in approximately 1,858 acres (7.5 km^2) of seabed impact. As described under anchoring above, these activities would contribute to changes in offshore water quality from the resuspension and deposition of sediment. Sediment dispersion modeling conducted for three other offshore wind projects (the Vineyard Wind 1 Project in Massachusetts, the Block Island Wind Farm in Rhode Island, and the Virginia Offshore Wind Technology Advancement Project of

Virginia) were reviewed and evaluated, and general sediment conditions and hydrodynamics are similar to those in the Project area (see COP Volume II, Section 2.1.2.2.1 for detailed descriptions; Ocean Wind 2023). The sediments within each project area were predominantly sands and current velocities were within similar ranges, indicating that the results of each modeling effort would be expected to be representative of the Project site. Turbidity concentrations greater than 10 mg/L would be short in duration up to 6 hours and limited to within approximately 50 to 200 meters of the trench in the offshore area. BOEM anticipates that offshore wind projects would use dredging only when necessary and rely on other cable laying methods for reduced impacts (such as jet plow or mechanical plow) where feasible. Due to the localized areas of disturbances and range of variability within the water column, the cumulative impacts of increased sediments and turbidity from cable emplacement and maintenance are anticipated to be localized, short term, and adverse, resulting in a minor impact on ambient water quality. If multiple projects are being constructed at the same time, the impacts would be greater than those identified for one project and would likely not overlap each other geographically due to the localized natures of the plumes. New cable emplacement and maintenance activities 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 impacts on water quality would be minor and not expected to appreciably contribute to cumulative impacts on water quality.

Presence of structures: Using the assumptions in Table F2-2, reasonably foreseeable offshore wind projects are estimated to result in no more than 482 structures by 2030 within the water quality geographic analysis area. These structures could disturb up to 366 acres (1.5 km^2) 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. 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. Structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016; Cazenave et al. 2016). Results from a recent BOEM (2021c) hydrodynamic model of four different WTG build-out scenarios of the offshore Rhode Island and Massachusetts lease areas found that offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature stratification),via their influence on currents from WTG foundations and by extracting energy from the wind. The results of the hydrodynamic model study show that introduction of the offshore wind structures into the offshore WEA modifies the oceanic responses of current magnitude, temperature, and wave heights by (1) reducing the current magnitude through added flow resistance, (2) influencing the temperature stratification by introducing additional mixing, and (3) reducing current magnitude and wave height by extracting of energy from the wind by the offshore wind turbines. BOEM conducted a similar model offshore Rhode Island and Massachusetts that evaluated ocean processes during two extreme weather events: the February 1978 Nor'easter storm (a 100-year storm) and the August 1991 Hurricane Bob (BOEM 2016). The results indicate that the wind turbine facility on the eastern shelf of Block Island, Rhode Island can cause more significant local and regional impacts than offshore wind facilities over the outer shelves off Massachusetts and Rhode Island. Inside the wind turbine area, the maximum change during the nor'easter storm and hurricane cases can be 0.2 to 0.4 meter for surface elevation, 3.5 to 7.3 meters for significant wave height, 0.7 to 1.7 m/s for vertically averaged, near-surface and near-bottom velocities, and 16.8 to 28.2 newtons per m^2 for bottom stress (BOEM 2016). Alterations in currents and mixing would affect water quality parameters such as temperature, DO, and salinity, but would vary seasonally and regionally. WTGs and the OSS associated with reasonably foreseeable offshore wind projects would be placed in average water depths of 100 to 200 feet 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 anticipates that developers would 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 the 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.

Discharges: Other 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 York and New Jersey lease areas beginning in 2023 and continuing through 2030, and then lessen to near-baseline levels during operation. Increased vessel traffic would be localized near affected ports and offshore construction areas. 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. 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 OSS 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 OSS during operation would be temporary. During decommissioning, all offshore wind structures would be drained of fluid chemicals via vessel, dismantled, and removed. BOEM anticipates decommissioning to have temporary impacts on water quality, with a return to baseline conditions.

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 cumulative impact of discharges from vessels is anticipated to be localized and short term. Based on the above, BOEM anticipates discharges to have a minor impact on water quality, as the level of impact in the water quality geographic analysis area from offshore wind development would be similar to that under existing conditions and would not be expected to appreciably contribute to cumulative impacts on water quality.

Land disturbance: Other 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, substation). 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. It is assumed that a SWPPP and erosion and sedimentation controls would likely be implemented during the construction period to minimize impacts, resulting in infrequent and temporary erosion and sedimentation events.

In addition, onshore construction and installation activities would involve the use of fuel and lubricating and hydraulic oils. Use of heavy equipment onshore could result in potential spills during active use or refueling activities. It is assumed that a Spill Prevention, Control, and Countermeasure 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 or space is minimal, and the total amount of erosion that occurs and impacts on water quality at any one given time could be minimal. Land disturbance from 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.

3.21.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and water quality would continue to be affected by natural and human-caused IPFs. BOEM expects ongoing activities to have continuing localized temporary to permanent impacts on water quality, ranging from negligible 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 a **moderate** impact on water quality.

Cumulative Impacts of the No Action Alternative: Planned activities would contribute to water quality impacts primarily through accidental releases, sediment resuspension, and runoff from land disturbance. BOEM anticipates that the impacts associated with Atlantic Shores South, Atlantic Shores North, and Ocean Wind 2 would generally be negligible to minor and include sediment resuspension during construction and decommissioning (both from regular cable laying and from prelaying); vessel discharges; sediment contamination; discharges from the WTGs and OSS during operation; sediment plumes due to scour; and erosion and sedimentation from onshore construction. Construction and decommissioning activities associated with Atlantic Shores South, Atlantic Shores North, and Ocean Wind 2 would lead to increases in sediment suspension and turbidity in the offshore lease areas during the first 6 to 10 years of construction of projects and in the latter part of the 30-year life spans of offshore wind projects due to decommissioning activities. However, sediment suspension and turbidity increases would be temporary and localized and BOEM anticipates the impact to be minor. BOEM has considered the possibility of impacts resulting from accidental releases; a moderate impact could occur if there was a large-volume, catastrophic 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 the cumulative impacts of the No Action Alternative on water quality would be **moderate**, primarily driven by the unlikely event of a large-volume, catastrophic release.

3.21.4 Relevant Design Parameters & Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; BOEM expects any potential variances in the proposed Project build-out within the range of the PDE to result in impacts similar to or less than those described in the sections below. The following proposed-Project design parameters (Appendix E) 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 OSS and the amount of cable laid determines the area of seafloor and volume of sediment disturbed by installation. Representing the maximum-case scenario, a maximum of 98 WTGs installed, three OSS, 190 miles (300 kilometers) of inter-array cable, 19 miles (30 kilometers) of OSS interconnector cable, and 174 miles (281 kilometers) of offshore export cable (Appendix E).
- 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 OSS (determining the total area of foundation footprints); the number of monopile foundations and jacket foundations (OSS only); the total length of inter-array cable; the total area of scour protection needed; and the number, type, and frequency of vessels used in each phase of the proposed Project. Changes in the design may affect the magnitude (number of structures and vessels), location (WTG and other Project element layouts), and mechanism (installation method, non-routine event) of water quality impacts.

Ocean Wind has committed to measures to minimize impacts on water quality. Turbidity reduction measures would be implemented to the extent practicable to minimize impacts on hard-bottom habitats, including seagrass communities, from construction activities (WQ-01). All vessels will be certified to conform to vessel operations and maintenance protocols designed to minimize the risk of fuel spills and leaks (WQ-02) (COP Volume II, Table 1.1-2; Ocean Wind 2023).

3.21.5 Impacts of the Proposed Action on Water Quality

3.21.5.1. Impacts on the Proposed Action

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park, which is described in Section 3.21.6, *Impacts of Alternatives B, C, D, and E on Water Quality*.

The Proposed Action would contribute to impacts through all of the IPFs named in Section 3.21.3.2. The most impactful IPFs would likely include new cable emplacement and maintenance that could cause noticeable temporary impacts during construction through increased suspended sediments and turbidity, the presence of structures that could result in alteration of local water currents and lead to the formation of sediment plumes, and discharges that could result in localized turbidity increases during discharges or bottom disturbance during dredged material disposal.

Accidental releases: Similar to under other offshore wind projects, chemicals (e.g., coolants, oils, diesel fuel, other chemicals) would be used and stored in facilities and black and gray water may be stored in sump tanks on facilities. The Proposed Action would have a maximum of 39,690 gallons of coolants, 426,671 gallons of oils and lubricants, and 236,216 gallons of diesel stored within WTG foundations and OSS within the water quality geographic analysis area. As discussed previously, the risk of a spill from any single offshore structure would be low, and any effects would likely be localized. A reduction in the number of WTGs required due to increased capacity would result in a smaller total amount of materials being stored offshore. Modeling conducted for an area near the proposed Project area (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), 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 fewer WTGs under the Proposed Action (98 instead of 125), which would lead to a decreased likelihood of spill events compared to the Bejarano et al. (Bejarano et al. 2013) model. There is potential for moderate water quality impacts due to a maximum-case scenario accidental release; however, due to the very low likelihood of a maximum-case scenario release occurring, the expected size of the most likely spill to be small, and the expected occurrence to be of low frequency, the overall impact is anticipated to be short term, localized, and minor, resulting in little change to water quality.

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 OSS, the lighting and marking plan that would be implemented, and the inclusion of proposed Project components on navigation charts. Ocean Wind would implement its Oil Spill Response Plan (COP Volume III, Appendix A; Ocean Wind 2023), which would provide for rapid spill response, cleanup, and other measures to minimize any potential impact on affected resources from spills and accidental releases, including spills resulting from catastrophic events. In the unlikely event an allision or collision involving vessels or components associated with the Proposed Action resulted in a large spill, impacts from the Proposed Action alone on water quality would be short term to long term depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill. In addition, Ocean Wind has committed to a mitigation measure requiring that vessels conform to O&M protocols designed to minimize risk of fuel spills and leaks (WQ-02; COP Volume II, Table 1.1-2; Ocean Wind 2023). With implementation of this mitigation measure, risk of fuel spills and leaks from vessels would be minimized and the impact considered minor.

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. Ocean Wind 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 would result in minor, temporary, and long-term impacts on water quality as a result of releases from heavy equipment during construction and other cable installation activities.

Ocean Wind proposes to use an onshore O&M facility in Atlantic City, New Jersey. Construction of the O&M facility would be separately reviewed and authorized by USACE and local authorities, as needed. BOEM anticipates that use of the facility would result in minor impacts on water quality because a potential release at the facility would likely be relatively small and would be cleaned up in accordance with federal and state regulations.

Anchoring: There would be increased vessel anchoring during the construction, installation, O&M, and decommissioning of offshore components of the Proposed Action. Anchoring would cause increased turbidity levels. Impacts on water quality from the Proposed Action alone due to anchoring would be localized, short term, and minor during construction and decommissioning. Anchoring during operation would decrease due to fewer vessels required during operation, resulting in reduced impacts. Ocean Wind anticipates between 20 and 65 vessels operating simultaneously during construction, depending upon the activity. The number of vessels is anticipated to result in 14 acres (0.05 km^2) of impact from anchoring, which would be additive with the impact(s) of any and all other anchoring activities, including offshore wind activities that occur within the water quality geographic analysis area during the same timeframe, resulting in a total of 298 acres (1.2 km^2) of seabed impact from anchoring.

Cable emplacement and maintenance: The installation of array cables and offshore export cables would include site preparation activities (e.g., sandwave clearance, boulder removal) and cable installation via jet plow, 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). As described in Section 3.21.3.2, sediment dispersion modeling was conducted for three other offshore wind projects with conditions representative of the Wind Farm Area (see COP Volume II, Section 2.1.2.2.1 for detailed descriptions; Ocean Wind 2023). The modeling indicated sediments resuspended during trenching would settle quickly to the seabed within the trench, potential plumes would be limited to right above the seabed and not within the water column, and concentrations greater than 10 mg/L would be short in duration (up to 6 hours) and limited to within approximately 50 to 200 meters of the center of the trench. Jet plow activities in near-shore areas such as Barnegat Bay for the Project would be similar to the modeling results for other shallow water areas where the mostly fine sediment (silts and clays) were projected to persist for 2 days at very low levels of 10 mg/L above background (Ocean Wind 2023 citing Normandeau 2015). These impacts on water quality for finer sediments are anticipated to be localized adjacent to the trench and temporary in nature. Therefore, given the known hydrodynamic conditions within the area of the Project and the expected BMPs associated with jet plowing technologies, no long-term impacts on water quality are anticipated following cable installation activities. BOEM anticipates the Proposed Action alone would have negligible, long-term impacts on water quality via this mechanism. Overall, impacts on water quality from the Proposed Action due to cable emplacement and resulting suspension of sediment and turbidity would be short term and minor.

Port utilization: The current bearing capacity of existing ports was considered suitable for WTGs, requiring no port modifications for supporting offshore wind energy development (DOE 2014). During construction, several ports may be used, including Atlantic City, New Jersey; Paulsboro, New Jersey; Norfolk, Virginia; Hope Creek, New Jersey; or Charleston, South Carolina. During proposed Project operations, a retired marine terminal in Atlantic City would be used as the O&M facility. The impacts on water quality could include accidental fuel spills or sedimentation during port use. The incremental increases in ship traffic at the ports would be small; multiple authorities regulate water quality impacts from these operations (BOEM 2019). Therefore, the impacts of the Proposed Action alone on water quality from port utilization would be negligible.

Presence of structures: Existing stationary facilities that present allision risks are limited in the open waters of the geographic analysis area. Dock facilities and other structures are concentrated along the coastline. The Proposed Action would add up to 98 WTGs, three OSS, and related Project elements, which would increase seabed disturbance and potential water quality impacts. In the water quality geographic analysis area, offshore wind activities including the Proposed Action would result in 446 acres (1.8 km^2) of impact from installation of foundations and scour protection and 141 acres (0.57 km^2) of impact from hard protection for offshore cables and inter-array cables. As described in Section 3.21.3.2, results from a recent BOEM (2021c) 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 3.21.3.2, the presence of WTGs during an extreme weather event can affect oceanic processes (BOEM 2016).

Discharges: During construction of the Proposed Action, vessel traffic would increase in and around the Wind Farm Area, leading to potential discharges of uncontaminated water and treated liquid wastes. COP Table 8.2-1 lists types of waste potentially produced by the Proposed Action (COP Volume I, Section 8.2; Ocean Wind 2023). Ocean Wind would only be allowed to discharge uncontaminated water (e.g., uncontaminated ballast water and uncontaminated water used for vessel air conditioning) or treated liquid wastes overboard (e.g., treated deck drainage and sumps). Other waste such as sewage; and solid waste or chemicals, solvents, oils, and greases from equipment, vessels, or facilities would be stored and properly disposed of on land or incinerated offshore.

Ocean Wind expects substantially less vessel use during routine O&M than during construction. Vessel use would consist of scheduled inspection and maintenance activities, with corrective maintenance as needed. In a year, the Proposed Action would generate a maximum of 908 crew vessel trips, 102 jack-up vessel trips, 104 supply vessel trips, and 2,278 crew transfer vessel trips or service operations vessel trips (COP Volume I, Section 6.1.3.5, Table 6.1.2-11; Ocean Wind 2023). The proposed Project would require all vessels to comply with regulatory requirements related to the prevention and control of discharges, accidental spills, and nonindigenous species. All vessels would need to comply with waste and water management regulations described in Section 3.21.3.2, including USCG ballast water management requirements and USCG bilge water regulation. The bilge water from the proposed Project would either be retained onboard vessels in a holding tank and discharged to an onshore reception facility or treated onboard with an oily water separator, after which the treated water could be discharged overboard. In addition, bilge water would not be allowed to be discharged into the sea unless the oil content of the bilge water without dilution is less than 15 parts per million (33 CFR 151.10). For vessels operating within 3 nm from shore, bilge water regulations under USEPA's National Pollutant Discharge Elimination System program apply to any of the proposed Project's vessels that are covered by a Vessel General Permit (those that are 79 feet [24 meters] or greater in length). Bilge discharges within 3 nm from shore are subject to the rules in Section 2.2.2 of the Vessel General Permit and must occur in compliance with 40 CFR Parts 110, 116, and 117, and 33 CFR Part 151.10. Ocean Wind has also committed to developing and implementing a waste management plan for the Project (COP Volume II, Table 1.1-2, GEN-10; Ocean Wind 2023). With implementation of these APMs and the regulatory requirements described above, the temporary impact of routine vessel discharge is expected to be minor.

The WTGs and OSS 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 OSS during operation would be temporary. During decommissioning, Ocean Wind would drain all fluid chemicals from the WTGs and OSS and dismantle and remove them. BOEM anticipates decommissioning to have temporary impacts on water quality, with a return to baseline conditions.

Overall, the impacts on water quality from the Proposed Action 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 of the Oyster Creek cable corridor would require up to 32 acres of total ground disturbance, with a total permanent corridor disturbance of 19 acres. Construction of the BL England cable corridor would require up to 48 acres of total ground disturbance, with a total permanent corridor disturbance of 29 acres. The BL England and Oyster Creek substation sites would require approximately 13 and 31.5 acres, respectively, to accommodate the area for the substation equipment and buildings, energy storage, stormwater management, and landscaping. During construction, up to 3 acres would be required for temporary workspace. Construction and installation of onshore components (e.g., substations, cable installation) would expose bare soils until permanent stabilization is achieved. Precipitation events could potentially erode the soils and discharge sediment-laden runoff into nearby surface waters, leading to increased turbidity. Ocean Wind would implement erosion and sedimentation controls during the construction period. Construction would lead to an increased potential for surface 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 a Spill Prevention, Control, and Countermeasure Plan and SWPPP, would be implemented. As such, impacts from the Proposed Action on surface water quality from land disturbance would be negligible to minor.

Onshore construction would disturb the ground with depths of up to 8 feet (e.g., trenching for onshore cable installation), which has the potential to interact with groundwater if groundwater were shallow enough to interact with the disturbance. However, as mentioned in Section 3.21.1, groundwater depths in the aquifer beneath the Onshore Project area (including those associated with the sole-source aquifer) are approximately 40 feet or more below the surface, which is too deep to have any direct interaction with or be affected by construction activities. Any contaminants spilled during construction would be localized, contained, and cleaned up per permitting requirements and Ocean Wind's Spill Prevention, Control, and Countermeasure Plan and, therefore, would not be anticipated to reach groundwater or have any effect on groundwater quality. Due to the depths of groundwater, BOEM does not anticipate any impact from construction, O&M, or decommissioning.

3.21.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities. 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., National Pollutant Discharge Elimination System permits, Vessel General Permit, Oil Spill Response Plan, Spill Prevention, Control, and Countermeasure Plan), adverse impacts on water quality would be minimized.

Accidental releases: The cumulative impact on water quality would likely be moderate, mostly as a result of the unlikely event of a large-volume, catastrophic release. 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 Oil Spill Response Plan for the Project. 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.

Anchoring: The contribution of the Proposed Action to the cumulative anchoring impacts on water quality are 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 any and all other cable-installation activities, including offshore wind activities, that occur within the water quality geographic analysis area and that would have overlapping timeframes during which sediment is suspended.

Port utilization: Cumulative port utilization impacts of the Proposed Action would likely be short term and minor. There could be limited overlap in construction schedules for cable installation for the Ocean Wind 1 Project and the Atlantic Shores South project in the water quality geographic analysis area. The contribution of the Proposed Action to the cumulative port utilization impacts on water quality would likely be localized, short term, and noticeable.

Presence of structures: The contributions of the Proposed Action to the cumulative structure-placement impacts on water quality would likely be constant over the life of the 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. Significant scour is not expected even without scour protection due to the low current speeds and minimal seabed mobility in the Wind Farm Area (COP Volume II, Table 2.1.2-13; Ocean Wind 2023). The addition of scour protection would further minimize effects on local sediment transport. The impacts from the Proposed Action on water quality due to the presence of structures would be negligible to minor during construction, O&M, and conceptual decommissioning. In addition, as described in Section 3.21.3.2, 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).

Discharges: 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, in context of reasonably foreseeable environmental trends, 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.

3.21.5.3. Conclusions

Impacts of the Proposed Action. BOEM anticipates the impacts on water quality resulting from the Proposed Action would be **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 OSS 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.

Cumulative Impacts of the Proposed Action. 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. BOEM anticipates that the contribution of the Proposed Action to these impacts would be noticeable. The main drivers for this impact rating are the short-term, localized effects from increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operations due to the presence of structures. BOEM has considered the possibility of a moderate impact resulting from accidental releases; this level of impact could occur if there was a large-volume, catastrophic release. While it is an impact that should be considered, it is unlikely to occur. The Proposed Action would contribute to the cumulative impact rating primarily through the increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operation due to the presence of structures.

3.21.6 Impacts of Alternatives B, C, D, and E on Water Quality

BOEM identified a combination of Alternative A (the Proposed Action) and Alternative E as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for the Proposed Action except for the export cable route across Island Beach State Park.

Impacts of Alternatives B, C, D, and E. The impacts resulting from individual IPFs under all action alternatives would be either the same or less than those described under the Proposed Action due to the same (Alternatives C-1, C-2, and E) or reduced (Alternatives B-1, B-2, and D) number of WTGs in the Wind Farm Area. While the reduced number of structures may slightly reduce localized water quality impacts during construction and operations, the difference in impacts compared to the Proposed Action would not be materially different. BOEM expects that the modifications to the Oyster Creek export cable route to avoid impacts on SAV in Barnegat Bay under Alternative E would not significantly change the potential impacts on water quality because cable emplacement would still result in short-term and localized sediment suspension, land disturbance would be small, and mitigation measures, such as the use of a Spill Prevention, Control, and Countermeasure Plan and SWPPP, would be implemented. Therefore, BOEM does not anticipate the impacts from the action alternatives to be materially different than those described under the Proposed Action.

Cumulative Impacts of Alternatives B, C, D, and E. The cumulative impacts on water quality would be moderate for the same reasons described for the Proposed Action. The incremental impacts contributed by the action alternatives to the cumulative water quality impacts would be similar to those described under the Proposed Action.

3.21.6.1. Conclusions

Impacts of Alternatives B, C, D, and E. As discussed above, the expected **moderate** impacts associated with the Proposed Action would not change substantially under the action alternatives. The same construction and installation, O&M, and conceptual decommissioning activities would still occur, albeit at differing scales in some cases. Alternatives B-1, B-2, and D may result in slightly less, but not materially different, minor impacts on water quality due to a reduced number of WTGs that would need to be constructed and maintained. Alternatives C-1 and C-2 would have the same WTG number as the Proposed Action and, therefore, would have similar minor impacts on water quality. Alternative E would result in similar, but not materially different, minor impacts on water quality in relation to sediment disturbance and turbidity and onshore ground disturbance. While a larger spill could have moderate impacts on water quality, the likelihood of a spill this size is very low.

Cumulative Impacts of Alternatives B, C, D, and E. Incremental impacts contributed by the action alternatives to the cumulative impacts on water quality would range from undetectable to noticeable. Because the impacts of the Proposed Action would not change under the action alternatives, BOEM anticipates that the cumulative impacts of the action alternatives on water quality would be the same as described for the Proposed Action. Therefore, the cumulative impacts of the action alternatives would be **moderate**, primarily driven by increases in turbidity and sedimentation due to anchoring and cable emplacement, and alteration of water currents and increased sedimentation 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.

3.21.7 Proposed Mitigation Measures

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

Appendix H. Mitigation and Monitoring

This Final EIS assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from the construction, O&M, and conceptual decommissioning of the Project proposed by Ocean Wind in its COP. The Project described in the COP and this Final EIS would be approximately 1,100 MW in scale and sited 15 miles (13 nm) southeast of Atlantic City, New Jersey within the area of Lease OCS-A 0498 (Lease Area). The Project is designed to serve demand for renewable energy in New Jersey.

As part of the Project, Ocean Wind has committed to implement APMs to avoid, reduce, mitigate, or monitor impacts on the resources discussed in Chapter 3 of the Final EIS. These APMs are described in Table H-1 and assessed as part of the Proposed Action. BOEM considers as part of the Proposed Action only those measures that Ocean Wind has committed to in the COP (Ocean Wind 2023), including measures in Volume III, Appendix AA, *Protected Species Mitigation and Monitoring Plan (PSMMP): Marine Mammals, Sea Turtles, and ESA-Listed Fish Species*, Appendix AB, *Avian and Bat Post-Construction Monitoring Framework*, and Appendix AE, *Fisheries Mitigation Efforts*. Table H-1 also includes mitigation measures that Ocean Wind has proposed in its *Post-Review Discovery Plan*. The *Memorandum of Agreement Among the Bureau of Ocean and Energy Management, the New Jersey State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding the Ocean Wind Offshore Wind Farm Project* is included as an attachment to Appendix N. The following documents are included as attachments to the Memorandum of Agreement: Attachment 4, *Historic Property Treatment Plan for the Ocean Wind 1 Farm Ancient Submerged Landform Features Subject to Adverse Effect Federal Waters on the Outer Continental Shelf*; Attachment 5, *Historic Properties Treatment Plan for the Ocean Wind 1 Offshore Wind Farm Project Historic Properties Subject to Adverse Effects Cape May and Atlantic Counties, New Jersey*; Attachment 6, *Post-Review Discovery Plan for Terrestrial Resources for the Ocean Wind Offshore Wind Farm for Lease Area OCS A-0498 Construction and Operations Plan*; and Attachment 7, *Post-Review Discovery Plan for Submerged Cultural Resources for the Ocean Wind Offshore Wind Farm for Lease Area OCS A-0498 Construction and Operations Plan*.

BOEM may select alternatives and require additional mitigation or monitoring measures to further protect and monitor these resources. These additional mitigation and monitoring measures are shown in Table H-2 and may result from reviews under several environmental statutes (ESA, MSA, and NHPA) as discussed in Appendix A of the Final EIS, or other sources. Please note that not all of these mitigation measures are within BOEM's statutory and regulatory authority and some may be required by other governmental entities. Table H-2 provides descriptions of these measures as well as measures arising from BOEM's own authorities. Other measures identified during development of this EIS are listed in Table H-3, and Table H-4 identifies measures that may be required by authorizations and permits issued to the Lessee.

If BOEM decides to approve the COP, the ROD will state which of the mitigation and monitoring measures identified by BOEM in Table H-2 and Table H-3 have been adopted, and if not, why they were not. The ROD will describe the specific terms and conditions of these measures for which compliance is required (40 CFR 1505.3). Ocean Wind would be required to certify compliance with these terms and conditions under 30 CFR 285.633(a). Furthermore, BOEM will periodically review the activities conducted under the approved COP, with the frequency and extent of the review based on the significance of any changes in available information and on onshore or offshore conditions affecting, or affected by, the activities conducted under the COP in accordance with 30 CFR 585.634(b).

Monitoring may be required to evaluate the effectiveness of mitigation measures or to identify if resources are responding as predicted to impacts from the Proposed Action. This monitoring would typically be developed in coordination among BOEM and agencies with jurisdiction over the resource to be monitored. The information generated by monitoring may be used to (1) modify how a mitigation measure identified in the COP or ROD is being implemented, (2) revise or develop new mitigation or monitoring measures for which compliance would be required under the Ocean Wind 1 COP in accordance with 30 CFR 585.634(b), (3) develop measures for future projects, or (4) contribute to regional efforts for better understanding of the impacts and benefits resulting from offshore wind energy projects in the Atlantic (e.g., a potential cumulative impact assessment tool). Unless specified as an APM, the proposed mitigation measures described below would not change the impact ratings on the affected resource, as described in Chapter 3 of the Final EIS, but would further reduce expected impacts or inform the development of additional mitigation measures if required.

Table H-1 Applicant-Proposed Measures

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
GEN-01	Site onshore export cable corridors and landfall within existing rights-of-way or previously disturbed/developed lands to the extent practicable.	Multiple	Measure incorporated into project design
GEN-02	Site onshore, cable landfall and offshore facilities to avoid known locations of sensitive habitat (such as known nesting beaches) or species during sensitive periods (such as nesting season); important marine habitat (such as high density, high value fishing grounds as determined by fishing revenues estimate [BOEM Geographical Information System (GIS) Data - see Section 2.3.4 of the Ocean Wind 1 COP]); and sensitive benthic habitat; to the extent practicable. Avoid hard-bottom habitats and seagrass communities, where practicable, and restore any damage to these communities.	Multiple	Measure incorporated into project design
GEN-03	Avoid areas that would require extensive seabed or onshore alterations to the extent practicable.	Multiple	Measure incorporated into project design
GEN-04	Bury onshore and offshore cables below the surface or seabed to the extent practicable and inspect offshore cable burial depth periodically during project operation, as described in the Project Description, to ensure that adequate coverage is maintained to avoid interference with fishing gear/activity.	Multiple	Measure incorporated into project design
GEN-05	Use existing port and onshore operations and maintenance (office, warehouse, and workshop) facilities to the extent practicable and minimize impacts to seagrass by restricting vessel traffic to established traffic routes where these resources are present.	Multiple	Measure incorporated into project design
GEN-06	Develop and implement a site-specific monitoring program to ensure that environmental conditions are monitored during construction, operation, and decommissioning phases, designed to ensure environmental conditions are monitored and reasonable actions are taken to avoid and/or minimize seabed disturbance and sediment dispersion, consistent with permit conditions. The monitoring plan will be developed during the permitting process, in consultation with resource agencies.	Multiple	Measure incorporated into project design
GEN-07	Implement aircraft detection lighting system (ADLS) on wind turbine generators (WTGs). Comply with Federal Aviation Administration (FAA), BOEM, and U.S. Coast Guard (USCG) lighting, marking and signage requirements to aid navigation per USCG navigation and inspection circular (NVIC) 02-07 (USCG 2007) and comply with any other applicable USCG requirements while minimizing the impacts through appropriate application including directional aviation lights that minimize visibility from shore. Information will be provided to allow above water obstructions and underwater cables to be marked in sea charts, aeronautical charts, and nautical handbooks.	Multiple	Measure incorporated into project design
GEN-08	To the extent practicable, use appropriate installation technology designed to minimize disturbance to the seabed and sensitive habitat (such as beaches and dunes, wetlands and associated buffers, streams, hard-bottom habitats, seagrass beds, and the near-shore zone); avoid anchoring on sensitive habitat; and implement turbidity reduction measures to minimize impacts to sensitive habitat from construction activities.	Multiple	Measure incorporated into project design
GEN-09	During pile-driving activities, use ramp up procedures as agreed with National Marine Fisheries Service (NMFS) for activities covered by Incidental Take Authorizations, allowing mobile resources to leave the area before full-intensity pile-driving begins.	Multiple	Measure incorporated into project design
GEN-10	Prepare waste management plans and hazardous materials plans as appropriate for the Project.	Multiple	Measure incorporated into project design
GEN-11	Establish and implement erosion and sedimentation control measures in a Stormwater Pollution Prevention Plan (SWPPP, authorized by the State), and Spill Prevention, Control, and Countermeasures (SPCC) Plan to minimize impacts to water quality (signed/sealed by a New Jersey Professional Engineer and prepared in accordance with applicable regulations such as NJDEP Site Remediation Reform Act, Linear Construction Technical Guidance, and Spill Compensation and Control Act). Development and implementation of an Oil Spill Response Plan (OSRP, part of the SPCC plan) and SPCC plans for vessels.	Multiple	**SWPPP**, NJDEP **SPCC**, BSEE, USCG, USEPA, and NJDEP
GEN-12	Where HDD trenchless technology methods are used, develop, and implement an Inadvertent Return Plan that includes measures to prevent inadvertent returns of drilling fluid to the extent practicable and measures to be taken in the event of an inadvertent return.	Multiple	**Inadvertent Return Plan**, USACE and NJDEP

[1] BOEM and BSEE are in the process of transferring enforcement authorities from BOEM to BSEE.

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
GEN-13	Restore disturbance areas in the Onshore Project Area to preexisting contours (maintaining natural surface drainage patterns) and allow vegetation to become reestablished once construction activities are completed, to the extent practicable.	Multiple	USACE, NJDEP and/or local authorities
GEN-14	Develop and implement a communication plan to inform the USCG, Department of Defense (DOD) headquarters, harbor masters, public, local businesses, commercial and recreational fishers, among others of construction and maintenance activities and vessel movements, as coordinated by the Marine Coordination Center and Marine Affairs.	Multiple	**Communication Plan**
GEN-15	Develop and implement an Onshore Maintenance of Traffic Plan to minimize vehicular traffic impacts during construction. Ocean Wind would designate and utilize onshore construction vehicle traffic routes, construction parking areas, and carpool/bus plans to minimize potential impacts.	Multiple	**Onshore Maintenance of Traffic Plan,** NJDOT and/or local authorities
GEN-16	Prior to the start of operations, Ocean Wind will hold training to establish responsibilities of each involved party, define the chains of command, discuss communication procedures, provide an overview of monitoring procedures, and review operational procedures. This training will include all relevant personnel, crew members and protected species observers (PSO). New personnel must be trained as they join the work in progress. Vessel operators, crew members and protected species observers shall be required to undergo training on applicable vessel guidelines and the standard operating conditions. Ocean Wind will make a copy of the standard operating conditions available to each project-related vessel operator.	Multiple	BOEM and BSEE
GEN-17	Implement Project and site-specific safety plans (Safety Management System, Appendix B).	Multiple	Required measure per 30 CFR 285.811
GEN-18	No permanent exclusion zones during operation	Multiple	BOEM and BSEE
GEO-01	Reduce scouring action by ocean currents around foundations and to seabed topography by taking reasonable measures and employing periodic routine inspections to ensure structural integrity.	Multiple	Measure incorporated into project design.
GEO-02	Take reasonable actions (use BMPs) to minimize seabed disturbance and sediment dispersion during cable installation and construction of project facilities.	Multiple	Measure incorporated into project design.
GEO-03	Conduct periodic and routine inspections to determine if non-routine maintenance is required.	Multiple	Measure incorporated into project design.
GEO-04	In contaminated onshore areas, comply with State regulations requiring the hiring of a Licensed Site Remediation Professional (LSRP) to oversee the linear construction project and adherence to a Materials Management Plan (MMP). The MMP prepared for construction can also be followed as a best management practice when maintenance requires intrusive activities.	Multiple	**[Onshore] Materials Management Plan,** NJDEP
WQ-01	Implement turbidity reduction measures to minimize impacts to hardbottom habitats, including seagrass communities, from construction activities, to the extent practicable.	Water Quality	USACE and NJDEP
WQ-02	All vessels will be certified by the Project to conform to vessel operations and maintenance protocols designed to minimize the risk of fuel spills and leaks.	Water Quality	Measure incorporated into project design.
AQ-01	Use low sulfur fuels to the extent practicable (15 parts per million [ppm] per 40 Code of Federal Regulations [CFR] §80.510(c) as applicable).	Air Quality	Measure incorporated into project design.
AQ-02	Select engines designed to reduce air pollution to the extent practicable (such as U.S. Environmental Protection Agency [USEPA] Tier 3 or 4 certified).	Air Quality	Measure incorporated into project design.

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
AQ-03	Limit engine idling time.	Air Quality	Measure incorporated into project design.
AQ-04	Comply with international standards regarding air emissions from marine vessels.	Air Quality	Measure incorporated into project design.
AQ-05	Implement dust control plan.	Air Quality	Measure incorporated into project design.
AQ-06	Minimize fugitive emissions of sulfur hexafluoride (SF_6) contained in turbine and substation switchgear in the following ways. Follow manufacturer recommendations for service and repair of the affected breakers and switches. Conduct visual inspections of the switchgear and monitoring equipment according to manufacturer recommendations. Create alarms based on the pressure readings in the breakers/switches, so leaks can be detected when substantial SF_6 leakage occurs. Upon a detectable pressure drop that is >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). Keep a log of all detected leaks and maintenance procedures potentially affecting SF_6 emissions from circuit breakers/switches. Capture and recycle SF_6 removed from breakers and switches during maintenance.	Air Quality	Measure incorporated into project design.
TCHF-01	Coordinate with the New Jersey Department of Environmental Protection (NJDEP) and United States Fish and Wildlife Service (USFWS) to identify unique or protected habitat or known habitat for threatened or endangered and candidate species and avoid these areas to the extent practicable.	Coastal Habitat and Fauna	Measure incorporated into project design.
TCHF-02	Conduct maintenance and repair activities in a manner to avoid or minimize impacts to sensitive species and habitat such as beaches, dunes, and the near-shore zone.	Coastal Habitat and Fauna	BOEM, BSEE, USACE, USFWS, and NJDEP
TCHF-03	Wetland mitigation options are being coordinated with state and federal agencies and may include a mix of banking and onsite restoration, depending on agency preference and availability.	Wetlands	USACE and NJDEP
BIRD-01	Evaluate avian use by conducting pre-construction surveys for raptor nests, wading bird colonies, seabird nests, and shorebird nests during nesting periods. (Focus being listed species or species identified of special concern by the Federal or State government.)	Birds	Measure incorporated into project design.
BIRD-02	An avian post-construction monitoring framework will be developed and coordinated with NJDEP and USFWS and implemented as required	Birds	**Avian and Bat Post-construction Monitoring Framework,** BOEM, BSEE, USFWS and NJDEP
BIRD-03	Cut trees and vegetation, where possible, during the winter months when most migratory birds are not present at the site.	Birds	USFWS and NJDEP
BIRD-04	Use lighting technology that minimizes impacts on avian and bat species to the extent practicable.	Birds	Measure incorporated into project design.
BIRD-06	WTG air gaps (minimum blade tip elevation to the sea surface) to minimize collision risk to marine birds which fly close to ocean surface.	Birds	Measure incorporated into project design.
BIRD-07	Ocean Wind has sited Wind Farm Area facilities in the eastern portion of the original Lease Area, outside the migratory pathway, to reduce exposure to birds.	Birds	Measure incorporated into project design.

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
BAT-01	Onshore, the Project will avoid potential impacts by conducting tree clearing during the winter months, to the extent practicable.	Bats	USFWS and NJDEP
BAT-02	If tree clearing is required in areas with trees suitable for bat roosting during the period when northern long-eared bats may be present, develop avoidance and minimization measures in coordination with USFWS and NJDEP and conduct pre-construction habitat surveys.	Bats	USFWS and NJDEP
BAT-03	A bat post-construction monitoring framework will be developed and coordinated with NJDEP and USFWS and implemented as required.	Bats	**Avian and Bat Post-construction Monitoring Framework,** BOEM, BSEE, USFWS, and NJDEP
BENTH-01	Ocean Wind is conducting appropriate pre-siting surveys to identify and characterize potentially sensitive seabed habitats and topographic features.	Benthic Resources	Measure incorporated into project design.
BENTH-02	Use standard underwater cables which have electrical shielding to control the intensity of electromagnetic fields (EMF). EMF will be further refined as part of the design or cable burial risk assessment.	Benthic Resources	Measure incorporated into project design.
BENTH-03	Conduct a submerged aquatic vegetation (SAV) survey of the proposed inshore export cable route.	Benthic Resources	Measure incorporated into project design.
FISH-01	Evaluate geotechnical and geophysical survey results to identify sensitive habitats (e.g., shellfish and SAV beds) and avoid these areas during construction, to the extent practicable.	Fish and EFH	BOEM, BSEE, NJDEP, and USACE
FISH-02	Ocean Wind will coordinate with NJDEP, NMFS and USACE regarding time of year restrictions for winter flounder and river herring, as well as summer flounder habitat areas of particular concern (HAPC).	Fish and EFH	Measure incorporated into project design.
MMST-01	Vessels related to project planning, construction, and operation shall travel at speeds in accordance with National Oceanic and Atmospheric Administration (NOAA) requirements or the agreed to adaptive management plan per to Project PSMMP when assemblages of cetaceans are observed. Vessels will also maintain a reasonable distance from whales, small cetaceans, and sea turtles, as determined through site-specific consultations (specifics to be added based on consultations).	Marine Mammals, Sea Turtles	BOEM, BSEE, EPA, NMFS, and USACE
MMST-02	Project-related vessels will be required to adhere to NMFS Regional Viewing Guidelines for vessel strike avoidance measures during construction and operation to minimize the risk of vessel collision with marine mammals and sea turtles. Operators shall be required to undergo training on applicable vessel guidelines.	Marine Mammals, Sea Turtles	BOEM, BSEE, EPA, NMFS, and USACE
MMST-03	Vessel operators will monitor NMFS North Atlantic right whale (NARW) reporting systems (e.g., the Early Warning System, Sighting Advisory System) [daily] for the presence of NARW during planning, construction, and operations within or adjacent to Seasonal Management Areas and/or Dynamic Management Areas.	Marine Mammals, Sea Turtles	BOEM, BSEE, EPA, NMFS, and USACE
MMST-04	Ocean Wind will post a qualified observer as agreed to during the NMFS incidental take authorization process, on site during construction activities to avoid and minimize impacts to marine species and habitats in the Project Area.	Marine Mammals, Sea Turtles	BOEM, BSEE, EPA, NMFS, and USACE
MMST-05	Obtain necessary permits to address potential impacts on marine mammals from underwater noise, and establish appropriate and practicable mitigation and monitoring measures in coordination with regulatory agencies.	Marine Mammals, Sea Turtles	BOEM, BSEE, EPA, NMFS, and USACE
MMST-06	Develop and implement a PSMMP.	Marine Mammals, Sea Turtles	**PSMMP,** BOEM, BSEE, EPA, NMFS, and USACE

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
SOC-01	Comply with NJDEP noise regulations (New Jersey Administrative Code [N.J.A.C.] 7:29), which limit noise from industrial facilities received at residential property lines to 50 decibels during nighttime (10:00 p.m. to 7:00 a.m.) and 65 decibels during daytime as well as specific octave band noise limits, and comply with any local noise regulations, to the extent practicable, to minimize impacts on nearby communities.	Demographics, Employment, and Economics, Environmental Justice	NJDEP and/or local authorities
CUL-01	Develop and implement a Post-Review Discovery Plan.	Cultural Resources	**Post-review Discovery Plan,** BOEM, BSEE, and NJDEP
CUL-02	Use the results of geotechnical and geophysical surveys to identify potential cultural resources. Any cultural resources found will be avoided to the extent practicable. Where avoidance is not practicable, coordinate with relevant agencies and affected tribes to determine minimization and mitigation as necessary.	Cultural Resources	Measure incorporated into project design
CUL-03	Conduct background research and consult with the State Historic Preservation Office (SHPO) to determine the need for cultural resource surveys onshore. Any cultural resources found will be avoided to the extent practicable. Where avoidance is not practicable, coordinate with SHPO and affected tribes to determine minimization and mitigation as necessary.	Cultural Resources	Measure incorporated into project design
CUL-04	The Project has been designed to minimize visual impacts to historic and cultural properties to the extent feasible. The Project's layout was adjusted to align turbines at the eastern portion of the lease area, so that closest turbines are at least 15 miles from shore. Visibility of the turbine array from all identified properties within the Preliminary Area of Potential Effect would be minimized and mitigated further by measures adopted in this table including ADLS and markings (GEN-07), and as in COP Appendix F-4.	Cultural Resources	Measure incorporated into project design.
CUL-05	Mitigation in the form of documentation, planning, or educational materials will be coordinated with stakeholders, as in COP Appendix F-4.	Cultural Resources	BOEM, BSEE, EPA, USACE
CUL-06	Develop an anchoring plan for vessels prior to construction to identify avoidance/no anchorage areas.	Cultural Resources	BOEM, BSEE, EPA, USACE
REC-01	Develop a construction schedule to minimize activities in the onshore export cable route during the peak summer recreation and tourism season, where practicable.	Recreation and Tourism	NJDEP
REC-02	Coordinate with local municipalities to minimize impacts to popular events in the area during construction, to the extent practicable.	Recreation and Tourism	NJDEP and local municipalities
CFHFISH-01	Work cooperatively with commercial/recreational fishing entities and interests to ensure that the construction and operation of the Project will minimize potential conflicts with commercial and recreational fishing interests. Review planned activities with potentially affected fishing organizations and port authorities to prevent unreasonable fishing gear conflicts.	Commercial Fisheries and For-Hire Recreational Fishing	Measure incorporated into project design.
CFHFISH-02	Develop and implement a Fisheries Communication and Outreach Plan. (COP Appendix O) The plan includes the appointment of a dedicated fisheries liaison as well as fisheries representatives who will serve as conduits for providing information to, and gathering feedback from, the fishing industry, as well as Project-specific details on fisheries engagements.	Commercial Fisheries and For-Hire Recreational Fishing	Measure incorporated into project design.
CFHFISH-03	Implement Ørsted's corporate policy and procedure to compensate commercial/recreational fishing entities for gear loss as a result of Project activities (Appendix AE).	Commercial Fisheries and For-Hire Recreational Fishing	Measure incorporated into project design.

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
CFHFISH-04	Ocean Wind will develop a Navigational Safety Fund by providing eligible commercial, charter, and for-hire fishing vessels operating in and near the Wind Farm Area with reimbursement for new radar equipment and/or training courses (Appendix AE).	Commercial Fisheries and For-Hire Recreational Fishing	Measure incorporated into project design.
LU-01	Develop crossing and proximity agreements with utility owners prior to utility crossings. (Crossing agreements in U.S. waters are supported by the International Cable Protection Committee (ICPC), which provides a framework for establishing cable crossing agreements.)	Land Use and Coastal Infrastructure	Measure incorporated into project design.
NAV-01	Ocean Wind has engaged and will continue to engage with FAA and DOD with regards to potential effects to aviation and radar.	Navigation and Vessel Traffic	Measure incorporated into project design.
NAV-02	Site facilities to avoid unreasonable interference with major ports and USCG-designated Traffic Separation Schemes.	Navigation and Vessel Traffic	Measure incorporated into project design.
NAV-03	Select structures within the proposed Wind Farm Area will be equipped with strategically located Automatic Identification System (AIS) transponders.	Navigation and Vessel Traffic	BOEM, BSEE, and USCG
NAV-04	WTGs will be arranged in equally spaced rows on a northwest to southeast orientation to aid the safe navigation of vessels operating within the Wind Farm Area.	Navigation and Vessel Traffic	Measure incorporated into project design.
OUSE-01	Evaluate geotechnical and geophysical survey results to identify existing conditions, existing infrastructure, and other marine uses. Areas of other marine uses will be avoided to the extent practicable, and Ocean Wind will coordinate with other users where avoidance is not practicable.	Other Uses	Measure incorporated into project design.
VIS-01	Address key design elements, including visual uniformity, use of tubular towers, and proportion and color of turbines.	Scenic and Visual Resources	Measure incorporated into project design.
VIS-02	Ocean Wind has used appropriate viewshed mapping, photographic and virtual simulations, computer simulation, and field inventory techniques to determine the visibility of the proposed project. Simulations illustrate sensitive and scenic viewpoints.	Scenic and Visual Resources	Measure incorporated into project design.
VIS-03	Seek public input in evaluating the visual site design elements of proposed wind energy facilities.	Scenic and Visual Resources	Measure incorporated into project design.
VIS-04	Security lighting for onshore facilities will be downshielded to mitigate light pollution.	Scenic and Visual Resources	NJDEP and local municipalities
VIS-05	Where substation components may be visible and highly contrasting with their surroundings, the Project would provide supplemental plantings and other landscape elements to screen the substation from public view.	Scenic and Visual Resources	Measure incorporated into project design.
VIS-06	Consideration will be given to visually adapt the buildings and other substation components into their physical context. The forms, lines, colors, and textures of these components will be influenced by their immediate surroundings and selected to minimize visual contrast and potential visual impact. Non-reflective paint will be used on all Project components.	Scenic and Visual Resources	Measure incorporated into project design.
Applicant-Proposed Measures in the MMPA LOA Application, dated February 2022, the PSMMP (COP Appendix AA; Ocean Wind 2023), and the LOA Update Memo (August 2022)			
PSO/Passive acoustic monitoring (PAM) training and requirements	• PSOs must be provided by a third-party provider. • PSO and PAM operators will have completed PSO training, and have team leads with experience in the northwestern Atlantic Ocean on similar projects; remaining PSOs and PAM operators will have previous experience on similar projects and the ability to work with the relevant software; PSOs and PAM operators will complete a Permits and Environmental Compliance (PECP) training and a two-day training and refresher session with the PSO provider and the Project compliance representatives before the anticipated start of Project activities.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
	• No individual PSO will work more than 4 consecutive hours without a 2-hour break, or longer than 12 hours during a 24-hour period. • Each PSO will be provided one 8-hour break per 24-hour period to sleep. • Observations will be conducted from the best available vantage point(s) on the vessels (stable, elevated platform from which PSOs have an unobstructed 360-degree view of the water). • PSOs will systematically scan with the naked eye and a 7 x 50 reticle binocular, supplemented with night-vision equipment when needed. • When monitoring at night or in low visibility conditions, PSOs will monitor for marine mammals and other protected species using night-vision goggles with thermal clip-ons, a hand-held spotlight, and/or a mounted thermal camera system. • Activities with larger monitoring zones will use 25 x 150 mm "big eye" binoculars. • Vessel personnel will be instructed to report any sightings to the PSO team as soon as they are able and it is safe to do so. • Members of the monitoring team will consult with NMFS' North Atlantic right whale reporting system for the presence of North Atlantic right whales in the Project area. • Any NARW sightings will be reported as soon as possible, and no later than within 24 hours, to the NMFS Right Whale Sighting Advisory System (RWSAS) hotline.		
Vessel Strike Avoidance Policy – General Measures	• The Project will implement a vessel strike avoidance policy for all vessels under contract to Ørsted to reduce the risk of vessel strikes, and the likelihood of death and/or serious injury to marine mammals that may result from collisions with vessels. • Vessel operators and crews shall receive protected species identification training. This training will cover sightings of marine mammals and other protected species known to occur or which have the potential to occur in the Project area. It will include training on making observations in both good weather conditions (i.e., clear visibility, low wind, low sea state) and bad weather conditions (i.e., fog, high winds, high sea states, in glare). Training will include not only identification skills but information and resources available regarding applicable federal laws and regulations for protected species. It will also cover any Critical Habitat requirements, migratory routes, seasonal variations, behavior identification, etc. • All attempts shall be made to remain parallel to the animal's course when a traveling marine mammal is sighted in proximity to the vessel in transit. All attempts shall be made to reduce any abrupt changes in vessel direction until the marine mammal has moved beyond its associated separation distance (as described above). • If an animal or group of animals is sighted in the vessel's path or in proximity to it, or if the animals are behaving in an unpredictable manner, all attempts shall be made to divert away from the animals or, if unable due to restricted movements, reduce speed and shift gears into neutral until the animal(s) has moved beyond the associated separation distance (except for voluntary bow riding dolphin species). • All vessels will comply with NMFS regulations and speed restrictions and state regulations as applicable for NARW (see vessel speed restriction Standard Plan and Adaptive Plan outlines below). • All vessels will comply with the approved adaptive speed plan which will include additional measures including travel within established NARW Slow zones • Ocean Wind will submit a final NARW Vessel Strike Avoidance Plan at least 90 days prior to commencement of vessel use that details the Adaptive Plan and specific monitoring equipment to be used. The plan will, at minimum, describe how PAM, in combination with visual observations, will be conducted to ensure the transit corridor is clear of NARWs. The plan will also provide details on the vessel-based observer protocols on transiting vessels. • All attempts shall be made to remain parallel to the animal's course when a traveling marine mammal is sighted in proximity to the vessel in transit. All attempts shall be made to reduce any abrupt changes in vessel direction until the marine mammal has moved beyond its associated separation distance (as described above). • If an animal or group of animals is sighted in the vessel's path or in proximity to it, or if the animals are behaving in an unpredictable manner, all attempts shall be made to divert away from the animals or, if unable due to restricted movements, reduce speed and shift gears into neutral until the animal(s) has moved beyond the associated separation distance (except for voluntary bow riding dolphin species).	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Vessel separation distances	Vessels will maintain, to the extent practicable, separation distances of: • >500 m distance from any sighted North Atlantic right whale or unidentified large marine mammals; • >100 m from all other large whales; • >50 m for dolphins, porpoises, seals, and sea turtles.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
Vessel speed restrictions – Standard Plan	• All vessels will comply with NMFS regulations and speed restrictions and state regulations as applicable for NARW. • All vessels 65 ft (20 m) or longer subject to the jurisdiction of the U.S. will comply with a 10-knot speed restriction when entering or departing a port or place subject to U.S. jurisdiction, and in any SMA during NARW migratory and calving periods from November 1 to April 30 (Mid-Atlantic SMAs specific to the Project area: ports of New York/New Jersey and the entrance to the Delaware Bay in the vicinity of the Project area); also, in the following feeding areas as follows: from January 1 to May 15 in Cape Cod Bay; from March 1 to April 30 off Race Point; and from April 1 to July 31 in the Great South Channel. • **Between November 1 and April 30:** Vessels of all sizes will operate port to port (from ports in NJ, NY, MD, DE, and VA) at 10 knots or less. Vessels transiting from other ports outside those described will operate at 10 knots or less when within any active SMA or within the Offshore Wind Area including the lease area and export cable route. • **Year Round**: Vessels of all sizes will operate at 10 knots or less in any DMAs. • **Between May 1 and October 31:** All underway vessels (transiting or surveying) operating at >10 knots will have a dedicated visual observer (or NMFS approved automated visual detection system) on duty at all times to monitor for marine mammals within a 180° direction of the forward path of the vessel (90° port to 90° starboard). Visual observers must be equipped with alternative monitoring technology for periods of low visibility (e.g., darkness, rain, fog). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. Visual observers may be third-party observers (i.e., NMFS-approved PSOs) or crew members. • A complete vessel speed plan for sea turtles and ESA-listed fish will be included in the Protected Species Mitigation and Monitoring Plan (PSMMP).	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS

Vessel speed restrictions – Adaptive Plan	• The Standard Plan outlined above will be adhered to except in cases where crew safety is at risk, and/or labor restrictions, vessel availability, costs to the project, or other unforeseen circumstance make these measures impracticable. To address these situations, an Adaptive Plan will be developed in consultation with NMFS to allow modification of speed restrictions for vessels. Should Ocean Wind choose not to implement this Adaptive Plan, or a component of the Adaptive Plan is offline (e.g., equipment technical issues), Ocean Wind will default to the Standard Plan (described above).
	• The Adaptive Plan will not apply to vessel subject to speed reductions in SMAs as designated by NOAA's Vessel Strike Reduction Rule.
	• **Year Round:** A semi-permanent acoustic network comprising near real-time bottom mounted and/or mobile acoustic monitoring platforms will be installed such that confirmed NARW detections are regularly transmitted to a central information portal and disseminated through the situational awareness network.
	  o The transit corridor and Offshore Wind Area will be divided into detection action zones.
	  o Localized detections of NARWs in an action zone would trigger a slow-down to 10 knots or less in the respective zone for the following 12 h. Each subsequent detection would trigger a 12-h reset. A zone slow-down expires when there has been no further visual or acoustic detection in the past 12 h within the triggered zone.
	  o The detection action zones size will be defined based on efficacy of PAM equipment deployed and subject to NMFS approval as part of the NARW Vessel Strike Avoidance Plan.
	• **Year Round**: All underway vessels (transiting or surveying) operating >10 knots will have a dedicated visual observer (or NMFS approved automated visual detection system) on duty at all times to monitor for marine mammals within a 180° direction of the forward path of the vessel (90° port to 90° starboard). Visual observers must be equipped with alternative monitoring technology for periods of low visibility (e.g., darkness, rain, fog). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. Visual observers may be third-party observers (i.e., NMFS-approved PSOs) or crew members.
	• **Year-round:** any DMA is established that overlaps with an area where a project vessel would operate, that vessel, regardless of size when entering the DMA, may transit that area at a speed of >10 knots. Any active action zones within the DMA may trigger a slow down as described above.
	• If PAM and/or automated visual systems are offline, the Standard Plan measures will apply for the respective zone (where PAM is offline) or vessel (if automated visual systems are offline).
		Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS

Situational Awareness System/ Common Operating Picture	• Ocean Wind will establish a situational awareness network for marine mammal and sea turtle detections through the integration of sighting communication tools such as Mysticetus, Whale Alert, WhaleMap, etc. • Sighting information will be made available to all project vessels through the established network. • Ocean Wind's Marine Coordination Center will serve to coordinate and maintain a Common Operating Picture. • Systems within the Marine Coordination Center, along with field personnel, will: o monitor the NMFS North Atlantic right whale reporting systems daily;	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
	○ monitor the U.S. Coast Guard VHF Channel 16 throughout the day to receive notifications of any sighting; and ○ monitor any existing real-time acoustic networks.		
PSO/PAM data recording	• All data will be recorded using industry-standard software. • Data recorded will include information related to ongoing operations, observation methods and effort, visibility conditions, marine mammal detections, and any mitigation actions requested and enacted.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Long-term Monitoring	• Pre-construction marine mammal surveys will provide a baseline set of data for comparison against the monitoring efforts during construction. • Post-construction marine mammal surveys will provide for an assessment of the potential long-term impacts of the Project. • Survey will involve a combination of visual and acoustic monitoring techniques.	Marine Mammals	BOEM, BSEE, and NMFS
Operational Monitoring	• Visual monitoring and PAM for marine mammals will occur during vessel transits to and from the Project area as described above under vessel speed restrictions (standard and adaptive plans).	Marine Mammals	BOEM, BSEE, and NMFS
Impact Pile Driving			
Impact pile-driving time-of-year restriction	• No pile installation will occur from 01 January to 30 April.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Noise mitigation systems (NMS) during impact pile driving	• The Project will use a dual NMS-system for all impact piling events. The NMS will be a combination of two devices (e.g., bubble curtain, hydro-damper) to reduce noise propagation during monopile foundation pile driving. The Project is committed to achieving ranges associated with 10 dB of noise attenuation.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
PAM for impact pile driving	• 4-hour PAM operator rotations for 24-hour operation vessels. • There will be a PAM operator on duty conducting acoustic monitoring in coordination with the visual PSOs during all pre-start clearance periods, piling, and post-piling monitoring periods. • Passive acoustic monitoring will include and extend beyond the largest shutdown zone for low- and mid-frequency cetaceans. • The NARW pre-clearance zone will be monitored visually out to the extent of the low-frequency cetacean clearance/shutdown zone and acoustically out to 3,800 m in winter and 3,500 m in summer (see Table 1-5C).	Marine Mammals	BOEM, BSEE, and NMFS
Visual monitoring for impact pile driving	• Six to eight visual PSOs and PAM operators (may be located on shore) on the pile driving vessel and four to eight visual PSOs and PAM operators on any secondary marine mammal monitoring vessel. • Two visual PSOs will hold watch on each construction and secondary vessel during pre-start clearance, throughout pile driving, and 30 minutes after piling is completed. • PSOs will visually monitor the harbour porpoise, pinniped, and dolphin shutdown zones. • The secondary vessel will be positioned and circling at the outer limit of the low-frequency and mid-frequency cetacean shutdown zone (Table 1-5B). PSOs stationed on the secondary vessel will ensure the outer portion of the shutdown zones and prestart clearance zone are visually monitored.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Daytime visual monitoring for impact pile driving (daytime visual monitoring is defined by the period between nautical twilight rise and set for the region)	• Visual PSOs should begin surveying the monitoring zone at least 60 minutes prior to the start of pile driving. • PSOs will monitor for 30 minutes after each piling event. • PSOs will monitor the shutdown zone with the naked eye and reticle binoculars while one PSO periodically scans outside the shutdown zone using the mounted big eye binoculars. • The secondary vessel will be positioned and circling at the outer limit of the low-frequency and mid-frequency cetacean shutdown zones (Table 1-5B). • Monitoring equipment planned for use during standard daytime and low-visibility and nighttime piling is presented in Table 1-5A.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

<table>
<tr><th>Measure Number/Name</th><th>Table H-1. Description of Applicant-Proposed Measures</th><th>Resource Area Mitigated</th><th>BOEM's Identification of the Anticipated Enforcing Agency[1]</th></tr>
<tr><td></td><td>Table 1-5A. Monitoring equipment planned for use during standard daytime and low-visibility and nighttime piling.
<table>
<tr><th rowspan="2">Item</th><th colspan="2"></th><th colspan="2"></th></tr>
<tr><th>Number on Construction Vessel</th><th>Number on Secondary Vessel</th><th>Number on Construction Vessel</th><th>Number on Secondary Vessel</th></tr>
<tr><td>Visual PSOs on watch</td><td>2</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>PAM operators on duty[1]</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Reticle binoculars</td><td>2</td><td>2</td><td>0</td><td>0</td></tr>
<tr><td>Mounted thermal/IR camera system[2]</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Mounted "big-eye" binocular</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>Monitoring station for real time PAM system[3]</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Hand-held or wearable NVDs</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>IR spotlights</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Data collection software system</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>PSO-dedicated VHF radios</td><td>2</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Digital single-lens reflex camera equipped with 300-mm lens</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
</table>
[1] PAM operator may be stationed on the vessel or at an alternative monitoring location.
[2] The camera systems will be automated with detection alerts that will be checked by a PSO on duty; however, cameras will not be manned by a dedicated observer.
[3] The selected PAM system will transmit real time data to PAM monitoring stations on the vessels and/or a shore side monitoring station.</td><td></td><td></td></tr>
<tr><td>Daytime periods of reduced visibility for impact pile driving</td><td>• If the monitoring zone is obscured, the two PSOs on watch will continue to monitor the shutdown zone using thermal camera systems, handheld night-vision devices (NVD) and mounted IR camera (as able).
• All PSOs on duty will be in contact with the on-duty PAM operator who will monitor the PAM systems for acoustic detections of marine mammals that are vocalizing in the area.</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Nighttime visibility for construction and secondary vessels</td><td>• Pile driving during nighttime hours could potentially occur when a pile installation is started during daylight and, due to unforeseen circumstances, would need to be finished after dark. New piles could be initiated after dark to meet schedule requirements.
• Visual PSOs will rotate in pairs: one observing with a handheld NVD and one monitoring the infrared (IR) thermal imaging camera system. There will also be a PAM operator on duty conducting acoustic monitoring in coordination with the visual PSOs.
• The mounted thermal cameras may have automated detection systems or require manual monitoring by a PSO.
• PSOs will focus their observation effort during nighttime watch periods within the shutdown zones and waters immediately adjacent to the vessel.
• Deck lights will be extinguished or dimmed during night observations when using night-vision devices; however, if the deck lights must remain on for safety reasons, the PSO will attempt to use the NVD in areas away from potential interference by these lights. If a PSO is unable to monitor the visual clearance or shutdown zones with available NVDs. Piling will not commence or will be halted (as safe to do so).</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Acoustic monitoring during impact pile driving</td><td>• PAM should begin at least 30 minutes prior to the start of piling.
• One PAM operator on duty during both daytime and nighttime/low visibility monitoring.
• Since visual observations within the applicable shutdown zones can become impaired at night or during daylight hours due to fog, rain, or high sea states, visual monitoring with thermal and NVDs will be supplemented by PAM during these periods
• PAM operator will monitor during all pre-start clearance periods, piling, and post-piling monitoring periods (daylight, reduced visibility, and nighttime monitoring).
• Real-time PAM systems require at least one PAM operator to monitor each system by viewing data or data products that are streamed in real-time or near real-time to a computer workstation and monitor located on a Project vessel or onshore.
• PSOs will acoustically monitor a zones outlined in Table 1.5-C for all marine mammals, as well as the NARW specific clearance zones.
• It is expected there will be a PAM operator stationed on at least one of the dedicated monitoring vessels in addition to the PSOs or located remotely/onshore.
• PAM operators will complete specialized training for operating PAM systems prior to the start of monitoring activities.
• All on-duty PSOs will be in contact with the PAM operator on duty, who will monitor the PAM systems for acoustic detections of marine mammals that are vocalizing in the area.</td><td>Marine Mammals</td><td>BOEM, BSEE, and NMFS</td></tr>
</table>

<table>
<tr><th>Measure Number/Name</th><th>Table H-1. Description of Applicant-Proposed Measures</th><th>Resource Area Mitigated</th><th>BOEM's Identification of the Anticipated Enforcing Agency[1]</th></tr>
<tr><td></td><td>

The PAM operator will inform the Lead PSO on duty of animal detections approaching or within applicable ranges of interest to the pile-driving activity via the data collection software system (i.e., Mysticetus or similar system) who will be responsible for requesting the designated crewmember to implement the necessary mitigation procedures.
Acoustic monitoring during nighttime and low visibility conditions during the day will complement visual monitoring (e.g., PSOs and thermal cameras) and will cover an area of at least the PAM Clearance Zone presented in Table 1.5-C around each foundation.

</td><td></td><td></td></tr>
<tr><td>Shutdown zones for impact pile driving</td><td>

Shutdown zones and pre-clearance zones for Project impact pile driving activities are presented in Tables 1-5B and 1-5C for winter and summer seasons separately as sound speed profiles are faster during winter conditions and therefore have larger corresponding shutdown zones. The NARW pre-start clearance zones presented in Table 1-5C are equal to the Level B zone to avoid any unnecessary takes related to behavioral disturbance.
Noise mitigation systems (NMS; e.g., bubble curtains) are expected to reduce source levels below Level A (PTS) take zones (beyond the NMS minimum of 10 dB of Attenuation) for the following mid-frequency cetaceans: Atlantic white-sided dolphin, Atlantic spotted dolphin, short-beaked common dolphin, Risso's dolphin, bottlenose dolphin - coastal, bottlenose dolphin - offshore, long-finned pilot whale, and short-finned pilot whales therefore shut-down zones for those species are not required.

Table 1-5B. Mitigation and Monitoring Zones[1,2] during Impact Pile Driving for Summer and Winter (adapted from PSMMP dated February 2022) with 10 dB broadband sound attenuation
<table>
<tr><th rowspan="2">Species</th><th colspan="2">Summer (May through November)</th><th colspan="2">Winter (December only)</th></tr>
<tr><th>Pre-start Clearance Zone (m)[4]</th><th>Shutdown Zone (m)[5]</th><th>Pre-start Clearance Zone (m)[4]</th><th>Shutdown Zone (m)[5]</th></tr>
<tr><td>Low-frequency cetaceans (see Table 1-5C below for NARW)</td><td>1,650</td><td>1,650</td><td>2,490</td><td>2,490</td></tr>
<tr><td>Mid-Frequency Cetaceans (sperm whale only)</td><td>1,650</td><td>1,650</td><td>2,490</td><td>2,490</td></tr>
<tr><td>High-Frequency Cetaceans</td><td>880</td><td>880</td><td>1,430</td><td>1,430</td></tr>
<tr><td>Seals</td><td>80</td><td>80</td><td>240</td><td>240</td></tr>
<tr><td>Turtles</td><td colspan="4">500</td></tr>
</table>
1. The shutdown zones for large whales, porpoise, and seals are based upon the maximum Level A zone for each group.
[1] Zones are based upon the following modeling assumptions:
• 8/11-m (tapered) monopile with 10 dB broadband sound attenuation.
• Either one or two monopiles driven per day, and either two or three pin piles driven per day. When modeled injury (Level A) threshold distances differed among these scenarios, the largest for each species group was chosen for conservatism.
[2] Zone monitoring will be achieved through a combined effort of passive acoustic monitoring and visual observation (but not to monitor vessel separation distance).
[3] Zones are derived from modeling that considered animal movement and aversion parameters (see more details in Section 4.3.5)
[4] The pre-start clearance zones for large whales, porpoise, and seals are based upon the maximum Level A zone for each group.
[5] The shutdown zones for large whales, porpoise, and seals are based upon the maximum Level A zone for each group.
[6] No Level A exposures were calculated for blue whales resulting in no expected Level A exposure range; therefore, the exposure range for fin whales was used as a proxy due to similarities in species.
Table 1-5C. NARW Clearance and Real-time PAM Monitoring Zones[1] during Impact Piling in Summer and Winter (adapted from PSMMP dated February 2022)
<table>
<tr><th>Season</th><th>Minimum Visibility Zone[2]</th><th>PAM Clearance Zone (m)[3]</th><th>Visual Clearance Delay or Shutdown Zone (m)</th><th>PAM Clearance Delay or Shutdown Zone (m)</th></tr>
<tr><td>Summer</td><td>1,650</td><td>3,500</td><td>Any Distance</td><td>1,650</td></tr>
<tr><td>Winter</td><td>2,490</td><td>3,800</td><td>Any Distance</td><td>2,490</td></tr>
</table>
[1] Ocean Wind may request modification to zones based on results of sound field verification
[2] The minimum visibility zones for NARWs are based upon the maximum Level A zones for the whale group.
[3] The PAM pre-start clearance zone was set equal to the Level B zone to avoid any unnecessary take.
</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Pre-start clearance for impact pile driving</td><td>

Piling may be initiated at any time within a 24-hour period.
Prior to the beginning of each pile driving event, PSOs and PAM operators will monitor for marine mammals and sea turtles for a minimum of 30 minutes and continue at all times during pile driving.

</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
</table>

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
	• All shutdown zones will be confirmed to be free of marine mammals and sea turtles prior to initiating ramp-up and the low-frequency cetacean shutdown zone will be fully visible, and the NARW acoustic zone monitored for at least 30 minutes prior to commencing ramp-up. • If a marine mammal or sea turtle is observed entering or within the relevant shutdown zones prior to the initiation of pile driving activity, pile driving activity will be delayed and will not begin until either the marine mammal(s) or sea turtle(s) has voluntarily left the respective shutdown zones and been visually or acoustically confirmed beyond that shutdown zone, or when the additional time period has elapsed with no further sighting or acoustic detection (i.e., 15 minutes for dolphins, porpoises, and seals, 30 minutes for whales, 30 minutes for sea turtles). • A PSO will observe a behavioral monitoring zone of 1,200 m for all species of sea turtle, however the shutdown zone remains 500 m.		
Ramp-up (soft start) for impact pile driving	• Each monopile installation will begin with a minimum of 20-minute soft-start procedure. • Soft-start procedure will not begin until the shutdown zone has been cleared by the visual PSO or PAM operators. • If a marine mammal is detected within or about to enter the applicable shutdown zone, prior to or during the soft-start procedure, pile driving will be delayed until the animal has been observed exiting the shutdown zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for dolphins, porpoises, and seals, 30 minutes for whales, and 60 minutes for sea turtles).	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
Shutdowns for impact pile driving	• If a marine mammal or sea turtle is detected entering or within the respective shutdown zones after pile driving has commenced, an immediate shutdown of pile driving will be implemented unless determined shutdown is not feasible due to an imminent risk of injury or loss of life to an individual (as described in the PSMMP dated February 2022). • If shutdown is called for but it is determined that shutdown is not feasible due to risk of injury or loss of life, there will be a reduction of hammer energy. • Following shutdown, pile driving will only be initiated once all shutdown zones are confirmed by PSOs to be clear of marine mammals and sea turtles for the minimum species-specific time periods. • The shutdown zone will be continually monitored by PSOs and PAM operators during any pauses in pile driving. • If a marine mammal or sea turtle is sighted within the shutdown zones during a pause in piling, piling will be delayed until the animal(s) has moved outside the shutdown zone and no marine mammals are sighted for a period of 30 minutes or sea turtles for 30 minutes.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Post-impact piling monitoring	• PSOs will continue to survey the shutdown zones throughout the duration of pile installation and for a minimum of 30 minutes after piling has been completed.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Sound measurements for impact pile driving	• Received sound measurements will be collected during driving of the first three monopiles installed over the course of the Project using an NMS. • The goals of the of field verification measurements using an NMS include verification of modeled ranges; and providing sound measurements of impact pile driving using International Organization for Standardization (ISO)-standard methodology to build data that are comparable among projects. • Based on the sound field measurement results the Project may request a modification of the clearance and/or Shutdown zones.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Impact Pile Driving Reporting	• All data recording will be conducted using Mysticetus or similar software. • Operations, monitoring conditions, observation effort, all marine mammal detections, and any mitigation actions will be recorded. • Members of the monitoring team must consult NMFS' NARW reporting systems for the presence of NARWs in the Project area. • DMAs will be reported across all Project vessels. • Additional details regarding reporting are provided below under "Reporting."		
Vibratory Pile Driving			

Visual monitoring for vibratory pile driving	• All observations will take place from one of the construction vessel stationed at or near the vibratory piling location.
	• Two PSOs on duty on the construction vessel.
	• PSOs will continue to survey the shutdown zone using visual protocols throughout the installation of each cofferdam sheet pile and for a minimum of 30 minutes after piling has been completed.
	• Monitoring Equipment shall include:
	  ○ Two sets of 7 x 50 reticle binoculars
	  ○ Two hand-held or wearable NVDs
		Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

<table>
<tr><th>Measure Number/Name</th><th>Table H-1. Description of Applicant-Proposed Measures</th><th>Resource Area Mitigated</th><th>BOEM's Identification of the Anticipated Enforcing Agency[1]</th></tr>
<tr><td></td><td>Two IR spotlights
One data collection software system
Two PSO-dedicated VHF radios
One digital single-lens reflex camera equipped with 300-mm lens
One Mounted thermal/IR camera system
One Mounted "big-eye" binocular</td><td></td><td></td></tr>
<tr><td>Daytime visual monitoring for vibratory pile driving</td><td>Two PSOs will concurrently maintain watch from the construction or support vessel during the pre-start clearance period, throughout vibratory pile driving, and 30 minutes after piling is completed.
Two PSOs will conduct observations concurrently.
One observer will monitor the shutdown zones with the naked eye and reticle binoculars; one PSO will monitor in the same way but will periodically scan outside the shutdown zones.</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Daytime visual monitoring during periods of low visibility for vibratory pile driving</td><td>One PSO will monitor the shutdown zone with the mounted infrared camera while the other maintains visual watch with the naked eye/binoculars.</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Nighttime visual monitoring for vibratory pile driving</td><td>No PAM operations will be utilized due to the likelihood of masking effects of the vibratory sheet pile driving activities which will result in ineffective acoustic monitoring opportunities.</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Shutdown zones for vibratory pile driving</td><td>Shutdown zones and pre-clearance zones for Project vibratory pile driving activities are presented in Table 1-5D.
Table 1-5D. Mitigation and Monitoring Zones during Project Vibratory Sheet Pile Driving (adapted from PSMMP dated February 2022)
<table>
<tr><th>Species</th><th>Pre-start Clearance Zone[1] (m)</th><th>Shutdown Zone[2] (m)</th></tr>
<tr><td>Low-Frequency Cetaceans including NARW and Sperm whales</td><td>150</td><td>100</td></tr>
<tr><td>Medium-Frequency Cetaceans</td><td>150</td><td>50</td></tr>
<tr><td>High-Frequency Cetaceans</td><td>150</td><td>150</td></tr>
<tr><td>Pinnipeds in-water</td><td>150</td><td>60</td></tr>
<tr><td>Turtles</td><td>500</td><td>500</td></tr>
</table>
Notes: Zones are based on modeling with no animal movement or aversions applied.
[1] The pre-start clearance zones for large whales, porpoise, and seals are based upon the maximum Level A zone (128.2 m) and rounded up for PSO clarity.
[2] The shutdown zones for low-frequency cetaceans (including NARW) and high-frequency cetaceans are based upon the maximum Level A zone for each group and rounded up for PSO clarity. Shutdown zones for mid-frequency cetaceans (e.g., other dolphins and pilot whales) were set using precautionary distances.</td><td>Marine Mammals, Sea Turtles</td><td></td></tr>
<tr><td>Pre-start clearance for vibratory pile driving</td><td>PSOs will monitor the shutdown zone for 30 minutes prior to the start of vibratory pile driving.
If a marine mammal or sea turtle is observed entering or within the respective shutdown zones, piling cannot commence until the animal(s) has exited the shutdown zone or time has elapsed since the last sighting (30 minutes for large whales (low-frequency cetaceans and sperm whales), 15 minutes for dolphins (mid-frequency cetaceans), porpoises (high-frequency cetaceans), and pinnipeds, 60 minutes for sea turtles).
A PSO will observe a behavioral monitoring zone of 1,200 m for all species of sea turtle, however the shutdown zone remains 500 m.</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Ramp-up (soft start) for vibratory pile driving</td><td>Ramp-up will be initiated if the shutdown zone cannot be adequately monitored (i.e., obscured by fog, inclement weather, poor lighting conditions) for a 30-minute period.</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Shutdowns for vibratory pile driving</td><td>If a marine mammal or sea turtle is observed entering or within the respective shutdown zones after sheet pile installation has commenced, a shutdown will be implemented as long as health and safety is not compromised.
The shutdown zone must be continually monitored by PSOs during any pauses in vibratory pile driving, activities will be delayed until the animal(s) has moved outside the shutdown zone and no marine mammals are sighted for a period of 30 minutes for whales, 15 minutes for dolphins, porpoises and pinnipeds, and 60 minutes for sea turtles.</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
</table>

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
Reporting	• All data recording will be conducted using Mysticetus or similar software. • Operations, monitoring conditions, observation effort, all marine mammal detections, and any mitigation actions will be recorded. • Members of the monitoring team must consult NMFS' NARW reporting systems for the presence of NARWs in the Project area. • DMAs will be reported across all Project vessels. • Additional details regarding reporting are provided below under "Reporting."		
HRG Surveys			

General visual monitoring methods for HRG surveys	• The following mitigation and monitoring measures for HRG surveys apply only to sound sources with operating frequencies below 180 kHz. There are no mitigation or monitoring protocols required for sources operating >180 kHz.
	• Shutdown, pre-start clearance, and ramp-up procedures will not be conducted during HRG survey operations using only non-impulsive sources (e.g., Ultra-Short BaseLine (USBL) and parametric SBPs) other than non-parametric SBPs (e.g., CHIRPs).
	• Pre-clearance and ramp-up, but not shutdown, will be conducted when using non-impulsive, non-parametric SBPs.
	• Shutdowns will be conducted for impulsive, non-parametric HRG survey equipment other than CHIRP SBPs operating at frequencies <180 kHz.
	• Monitoring Equipment:
	  o Two pairs of 7x50 reticle binoculars
	  o One mounted thermal/ IR camera system during nighttime and low visibility conditions
	  o Two hand-held or wearable NVDs
	  o Two IR spotlights
	  o One data collection software system
	  o Two PSO-dedicated VHF radios
	  o One digital single-lens reflex camera equipped with a 300-mm lens
	• The PSOs will be responsible for visually monitoring and identifying marine mammals approaching or entering the established zones during survey activities.
	• Visual monitoring of the established Shutdown zones and monitoring zone will be performed by PSO teams on each survey vessel:
	  o Four to six PSOs on all 24-hour survey vessels.
	  o Two to three PSOs on all 12-hour survey vessels.
	  o PSOs will work in shifts such that no one PSO will work more than 4 consecutive hours without a 2-hour break or longer than 12 hours during any 24-hour period.
	• Table X provides the list of the personnel on watch and monitoring equipment available onboard each HRG survey vessel.
	• Observations will take place from the highest available vantage point on all the survey vessels. General 360° scanning will occur during the monitoring periods, and target scanning by the PSO will occur if cued to a marine mammal. PSOs will adjust their positions appropriately to ensure adequate coverage of the entire shutdown and monitoring zones around the respective sound sources.
	• It will be the responsibility of the Lead PSO on duty to communicate the presence of marine mammals as well as to communicate and enforce the action(s) that are necessary to ensure mitigation and monitoring requirements are implemented as appropriate.
	• The PSOs will begin observation of the shutdown zones prior to initiation of HRG survey operations and will continue throughout the survey activity and/or while equipment operating below 180 kHz is in use.
	• PSOs will monitor Mysticetus (or similar data system) and/or appropriate data systems for Dynamic Management Areas established within their survey area.
	• PSOs will also monitor the NMFS North Atlantic right whale reporting systems including Whale Alert and RWSAS once every 4-hour shift during Project-related activities within, or adjacent to, Seasonal management Areas and/or Dynamic Management Areas.
		Marine Mammals	BOEM, BSEE, and NMFS

<table>
<thead>
<tr><th>Measure Number/Name</th><th>Table H-1. Description of Applicant-Proposed Measures</th><th>Resource Area Mitigated</th><th>BOEM’s Identification of the Anticipated Enforcing Agency[1]</th></tr>
</thead>
<tbody>
<tr><td></td><td>Table X. Personnel and Equipment Compliment for Monitoring Vessels during HRG Surveys
<table>
<tr><th>Item</th><th>Number on Survey Vessel</th></tr>
<tr><td>PSOs on watch (Daytime)</td><td>1</td></tr>
<tr><td>PSOs on watch (Nighttime)</td><td>2</td></tr>
<tr><td>Reticle binoculars</td><td>2</td></tr>
<tr><td>Mounted thermal/IR camera system</td><td>1</td></tr>
<tr><td>Hand-held or wearable NVD</td><td>2</td></tr>
<tr><td>IR spotlights</td><td>2</td></tr>
<tr><td>Data collection software system</td><td>1</td></tr>
<tr><td>PSO-dedicated VHF radios</td><td>2</td></tr>
<tr><td>Digital single-lens reflex camera equipped with 300-mm lens</td><td>1</td></tr>
</table>
IR = infrared; NVD = night vision devices; PSO = protected species observer; VHF = very high frequency</td><td></td><td></td></tr>
<tr><td>Autonomous Surface Vehicle/ (ASV) Operations for HRG Surveys</td><td>

Mobile and hybrid PAM systems utilizing autonomous surface vehicles (ASVs) and radio-linked autonomous acoustic recorders (AARs) shall be considered when they can meet monitoring and mitigation requirements in a cost-effective manner.
Should an ASV be utilized during surveys, the following procedures will be implemented:

PSOs will be stationed aboard the mother vessel to monitor the ASV in a location which will offer a clear, unobstructed view of the ASV’s shutdown and monitoring zones.
When in use, the ASV will be within 800 m (2,625 ft) of the primary vessel while conducting survey operations.
For monitoring around an ASV, if utilized, a dual thermal/high definition (HD) camera will be installed on the mother vessel facing forward and angled in a direction so as to provide a field of view ahead of the vessel and around the ASV.
PSOs will be able to monitor the real-time output of the camera on hand-held iPads. Images from the cameras can be captured for review and to assist in verifying species identification.
A monitor will also be installed on the bridge displaying the real-time picture from the thermal/HD camera installed on the front of the ASV itself, providing an additional forward field of view of the craft.
Night-vision goggles with thermal clip-ons, as mentioned above, and a hand-held spotlight will be provided such that PSOs can focus observations in any direction around the mother vessel and/or the ASV.

</td><td>Marine Mammals</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Daytime visual monitoring for HRG surveys (period between nautical twilight rise and set for the region)</td><td>

One PSO on watch during all pre-clearance periods and all source operations.
PSOs will use reticle binoculars and the naked eye to scan the monitoring zone for marine mammals and sea turtles
</td><td>Marine Mammals</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Nighttime and low visibility visual monitoring for HRG surveys</td><td>

The lead PSO will determine if conditions warrant implementing reduced visibility protocols.
Two PSOs on watch during all pre-clearance periods and operations.
Each PSO will use the most appropriate available technology (i.e., infrared camera and night-vision device) and viewing locations to monitor the shutdown zones and maintain vessel separation distances.
</td><td>Marine Mammals</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Pre-start clearance for HRG surveys</td><td>

Pre-start clearance survey will only be conducted for non-impulsive, non-parametric SBPs and impulsive, non-parametric HRG survey equipment other than CHIRP SBPs operating at frequencies <180 kHz
Prior to the initiation of equipment ramp-up, PSOs and PAM operators will conduct a 30-minute watch of the shutdown zones to monitor for marine mammals.
The shutdown zones must be visible using the naked eye or appropriate visual technology during the entire clearance period for operations to start; if the shutdown zones are not visible, source operations <180 kHz will not commence.
If a marine mammal is observed within its respective shutdown zone during the pre-clearance period, ramp-up will not begin until the animal(s) has been observed exiting its respective shutdown zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes, 30 minutes for all other marine mammals).
</td><td>Marine Mammals</td><td>BOEM, BSEE, and NMFS</td></tr>
</tbody>
</table>

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
Ramp-up (soft start) for HRG surveys	• Ramp-ups will only be conducted for non-impulsive, non-parametric SBPs and impulsive, non-parametric HRG survey equipment other than CHIRP SBPs operating at frequencies <180 kHz. • Where technically feasible, a ramp-up procedure will be used for HRG survey equipment capable of adjusting energy levels at the start or re-start of HRG survey activities. Ramp-up procedures provide additional protection to marine mammals near the Project area by allowing them to vacate the area prior to the commencement of survey equipment use. • Ramp-up will not be initiated during periods of inclement conditions or if the shutdown zones cannot be adequately monitored by the PSOs, using the appropriate visual technology for a 30-minute period. • Ramp-up will begin by powering up the smallest acoustic HRG equipment at its lowest practical power output appropriate for the survey followed by a gradual increase in power and addition of other acoustic sources (as able). • If a marine mammal is detected within or about to enter its respective shutdown zone, ramp-up will be delayed. • Ramp-up will continue once the animal(s) has been observed exiting its respective shutdown zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes, 30 minutes for all other marine mammal species, and 30 minutes for sea turtles).	Marine Mammals	BOEM, BSEE, and NMFS
Shutdowns for HRG surveys	• Shutdowns will only be conducted for impulsive, non-parametric HRG survey equipment other than CHIRP SBPs operating at frequencies <180 kHz if a marine mammal or sea turtle is sighted at or within its respective shutdown zone. • Shutdowns will not be implemented for dolphins that voluntarily approach the survey vessel. • An immediate shutdown of the applicable HRG survey equipment (i.e., select sources operating <180 kHz) will be required if a marine mammal is sighted at or within its respective shutdown zone. • The vessel operator must comply immediately with any call for shutdown by the Lead PSO. Any disagreement between the Lead PSO and vessel operator should be discussed only after shutdown has occurred. • Subsequent restart of the survey equipment can be initiated if the animal has been observed exiting its respective shutdown zone within 30 minutes of the shutdown or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes and 30 minutes for all other species). Survey vessels may power down electromechanical equipment to lowest power output that is technically feasible for these species. • If the acoustic source is shut down for reasons other than mitigation (e.g., mechanical difficulty) for less than 30 minutes, it will be reactivated without ramp-up if PSOs have maintained constant observation and no detections of any marine mammal have occurred within the respective shutdown zones. • If the acoustic source is shut down for a period longer than 30 minutes or PSOs were unable to maintain constant observation, then ramp-up and pre-start clearance procedures will be initiated.	Marine Mammals	BOEM, BSEE, and NMFS
Shutdown zones for HRG surveys	• Shutdowns will only be conducted for impulsive, non-parametric HRG survey equipment other than CHIRP SBPs operating at frequencies <180 kHz. • Shutdown Zones: ○ North Atlantic right whale: 500 meters (547 yards). ○ Fin whale, minke whale, sei whale, humpback whale, blue whale, sperm whale, Risso's dolphin, long & short-finned pilot whales, harbor porpoise, gray seal, harbor seal, and all species of sea turtles: 100 meters (110 yards). ○ Delphinids (Atlantic white sided dolphin, Atlantic spotted dolphin, short-beaked common dolphin, and bottlenose dolphin [coastal and offshore stocks]): no shutdown zone.	Marine Mammals	BOEM, BSEE, and NMFS
Post-construction HRG survey reporting	• All data recording will be conducted using Mysticetus or similar software. • Operations, monitoring conditions, observation effort, all marine mammal detections, and any mitigation actions will be recorded. • Post construction, Ocean Wind will provide to BOEM and NMFS a final report annually for HRG survey activities. The final report must address any comments on the draft report provided to Ocean Wind by BOEM and NMFS. The report must include a summary of survey activities, all PSO and incident reports, and an estimate of the number of listed marine mammals observed and/or taken during these survey activities. • Additional details regarding reporting are provided below under "Reporting."	Marine Mammals	BOEM, BSEE, and NMFS
UXO			
Visual monitoring during UXO detonations (vessel-based)	• Monitoring Equipment ○ 2 visual PSOs and 1 PAM operator will be on watch on each PSO vessel.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
	○ There will be a team of six to eight visual and acoustic PSOs on UXO monitoring vessels. ○ A single vessel is anticipated to adequately cover a radius of 2,000 m. The number of vessels will depend on the size of the zones to be monitored. ○ PAM operators may be located remotely/onshore. ○ 2 reticle binoculars ○ 1 pair of mounted "big eye" binoculars ○ Data collection software system ○ PSO-dedicated VHF radios ○ Digital single-lens reflex camera equipped with 300-mm lens. • Daytime visual monitoring is defined by the period between civil twilight rise and set for the region. • During the 60-minute pre-start clearance period and 60 minutes after the detonation event, two PSOs will always maintain watch on the primary vessel; likewise, two PSOs will also maintain watch during the same time periods from a secondary vessel. • The total number of observers will be dictated by the personnel necessary to adhere to standard shift schedule and rest requirements while still meeting mitigation monitoring requirements for the Project. • During daytime observations, two PSOs on each vessel will monitor the clearance zones with the naked eye and reticle binoculars. One PSO will periodically scan outside the clearance zones using the mounted big eye binoculars. • PSOs will visually monitor the maximum low-frequency (Large Whale) pre-start clearance zones. This zone encompasses the maximum Level A exposure ranges for all marine mammal species except harbor porpoise, where Level A take has been requested due to the large zone sizes associated with high-frequency cetaceans. • The number of vessels deployed will depend on monitoring zone size and safety set back distance from detonation. Enough vessels will be deployed to cover the clearance and shutdown zones 100% and be determined by: the detonation category and associated clearance zone size, use of NMS, and minimum distance allowed to the detonation location. • Visual monitoring will be conducted from the primary monitoring vessel, and an additional vessel in cases where the monitoring zone is greater than 2,000 m (see Table 1-5E below). • There will be a PAM operator on duty conducting acoustic monitoring in coordination with the visual PSOs during all pre-start clearance periods and post-detonation monitoring periods. • Acoustic monitoring will include, and extend beyond, the pre-start clearance zones identified in Table 1-5E.		
Visual Monitoring during UXO detonations (Aerial Alternative)	• Aerial surveys are typically limited by low cloud ceilings, aircraft availability, survey duration, and HSE considerations and therefore are not considered feasible or practical for all detonation monitoring. However, some scenarios may necessitate the use of an aerial platform. For unmitigated detonations with clearance zones greater than 5 km, deployment of sufficient vessels may not be feasible or practical. For these events, visual monitoring will be conducted from an aerial platform. • During the 60 minute pre-start clearance period and 60-minutes after the detonation event as flight time allows, two PSOs will be deployed on an aerial platform. • Surveys will be conducted in a grid with 1 km line spacing, encompassing the clearance zone. • PSOs will monitor the clearance zones with the naked eye and reticle binoculars. • Aerial PSOs may exceed 4-hour watch duration but will be limited by total flight duration not likely to exceed 6 hours. • PSOs will visually monitor the maximum low-frequency cetacean pre-start clearance zones (Table 1.5-E). This zone encompasses the maximum Level A exposure ranges for all marine mammal species except harbor porpoise, where Level A take has been requested due to the large zone sizes associated with high-frequency cetaceans (e.g., up to 16 km for an E12 detonation). • There will be a PAM operator on duty conducting acoustic monitoring in coordination with the visual PSOs during all pre-start clearance periods and post-detonation monitoring periods. • Acoustic monitoring, will include, and extend beyond, the low-frequency cetaceans pre-start clearance zone.	Marine Mammals, Sea Turtles	
Time of Year/Nighttime Restrictions	• No UXO detonations are planned between January and April. • No UXO will be detonated during nighttime hours.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

<table>
<tr><th>Measure Number/Name</th><th>Table H-1. Description of Applicant-Proposed Measures</th><th>Resource Area Mitigated</th><th>BOEM's Identification of the Anticipated Enforcing Agency[1]</th></tr>
<tr><td>Passive acoustic monitoring during UXO detonations</td><td>
Acoustic monitoring will be conducted prior to any UXO detonation event in addition to visual monitoring in order to ensure that no marine mammals are present in the designated pre-clearance zones.
PAM operators will acoustically monitor a zone that encompasses a minimum of a 10 km radius around the source.
PAM will be conducted in daylight as no UXO will be detonated during nighttime hours.
One PAM operator may be stationed on the vessel or at an alternative monitoring location
It is expected there will be a PAM operator stationed on at least one of the dedicated monitoring vessels in addition to the PSOs; or located remotely/onshore.
PAM operators will complete specialized training for operating PAM systems prior to the start of monitoring activities.
All on-duty PSOs will be in contact with the PAM operator on-duty, who will monitor the PAM systems for acoustic detections of marine mammals that are vocalizing in the area.
For real-time PAM systems, at least one PAM operator will be designated to monitor each system by viewing data or data products that are streamed in real-time or near real-time to a computer workstation and monitor located on a Project vessel or onshore.
The PAM operator will inform the Lead PSO on duty of animal detections approaching or within applicable ranges of interest to the detonation activity via the data collection software system (i.e., Mysticetus or similar system) who will be responsible for requesting the designated crewmember to implement the necessary mitigation procedures.
</td><td>Marine Mammals</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Pre-start clearance for UXO detonations</td><td>
A 60-minute pre-start clearance period will be implemented prior to any UXO detonation. Visual PSOs will begin surveying the monitoring zone at least 60 minutes prior to the detonation event. PAM will also begin 60 minutes prior to the detonation event.
The pre-clearance zones (Table 1-5E) must be fully visible for at least 60 minutes prior to commencing detonation.
All marine mammals and sea turtles must be confirmed to be out of the clearance zone prior to initiating detonation.
If a marine mammal or sea turtle is observed entering or within the relevant clearance zones prior to the initiation of detonation activity, the detonation must be delayed.
The detonation may commence when either the marine mammal(s) has voluntarily left the respective clearance zone and been visually confirmed beyond that clearance zone, or, when 60 minutes have elapsed without redetection for whales, including the NARW, or 15 minutes have elapsed without redetection of dolphins, porpoises, and seals.

Table 1-5E. Mitigation and Monitoring Zones Associated with Mitigated (10 dB attenuation) UXO Detonation of Binned Charge Weights (adapted from PSMMP dated April 2022).
<table>
<tr><th rowspan="3">Species</th><th colspan="5"></th></tr>
<tr><th>E4 (2.3 kg)</th><th>E6 (9.1 kg)</th><th>E8 (45.5 kg)</th><th>E10 (227 kg)</th><th>E12 (454 kg)</th></tr>
<tr><th>Pre-Start Clearance Zone[2] (m)</th><th>Pre-Start Clearance Zone[2] (m)</th><th>Pre-Start Clearance Zone[2] (m)</th><th>Pre-Start Clearance Zone[2] (m)</th><th>Pre-Start Clearance Zone[2] (m)</th></tr>
<tr><td>Low-Frequency Cetaceans</td><td>552</td><td>982</td><td>1,730</td><td>2,970</td><td>3,780</td></tr>
<tr><td>Mid-Frequency Cetaceans</td><td>50</td><td>75</td><td>156</td><td>337</td><td>461</td></tr>
<tr><td>High-Frequency Cetaceans</td><td>1,820</td><td>2,590</td><td>3,900</td><td>5,400</td><td>6,200</td></tr>
<tr><td>Phocid Pinnipeds</td><td>182</td><td>357</td><td>690</td><td>1,220</td><td>1,600</td></tr>
<tr><td>Turtles</td><td><50</td><td>54</td><td>159</td><td>348</td><td>472</td></tr>
</table>
Notes: kg = kilograms; m = meters; PK = peak pressure level; SEL = sound exposure level.
[1] UXO charge weights are groups of similar munitions defined by the U.S. Navy and binned into five categories (E4-E12) by weight (equivalent weight in TNT). Four project sites (S1-S4) were chosen and modeled (see Hannay and Zykov 2022, Appendix C) for the detonation of each charge weight bin.
[2] Pre-start clearance zones were calculated by selecting the largest Level A threshold (the larger of either the PK or SEL noise metric) for marine mammals and the largest distance to the Permanent Threshold Shift (PTS) threshold for sea turtles. Auditory injury thresholds (PTS PK or SEL noise metrics) were larger than modeled distances to mortality and non-auditory injury criteria. The chosen values were the most conservative per charge weight bin across each of the four modeled sites.</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
</table>

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
Noise attenuation for UXO detonations	• Ocean Wind will use an NMS for all UXO detonation events. Although the exact level of noise mitigation that can be achieved by these systems is unknown, based on available data (Bellman et al. 2020, Bellman and Betke 2021) it is reasonable to expect the NMS to achieve 10 dB attenuation.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
Fisheries Monitoring			
General Measures	• Fisheries Monitoring for the Project will consist of regular surveys carried out by academic partners from Rutgers University, Monmouth University, and Delaware State University. • Fisheries monitoring was designed in accordance with recommendations set forth in "Guidelines for Providing Information on Fisheries for Application for Renewable Energy Development on the Atlantic Outer Continental Shelf" (BOEM 2019) and consideration to the Responsible Offshore Science Alliance (ROSA) Offshore Wind Project Monitoring Framework and Guidelines. • All vessels will comply with the vessel speed plan as outlined above for vessel speed restrictions – standard and adaptive plans. • Marine mammal watches and monitoring will occur during daylight hours prior to deployment of gear (e.g., trawls, longline gear) and will continue until gear is brought back on board. • If marine mammals are sighted in the area within 15 minutes prior to deployment of gear and are considered to be at risk of interaction with the research gear, then the sampling station is either moved or canceled or the activity is suspended until there are no sightings of nay marine mammal for 15 minutes within 1 nautical mile (1852 m) of sampling location.	Marine Mammals	BOEM, BSEE, and NMFS
Trawl Surveys	• Marine mammal monitoring will be conducted by the captain and/or a member of the scientific crew before, during, and after haul back. • Trawl operations will commence as soon as possible once the vessel arrives on station; the target tow time will be limited to 20 minutes. • Ocean Wind will initiate marine mammal watches (visual observation) within 1 nautical mile (1852 m) of the site 15 minutes prior to sampling. • If a marine mammal is sighted within 1 nautical mile (1852 m) of the planned sampling station in the 15 minutes before gear deployment, Ocean Wind will delay setting the trawl until marine mammals have not been resighted for 15 minutes or Ocean Wind may move the vessel away from the marine mammal to a different section of the sampling area. If, after moving on, marine mammals are still visible from the vessel, Ocean Wind may decide to move again or to skip the sampling station. • Ocean Wind will maintain visual monitoring effort during the entire period of time that trawl gear is in the water (i.e., throughout gear deployment, fishing, and retrieval). If marine mammals are sighted before the gear is fully removed from the water, (i.e. prior to haul back) the vessel will slow its speed and steer away from the sighted animal in order to minimize potential interactions. Further mitigating actions can be taken following consultation with and guidance from the NMFS Protected Resources Division. • Ocean Wind will open the codend of the net close to the deck/sorting area to avoid damage to animals that may be caught in gear. • Gear will be emptied as close to the deck/sorting area and as quickly as possible after retrieval. • Trawl nets will be fully cleaned and repaired (if damaged) before setting again. • Ocean Wind does not anticipate and is not requesting take of marine mammals incidental to research trawl surveys but, in the case of a marine mammal interaction, the Marine Mammal Stranding Network will be contacted immediately.	Marine Mammals	BOEM, BSEE, and NMFS
Structured Habitat Surveys (Chevron traps and Baited Remote Underwater Video [BRUVs])	• The chevron traps and BRUVs will be deployed on a limited soak duration (90 minutes or less), and the vessel will remain on location with the gear while it is sampling. • Buoy/end lines with a breaking strength of <1,700 pounds (lbs) will be used. All buoy line will use weak links that are chosen from the list of NMFS approved gear. This may be accomplished by using whole buoy line that has a breaking strength of 1,700 lbs; or buoy line with weak inserts that result in line having an overall breaking strength of 1,700 lbs. • All buoys will be labeled as research gear, and the scientific permit number will be written on the buoy. All markings on the buoys and buoy lines will be compliant with the regulations, and all buoy markings will comply with any specific marking instructions received by staff at NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division. • Any lines that go missing will be reported to the NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division as soon as possible. • The Project Team will not deploy either the chevron traps or the BRUVs if marine mammals are sighted near the proposed sampling station. Gear will not be deployed if marine mammals are observed within the area and if a marine mammal is deemed to be at risk of interaction, all gear will be immediately removed.	Marine Mammals	BOEM, BSEE, and NMFS

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
Acoustic Telemetry Surveys	• No specific mitigation relevant to this type of survey. • Vessel mitigation measures outlined above for all Project vessels will be employed while collecting samples.	Marine Mammals	BOEM, BSEE, and NMFS
eDNA Sampling	• Will coincide with the bottom trawl survey and associated mitigation measures. No specific mitigation relevant to this type of survey. • Vessel mitigation measures outlined above for all Project vessels will be employed while collecting samples.	Marine Mammals	BOEM, BSEE, and NMFS
Rod and reel surveys	• No specific mitigation relevant to this type of survey. • Vessel mitigation measures outlined above for all Project vessels will be employed while collecting samples.	Marine Mammals	BOEM, BSEE, and NMFS
Clam Survey	• No specific mitigation relevant to this type of survey. • Vessel mitigation measures outlined above for all Project vessels will be employed while collecting samples.	Marine Mammals	BOEM, BSEE, and NMFS
Glider – Oceanography	• No specific mitigation relevant to this type of survey. • Vessel mitigation measures outlined above for all Project vessels will be employed while retrieving equipment	Marine Mammals	BOEM, BSEE, and NMFS
Pelagic Fish	• Similar mitigation will be applied as described above for Structured Habitat Surveys. • Vessel mitigation measures outlined above for all Project vessels will be employed while retrieving equipment and collecting samples	Marine Mammals	BOEM, BSEE, and NMFS
Reporting Requirements			
Injured protected species reporting	• Any potential strikes, stranded, entangled, or dead/injured protected species regardless of cause, should be reported by the vessel captain or the PSO onboard to the Greater Atlantic (Northeast) Region Marine Mammal and Sea Turtle Stranding and Entanglement Hotline (866-755-NOAA [6622]) within 24 hours of a sighting. • If the injury or death was caused by a Project activities, the vessel captain or PSO on board will ensure that NMFS is notified immediately to the NMFS Office of Protected Resources and Greater Atlantic Regional Fisheries Office and no later than within 24 hours. The notification will include date and location (latitude and longitude) of the incident, name of the vessel/platform involved, and the species identification or a description of the animal, if possible. If the Project activity is responsible for the injury or death, Ocean Wind will supply a vessel to assist in any salvage effort as requested by NMFS. • If a NARW is involved in any of the above-mentioned incidents then the vessel captain or PSO onboard should also notify the Right Whale Sighting Advisory System (RWSAS) hotline immediately and no later than within 24 hours.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
Reporting observed impacts on species	• PSOs/PAM operators will report any observations concerning impacts on marine mammals to NMFS within 48 hours. • BOEM and NMFS will be notified within 24 hours if any evidence of an injured or dead sea turtle or ESA-listed fish species during construction activity is observed. • Any NARW sightings will be reported as soon as possible, and no later than within 24 hours, to the NMFS RWSAS hotline or via the Whale Alert Application.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
Report of activities and observations	• Ocean Wind will provide NMFS with a report within 90 calendar days following the completion of construction and HRG surveys, including a summary of the activities and an estimate of the number of marine mammals taken.	Marine Mammals	BOEM, BSEE, and NMFS
Report information	• Data on all marine mammal observations will be recorded and based on standards of marine mammal observer collection data by the PSOs. This information will include dates, times, and locations of survey operations; time of observation, location and weather; details of marine mammal sightings (e.g., species, numbers, behavior); and details of any observed taking (e.g., behavioral disturbances or injury). • All vessels will utilize a standardized data entry format. • A QA/QC'd database of all sightings and associated details (e.g., distance from vessel, behavior, species, group size/composition) within and outside of the designated shutdown zones, monitoring effort, environmental conditions, and Project-related activity will be provided after field operations and reporting are complete. This database will undergo thorough quality checks and include all variables required by the NMFS-issued Incidental Take Authorization (ITA) and BOEM Lease OCS-A 0498 and will be required for the Final Technical Report due to BOEM and NMFS. • During construction, weekly reports briefly summarizing sightings, detections and activities will be provided to NMFS and BOEM on the Wednesday following a Sunday-Saturday period. • Final reports will follow a standardized format for PSO reporting from activities requiring marine mammal mitigation and monitoring. • An annual report summarizing the prior year's activities will be provided to NMFS and to BOEM on April 1 every calendar year summarizing the prior year's activities.	Marine Mammals	BOEM, BSEE, and NMFS

Measure Number/Name	Table H-1. Description of Applicant-Proposed Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
SAV/Seabed Disturbance			
Siting	• Site cable landfall and offshore facilities to avoid known locations of sensitive benthic habitat, to the extent practicable. Avoid SAV communities, where practicable and restore any damage to these communities.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
Port construction and vessel traffic	• Use existing port and onshore operations and maintenance facilities to the extent practicable and minimize impacts to seagrass by restricting vessel traffic to established traffic routes where these resources are present.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
Monitoring	• Develop and implement a site-specific monitoring program to ensure environmental conditions are monitored during construction, operation, and decommissioning phases, designed to ensure environmental conditions are monitored and reasonable actions are taken to avoid and/or minimize seabed disturbance and sediment dispersion, consistent with permit conditions. The monitoring plan will be developed during the permitting process, in consultation with resource agencies.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
Construction	• To the extent practicable, use appropriate installation technology designed to minimize disturbance to seagrass beds; avoid anchoring on sensitive habitat; and implement turbidity reduction measures to minimize impacts to sensitive habitats from construction. • Take reasonable actions (use BMPs) to minimize seabed disturbance and sediment dispersion during cable installation and construction of Project facilities	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
Mitigation	• Implement the SAV Preliminary Mitigation Plan dated November 2022 (Ocean Wind 2022), which includes mapping efforts, monitoring activities, restoration of documented activities at an in-situ 1:1 ratio, annual reporting, as well as additional research to improve SAV mitigation in the future.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
BOEM PDCs/BMPs			
BOEM PDCs/BMPs	• Lessees and grantees should evaluate marine mammal use of the proposed project area and should design the project to minimize and mitigate the potential for mortality or disturbance. The amount and extent of ecological baseline data required should be determined on a project basis.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
BOEM PDCs/BMPs	• Vessels related to project planning, construction, and operation should travel at reduced speeds when assemblages of cetaceans are observed. Vessels also should maintain a reasonable distance from whales, small cetaceans, and sea turtles, and these should be determined during site-specific consultations.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
BOEM PDCs/BMPs	• Lessees and grantees should minimize potential vessel impacts to marine mammals and turtles by having project-related vessels follow the National Marine Fisheries Service (NMFS) Regional Viewing Guidelines while in transit. Operators should undergo training on applicable vessel guidelines.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
BOEM PDCs/BMPs	• Lessees and grantees should take efforts to minimize disruption and disturbance to marine life from sound emissions, such as pile driving, during construction activities.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
BOEM PDCs/BMPs	• Lessees and grantees should avoid and minimize impacts to marine species and habitats in the project area by posting a qualified observer on site during construction activities. These observers are approved by NMFS.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS

Table H-2 Mitigation and Monitoring Measures Resulting From Consultations

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
BOEM-proposed Bird and Bat Mitigation Measures in the USFWS BA					
5	O&M	Adaptive mitigation for birds and bats	BOEM will require that Ocean Wind develops and implements an Avian and Bat Post-Construction Monitoring Plan based on COP Appendix III, Appendix AB Avian and Bat Post-Construction Monitoring Framework in coordination with USFWS, NJDEP, and other relevant regulatory agencies. Annual monitoring reports will be used to determine the need for adjustments to monitoring approaches, consideration of new monitoring technologies, and/or additional periods of monitoring. Prior to commencing offshore construction activities, Ocean Wind must submit an Avian and Bat Post-Construction Monitoring Plan for BOEM and USFWS review. BOEM and USFWS will review the Avian and Bat Post-Construction Monitoring Plan and provide any comments on the plan within 30 calendar days of its submittal. Ocean Wind must resolve all comments on the Avian and Bat Post-Construction Monitoring Plan to BOEM and USFWS's satisfaction before implementing the plan. a. Monitoring. Ocean Wind must conduct monitoring as outlined in COP Appendix III, Appendix AB Avian and Bat Post-Construction Monitoring Framework (March 24, 2023), which will include acoustic monitoring of bats and nocturnally migrating birds, use by ESA-listed birds, and movement of marine around the turbines. b. Annual Monitoring Reports. Ocean Wind must submit to BOEM (at renewable_reporting@boem.gov), USFWS, and BSEE (at OSWSubmittals@bsee.gov) a comprehensive report after each full year of monitoring (pre- and post-construction) within 6 months of completion of the last avian survey. The report must include all data, analyses, and summaries regarding ESA-listed and non-ESA-listed birds and bats. BOEM, USFWS, and BSEE will use the annual monitoring reports to assess the need for reasonable revisions (based on subject matter expert analysis) to the Avian and Bat Post-Construction Monitoring Plan. BOEM, BSEE, and USFWS reserve the right to require reasonable revisions to the Avian and Bat Post-Construction Monitoring Plan and may require new technologies as they become available for use in offshore environments. c. Post-Construction Quarterly Progress Reports. Ocean Wind must submit quarterly progress reports during the implementation of the Avian and Bat Post-Construction Monitoring Plan to BOEM (at renewable_reporting@boem.gov) and the USFWS by the 15th day of the month following the end of each quarter during the first full year that the Project is operational. The progress reports must include a summary of all work performed, an explanation of overall progress, and any technical problems encountered. d. Monitoring Plan Revisions. Within 15 calendar days of submitting the annual monitoring report, Ocean Wind must meet with BOEM and USFWS to discuss the following: the monitoring results; the potential need for revisions to the Avian and Bat Post-Construction Monitoring Plan, including technical refinements or additional monitoring; and the potential need for any additional efforts to reduce impacts. If BOEM or USFWS determines after this discussion that revisions to the Avian and Bat Post-Construction Monitoring Plan are necessary, BOEM may require Ocean Wind to modify the Avian and Bat Post-Construction Monitoring Plan. If the reported monitoring results deviate substantially from the impact analysis included in the Final EIS, Ocean Wind must transmit to BOEM recommendations for new mitigation measures and/or monitoring methods. e. Operational Reporting. Ocean Wind must submit to BOEM (at renewable_reporting@boem.gov) and BSEE (at OSWSubmittals@bsee.gov) an annual report summarizing monthly operational data calculated from 10-minute SCADA data for all turbines together in tabular format: the proportion of time the turbines were operational (spinning at >x rpm) each month, the average rotor speed (monthly revolutions per minute [rpm]) of spinning turbines plus 1 standard deviation, and the average pitch angle of blades (degrees relative to rotor plane) plus 1 standard deviation. BOEM and BSEE will use this information as inputs for avian collision risk models to assess whether the results deviate substantially from the impact analysis included in the Final BA. f. Raw Data. The Lessee must store the raw data from all avian and bat surveys and monitoring activities according to accepted archiving practices. Such data must remain accessible to BOEM, BSEE and USFWS, upon request for the duration of the Lease. The Lessee must work with BOEM to ensure the data are publicly available.	Birds and Bats	BOEM, BSEE, and USFWS
6	C, O&M, D	Annual bird and bat mortality reporting	Annual Bird Mortality Reporting during construction and operation, and decommissioning. The Lessee must submit an annual report covering each calendar year, due by January 31 of the following year, documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning. The report must be submitted to BOEM (at renewable_reporting@boem.gov) and BSEE (at OSWSubmittals@bsee.gov) and USFWS. The report must contain the following information: the name of species, date found, location, a picture to confirm species identity (if possible), and any other relevant information. Carcasses with Federal or research bands must be reported to the United States Geological Survey Bird Band Laboratory. Any occurrence of dead ESA birds or bats must be reported to BOEM, BSEE, and USFWS as soon as practicable (taking into account	Birds and Bats	BOEM, USFWS, BSEE

[2] Enforcement by BOEM and BSEE will be conducted in accordance with Reorganization of Title 30 – Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf final rule, 88 *Federal Register* 6376.

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			crew and vessel safety), but no later than 24 hours after the sighting, and if practicable, carefully collect the dead specimen and preserve the material in the best possible state.		
3	C	Monitoring	BOEM will require that Ocean Wind implements monitoring and/or other conservation measures to minimize disturbance of rufa red knots and other ESA-listed birds, in coordination with USFWS and NJDEP.	Birds	BOEM, USFWS, NJDEP
3a	O&M	Bird Perching Deterrent	To minimize attracting birds (e.g. roseate terns) to operating turbines, Ocean Wind must install bird perching-deterrent devices where such devices can be safely deployed on WTGs and OSSs. Ocean Wind must submit for BOEM and USFWS approval a plan to deter perching on offshore infrastructure by roseate terns and other marine birds. The plan must include the type(s) and locations of bird perching deterrent devices, include a maintenance plan for the life of the project, allow for modifications and updates as new information and technology becomes available, and track the efficacy of the deterrents. The location of bird perching-deterrent devices must be proposed by Ocean Wind based on best management practices applicable to the appropriate operation and safe installation of the devices. Ocean Wind must confirm the locations of bird perching-deterrent devices as part of the documentation it must submit with the FDR.	Birds	BOEM, USFWS
3b	O&M	Light Impact Reduction	Ocean Wind must use an FAA-approved vendor for the Aircraft Detection Lighting System (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. Ocean Wind must confirm the use of an FAA-approved vendor for ADLS on WTGs and OSSs in the FIR.	Birds	FAA, BOEM
3c	O&M	Light Impact Reduction	Ocean Wind must light each WTG and OSS in a manner that is visible by mariners in a 360-degree arc around the WTG and OSS. To minimize the potential of attracting migratory birds, the top of each light shall be shielded to minimize upward illumination (Conditional on USCG approval). BOEM must provide USFWS with a copy of Ocean Wind's application to USCG to establish Private Aids to Navigation (PATON), which includes a lighting, marking, and signaling plan. The PATON application will include design specifications for maritime navigational lighting. Upon approval of the PATON by USCG, BOEM and USFWS will work together to determine the color, intensity, and duration of any light from maritime lanterns that is likely to reach the typical flight heights of listed birds, and will assess the degree to which the lighting is likely to attract or disorient birds.	Birds	USCG, BOEM
3d	O&M	Collision Reduction	For overhead power lines, Ocean Wind must follow best practices from the Avian Power Line Interaction Committee.	Birds	USFWS
3e	C, O&M, D	Habitat Impact Reduction	Both during and after construction, Ocean Wind must avoid Project-related intrusion (i.e., access through or disturbance from personnel or equipment) into any beach or dune from March 1 to August 31. In the event that emergency access to this area is needed during the restricted season, Ocean Wind must coordinate with the USFWS and the NJDEP's Endangered and Nongame Species Program to seek approval.	Birds	USFWS, NJDEP
3f	C, O&M, D	Species Disturbance Reduction	Both during and after construction, Ocean Wind must avoid Project activities within 500 feet of any beach or dune from March 15 to August 31. In the event that essential access to this area is needed during the restricted season, Ocean Wind must coordinate with the USFWS and the NJDEP's Endangered and Nongame Species Program to seek approval.	Birds	USFWS, NJDEP
3g	C	Habitat Impact Reduction	Rufa red knot: Along onshore export cable routes, Ocean Wind must avoid permanent modification of suitable red knot habitats. Where temporary habitat disturbance is unavoidable, Ocean Wind must develop a restoration plan in coordination with USFWS for BOEM and USFWS approval.	Birds	USFWS, BOEM
3h	C, O&M	Species Disturbance Reduction	Roseate tern: Ocean Wind must avoid disturbing roosting 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. USFWS anticipates most staging flocks of terns will occur from July through September.	Birds	USFWS
3i	C, O&M, D	Surveys, Avoidance, and Minimization	Eastern black rail and saltmarsh sparrow: No planned or routine Project entry or intrusion into Wetlands A, B, or C (adjacent to Roosevelt Blvd.) either during or after construction will occur. Emergency access must be coordinated with USFWS and NJDEP. If Ocean Wind elects to construct an Oyster Creek onshore cable route option other than the Holtec property route, Ocean Wind must retain a species expert to conduct a desktop and field assessment and to map suitable eastern black rail and saltmarsh sparrow habitat within the limits of disturbance. Ocean Wind must provide the assessment, mapping and associated spatial files in an ESRI ArcMap/ArcPro compatible format, and qualifications of the expert to BOEM and USFWS for review no later than 30 calendar days after the assessment has been completed. BOEM and USFWS will complete their reviews and identify any deficiencies that require a report revision by Ocean Wind within 30 calendar days of receipt of the assessment. If areas of suitable eastern black rail and/or saltmarsh sparrow habitat will be impacted by Project activities, Ocean Wind must coordinate with USFWS to develop appropriate conservation measures that Ocean Wind is required to implement to avoid adverse effects to these species. Conservation measures will include that construction activities and other Project-related intrusions into areas of suitable habitat will be seasonally restricted from April 1 through September 30 (April 1 through September 30 for eastern black rail and May 1 to September 30 for saltmarsh sparrow) in order to minimize the risk of directly disturbing or injuring adults, eggs, or chicks during sensitive periods of the breeding season.	Birds	BOEM, USFWS, NJDEP

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
4	C	Survey (ESA-listed bats)	BOEM will require that Ocean Wind conducts pre-construction surveys for ESA-listed bats and implements avoidance and minimization measures in coordination with USFWS and NJDEP.	Bats	USFWS, NJDEP
4a	C	Bat habitat impact reduction	GEN-13 will be modified to enhance bat habitat in coordination with USFWS and NJDEP. Ocean Wind 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 BOEM and USFWS for approval prior to commencing onshore construction activities.	Bats	USFWS, NJDEP
4b	C	Surveys, Avoidance, and Minimization (bat acoustic surveys)	If Ocean Wind elects to construct an Oyster Creek onshore cable route option other than the Holtec route, Ocean Wind must coordinate with BOEM, USFWS, and NJDEP prior to commencing onshore construction activities. After coordination with BOEM, USFWS, and NJDEP, Ocean Wind must retain the services of a USFWS Recognized and Qualified Bat Surveyor to conduct presence/absence surveys (acoustic or mist netting) along the proposed route that are consistent with the USFWS' Rangewide Indiana Bat and Northern Long-eared Bat Survey Guidelines. A survey work plan must be submitted to USFWS for approval before commencing the survey. A survey report, including maps and associated spatial files in an ESRI ArcGIS/ArcPro compatible format, must be provided to BOEM and USFWS for review no later than 30 calendar days after the survey has been completed. BOEM and USFWS will complete their reviews and identify any deficiencies that require a report revision by Ocean Wind. Based on the results of the presence/absence surveys, USFWS may recommend additional field investigations, such as a tree survey to assess roost habitat suitability and/or a mist netting/bat tracking effort to locate occupied roosts. If potential NLEB or tricolored bat roosting habitat will be impacted by Project activities, Ocean Wind must coordinate with USFWS to develop appropriate conservation measures that Ocean Wind is required to implement to avoid adverse effects to this species. Conservation Measures may include a seasonal restriction on tree clearing and avoidance of likely or known roost trees.	Bats	USFWS, NJDEP, BOEM
4c	O&M	Bat habitat impact reduction (non-routine tree clearing)	Ocean Wind will coordinate with the USFWS prior to any clearing of trees (> 3 inches dbh) required during operation and maintenance.	Bats	USFWS
4d	O&M	Bat habitat impact reduction (building/structure demolition)	Ocean Wind must contact USFWS to assess the potential risk to ESA-listed bat species should any abandoned or dilapidated buildings or structures require demolition during the O&M phase. If USFWS determines that adverse effects exist, Ocean Wind must notify BOEM and coordinate with USFWS to develop appropriate mitigation measures that Ocean Wind is required to implement to avoid adverse effects to listed bat species.	Bats	BOEM, USFWS
BOEM-proposed Plant Mitigation Measures in the USFWS BA					
1	C	Surveys, Avoidance, and Minimization (ESA-listed plants)	Ocean Wind must conduct pre-construction habitat surveys for ESA-listed plants and implement avoidance and minimization measures in coordination with USFWS and NJDEP.	Coastal Habitat and Fauna	BOEM/USACE, USFWS, NJDEP
1a	C	Surveys, Avoidance, and Minimization (ESA-listed plants; swamp pink)	Swamp Pink: If Ocean Wind elects to construct an Oyster Creek onshore cable route option other than the Holtec property route, Ocean Wind must retain a USFWS qualified surveyor to conduct a survey in accordance with USFWS swamp pink survey guidelines of all suitable habitats (i.e., forested wetlands) that will be subject to temporary disturbance or permanent modification as a result of Project activities, both during construction and from post-construction O&M activities, including areas crossed by HDD. The survey area will also include all forested wetlands within 300 feet of upland disturbance. Ocean Wind must submit the survey area(s), timing, methods, and qualifications of the surveyor(s) for BOEM/USACE and USFWS approval prior to the start of the survey. A survey report, including maps and associated spatial files in an ESRI ArcMap/ArcPro compatible format, must be provided to BOEM/USACE and USFWS for review no later than 30 calendar days after the survey has been completed. BOEM/USACE and USFWS will complete their reviews and identify any deficiencies that require a report revision by Ocean Wind within 30 calendar days of receipt of the survey report. If any swamp pink is found during the survey, the surveyor must document the distribution and abundance of plants and submit both the full survey report and a completed Natural Heritage Rare Plant Species Reporting Form (https://www.nj.gov/dep/parksandforests/natural/docs/NHRPSR_Form.pdf) to BOEM/USACE, USFWS, and the New Jersey Natural Heritage Program. If swamp pink is present in or adjacent to Project activities, Ocean Wind must coordinate with USFWS to develop appropriate conservation measures that Ocean Wind is required to implement to avoid adverse effects to this species including through direct and indirect effects to its habitat and seek any required authorizations to perform such activities.	Coastal Habitat and Fauna	USFWS, NJDEP, USACE
1b	C	Surveys, Avoidance, and Minimization (ESA-listed plants; Knieskern's beaked-rush)	Knieskern's beaked-rush: If Ocean Wind elects to construct an Oyster Creek onshore cable route option other than the Holtec property route, Ocean Wind must retain a USFWS qualified surveyor to conduct a survey between July and September and in accordance with USFWS Knieskern's beaked-rush survey guidelines of all suitable habitats that will be subject to temporary disturbance or permanent modification as a result of Project activities, both during construction and from post-construction O&M activities, including areas crossed by HDD. Survey areas must not be mowed for at least one month prior to the survey. Ocean Wind must submit the survey area(s), timing, methods, and qualifications of the surveyor(s) for BOEM/USACE and USFWS approval prior to the start of the survey. A survey report,	Coastal Habitat and Fauna	USFWS, NJDEP, USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			including maps and associated spatial files in an ESRI ArcGIS/ArcPro compatible format, must be provided to BOEM/USACE and USFWS for review no later than 30 calendar days after the survey has been completed. BOEM/USACE and USFWS will complete their reviews and identify any deficiencies that require a report revision by Ocean Wind within 30 calendar days of receipt of the survey report. If any Knieskern's beaked-rush is found during the survey, the surveyor must document the distribution and abundance of plants, and submit both the full survey report and a completed Natural Heritage Rare Plant Species Reporting Form to BOEM/USACE, USFWS and the New Jersey Natural Heritage Program. If Knieskern's beaked-rush is present in or adjacent to Project activities, Ocean Wind must coordinate with USFWS to develop appropriate conservation measures that Ocean Wind is required to implement to avoid adverse effects to this species and seek any required authorizations to perform such activities.		
1c	C	Surveys, Avoidance, and Minimization (ESA-listed plants, American chaffseed)	American chaffseed: Ocean Wind must retain a USFWS qualified surveyor to conduct a survey of all suitable American chaffseed habitats between June 1 and August 15 that will be subject to temporary disturbance or permanent modification as a result of Project activities, both during construction and from post-construction O&M activities, including areas crossed by HDD. Survey areas must not be mowed for at least one month prior to the survey and the survey will cover all areas of suitable habitat, not just transects. Ocean Wind must submit the survey area(s), timing, methods, and qualifications of the surveyor(s) for BOEM and USFWS approval prior to the start of the survey. A survey report, including maps and associated spatial files in an ESRI ArcGIS/ArcPro compatible format, must be provided to BOEM/USACE and USFWS for review no later than 30 calendar days after the survey has been completed. BOEM/USACE and USFWS will complete their reviews and identify any deficiencies that require a report revision by Ocean Wind within 30 calendar days of receipt of the survey report. If any American chaffseed is found during the survey, the surveyor must document the distribution and abundance of plants and submit both the full survey report and a completed Natural Heritage Rare Plant Species Reporting Form to BOEM/USACE, USFWS, and the New Jersey Natural Heritage Program. If American chaffseed is present in or adjacent to Project activities, Ocean Wind must coordinate with USFWS to develop appropriate conservation measures that Ocean Wind is required to implement to avoid adverse effects to this species and to seek any required authorizations to perform such activities.	Coastal Habitat and Fauna	USACE, USFWS, NJDEP
2	C	Restoration with Native Vegetation	GEN-13 will be modified to clarify that disturbed areas would be reestablished with native vegetation, and in areas that are permanently landscaped (e.g., substation site), Ocean Wind would coordinate with NJDEP Fish & Wildlife to determine if wildlife friendly habitats could be created.	Coastal Habitat and Fauna	USFWS, NJDEP
BOEM-proposed Monarch Butterfly Mitigation Measures in the USFWS BA					
2	C	Surveys, Avoidance, and Minimization (monarch butterfly)	Ocean Wind must conduct pre-construction surveys for milkweed (*Asclepias* spp.) and implement monarch butterfly avoidance and minimization measures in coordination with USFWS and NJDEP.	Coastal Habitat and Fauna	USFWS, NJDEP
2a	C, O&M	Surveys, Avoidance, and Minimization (monarch butterfly; avoid in-season milkweed clearing)	For areas where vegetation disturbance will occur during Project construction or post-construction operations and maintenance activities, Ocean Wind must survey the affected area for milkweed (*Asclepias* spp.) before the start of work. Ocean Wind must avoid clearing milkweed to the extent practical from May 15 through September 30 when monarch caterpillars may be present. If/when the monarch is proposed for federal listing, Ocean Wind will coordinate with the USFWS prior to initiating any in-season vegetation disturbance that may involve milkweed.	Coastal Habitat and Fauna	USFWS
2b	C	Revegetation Plan	GEN-13 will be modified to enhance monarch butterfly habitat in coordination with USFWS and NJDEP. BOEM will require that Ocean Wind develops a Revegetation Plan to enhance monarch butterfly habitat for areas of temporary disturbance and incidental to other Project activities. Ocean Wind must consult the New Jersey Monarch Butterfly Conservation Guide in developing the plan and submit the plan for USFWS review.	Coastal Habitat and Fauna	USFWS, NJDEP
2c	O&M	Milkweed Habitat Impact Reduction	Ocean Wind will not use herbicide for right-of way maintenance and in other portions of the Project where milkweed is likely to occur.	Coastal Habitat and Fauna	USFWS
DOD Measure Resulting from Military Aviation and Installation Assurance Siting Clearinghouse Review					
1	O&M	Fiber-optic sensing technology	Distributed fiber-optic sensing (DOFS) technology proposed for the wind energy project or associated transmission cables would be reviewed by the DOD to ensure that DOFS is not used to detect sensitive data from DOD activities, conduct any other type of surveillance of U.S. Government operations, or to otherwise pose a threat to national security.	Other Uses	BOEM, BSEE, and DOD
NHPA Section 106 Mitigation Measures from the Memorandum of Agreement					
1	C	Avoid or mitigate impacts on identified archaeological resources	The lessee must avoid any identified archaeological resource or TCP, including avoidance of 50-meter buffers for identified archaeological resources. If the lessee cannot avoid the resource, it must perform additional investigations for the purpose of determining eligibility for listing in the NRHP. Of those resources determined eligible, BOEM would require Phase III data recovery investigations for the purpose of resolving adverse effects per 36 CFR 800.6. If the lessee determines it cannot avoid an archaeological resource or TCP after the ROD has been issued, additional Section 106 consultation will be required.	Cultural Resources	BOEM, BSEE, USACE, NJDEP

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
2	C	Terrestrial archaeological monitoring and Terrestrial Post-Review Discovery Plan	Implementation of terrestrial archaeological monitoring and terrestrial post-review discovery plan for terrestrial archaeology, which include training and orientation for construction staff, designation of a Cultural Resources Compliance Manager, and post-review discovery procedures and contacts, to reduce potential impacts on any previously undiscovered archaeological resources (if present) encountered during construction.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
3	Prior to C	Historic Properties Treatment Plans	BOEM, with the assistance of the lessee, will develop and implement two Historic Property Treatment Plans in consultation with consulting parties who have demonstrated interest in specific historic properties and property owners to address impacts on archaeological resources and ancient submerged landforms if they cannot be avoided. A Historic Properties Treatment Plan for ancient submerged landforms will provide details an specification for actions to resolve adverse effects on 13 ancient submerged landforms (Targets 21-26, 28-31, and 33-35). A Historic Properties Treatment Plan for historic properties subject to adverse visual effects will also provide details and specification for actions consisting of mitigation measures to resolve adverse visual effects and cumulative adverse visual effects on: Brigantine Hotel, Brigantine City; Absecon Lighthouse, Atlantic City; Atlantic City Boardwalk, Atlantic City; Atlantic City Convention Hall, Atlantic City; Ritz-Carlton Hotel, Atlantic City; Riviera Apartments, Atlantic City; Vassar Square Condominiums, Ventnor City; 114 South Harvard Avenue, Ventnor City; Lucy the Margate Elephant, Margate City; Great Egg Coast Guard Station, Longport Borough; Ocean City Boardwalk, Ocean City; Ocean City Music Pier, Ocean City; The Flanders Hotel, Ocean City; Hereford Inlet Lighthouse, North Wildwood; North Wildwood Lifesaving Station, North Wildwood; U.S. Lifesaving Station #35, Stone Harbor Borough; Little Egg Harbor U.S. Lifesaving Station #23, Little Egg Harbor Township.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
4	Prior to C, C	Mitigation to resolve adverse effects to Ancient Submerged Land Forms (Targets 21–26, 28–31, and 33–35)	Preconstruction Geoarchaeology. The lessee will fulfill the following commitments: collaborative review of existing geophysical and geotechnical data with consulting Tribes; selection of coring locations in consultation with consulting Tribes; collection of two to three vibracores within each affected ASLF that has not been previously sampled, with a sampling focus on areas that will be disturbed by Project construction activities; written verification to BOEM that the samples collected are sufficient for the planned analyses and consistent with the agreed scope of work; collaborative laboratory analyses at a laboratory located in Rhode Island or New Jersey; screening of recovered sediments for debitage or micro-debitage associated with indigenous land uses; third-party laboratory analyses, including micro- and macro-faunal analyses, micro- and macro-botanical analyses, radiocarbon dating of organic subsamples, and chemical analyses for potential indirect evidence of indigenous occupations; temporary curation of archival core sections; draft reports for review by consulting Tribes; and final reporting. Signatories will be notified of completion of this measure. The collection of vibracores must be completed prior to commencing seabed disturbing activities.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
5	C, post-C	Mitigation to resolve adverse effects to Ancient Submerged Land Forms (Targets 21–26, 28–31, and 33–35)	Open-Source GIS and Story Maps. The lessee will fulfill the following commitments: consultation with the Tribes to determine the appropriate open-source GIS platform; review of candidate datasets and attributes for inclusion in the GIS; data integration; development of custom reports or queries to assist in future research or tribal maintenance of the GIS; work Sessions with consulting Tribes to develop Story Maps content, and inclusion of stories associated with other federally recognized Tribes; training session with Tribes to review GIS functionality; review of Draft Story Maps with Tribes; delivery of GIS to Tribes; and delivery of Final Story Maps. Signatories will be notified of completion of this measure. This measure may be completed during or post-construction.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
6	C, post-C	Mitigation to resolve adverse effects to Ancient Submerged Land Forms (Targets 21–26, 28–31, and 33–35)	ASLF Post-Construction Seafloor Impact Inspection. The lessee will fulfill the following commitments: development of a 3D model throughout ASLFs designated for review; development of the remotely operated vehicle (ROV) investigation methodology, including consultation with BOEM; ROV inspection of the seafloor along impacted portions of the selected ASLFs; review of candidate datasets and attributes for inclusion in the GIS; delivery of data interpretive technical report draft; delivery of final technical report. The lessee will provide consulting Tribes and BOEM, draft and final technical reports including 3D models and resulting seafloor impact assessments. Signatories will be notified of completion of this measure. This measure must be completed as early as possible and no later than one-month post-construction. If unanticipated issues arise during the course of offshore construction that prevent this measure from being completed within one-month post-construction, the lessee must notify BOEM and propose an alternate completion timeframe for consulting Tribes and BOEM approval.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
7	C, post-C	Mitigation to resolve adverse effects to Ancient Submerged Land Forms (Targets 21–26, 28–31, and 33–35)	Ethnographic Study. The lessee will fulfill the following commitments: funding ethnographic researcher selected by DTI for 2-year period; funding for researcher travel to New Jersey for research and site visits; funding for Delaware Tribe of Indians, Delaware Nation, and Stockbridge-Munsee Community Band of Mohican Indians technology upgrades associated with analysis of GIS data; funding for Delaware Tribe of Indians historic preservation oversight and indirect costs; funding for Stockbridge-Munsee Community Band of Mohican Indians THPO collaboration; provide relevant ASLF GIS data layers to Delaware Tribe of Indians for use in this study as well as provide a tutorial on the data; hold quarterly progress update calls lasting approximately one-half hour with Delaware Tribe of Indians until the final technical reports are issued; delivery of Final deliverables consisting of one confidential report that may contain sensitive resource information and one report that could be made available to the public (both reports will be distributed by the Tribes, at their discretion);	Cultural Resources	BOEM, BSEE, USACE, NJDEP

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			and funding for a presentation to highlight the results of the study to be coordinated and executed by Delaware Tribe of Indians. Other consulting parties will be notified of completion of this measure. This measure may be completed pre, during or post-construction.		
8	C, post-C	Multi-property and Multi-county mitigation	Historic Context addressing early 20th century New Jersey Shore Hotels. To resolve adverse effects to Brigantine Hotel, Atlantic County, Ritz-Carlton Hotel, Atlantic County, Haddon Hall/Resorts Casino Hotel, Atlantic County, and Flanders Hotel, Cape May County, the lessee will coordinate with BOEM to consult with New Jersey SHPO and interested Consulting Parties and property owners to determine what properties or areas will be the subject of the historic context and appropriate information to include. Tasks associated with the Historic Context Mitigation Measures can occur during and/or after construction, but must be completed within four years of MOA execution, unless the MOA is amended to reflect a different timeline.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
9	C, post-C	Multi-property and Multi-county mitigation	Historic Context addressing Mid-century High-rise residential buildings at the New Jersey shore. To resolve adverse effects on Riviera Apartments, Atlantic City, Atlantic County and Vassar Square Condominiums, Ventnor City, Atlantic County, the lessee will coordinate with BOEM to consult with New Jersey SHPO and interested Consulting Parties and property owners to determine what properties or areas will be the subject of the historic context and appropriate information to include. Tasks associated with the Historic Context Mitigation Measures can occur during and/or after construction, but must be completed within four years of MOA execution, unless the MOA is amended to reflect a different timeline.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
10	C, post-C	Multi-property and Multi-county mitigation	Historic Context addressing Boardwalks of the New Jersey Shore, with Surveys and Evaluations of Atlantic City Boardwalk, Ocean City Boardwalk, and Wildwood Boardwalk. To resolve adverse effects on Atlantic City Boardwalk, and Ocean City Boardwalk, the lessee will prepare a historic context and complete surveys and evaluations of Atlantic City Boardwalk, Ocean City Boardwalk, and Wildwood Boardwalk. The historic context will consider significance of historic boardwalks as potential cultural landscapes. the lessee, in coordination with BOEM, will consult with New Jersey SHPO and interested Consulting Parties and property owners to determine what properties or areas will be the subject of survey and evaluation, and appropriate information to include. Tasks associated with the Historic Context Mitigation Measures can occur during and/or after construction, but must be completed within four years of MOA execution, unless the MOA is amended to reflect a different timeline.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
11	C, post-C	Mitigation to resolve adverse effects on Lucy the Margate Elephant	Funding for Visitor Experience and Public Access for Lucy the Margate Elephant. The lessee will: determine priority projects in collaboration with the representatives for the property owner; use already available plans or develop plans appropriate to the identified project, and submit plans for review by BOEM and representatives of the property owner; take necessary steps to ensure the project is carried out by qualified contractors, including staff who meet SOI Professional Qualifications for Architecture or Architectural History, who will execute plans; and take necessary steps to ensure planned work is completed.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
12	C, post-C	Mitigation to resolve adverse effects on Absecon Lighthouse, Atlantic City	Funding for Visitor Experience and Public Access for Absecon Lighthouse. The lessee will: determine priority projects in collaboration with the representatives for the property owner; use already available plans or develop plans appropriate to the identified project, and submit plans for review by BOEM and representatives of the property owner; take necessary steps to ensure the project is carried out by qualified contractors, including staff who meet SOI Professional Qualifications for Architecture or Architectural History, who will execute plans; and take necessary steps to ensure planned work is completed.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
13	C, post-C	Mitigation to resolve adverse effects on Atlantic City Boardwalk, Atlantic City	Funding for Visitor Experience and Public Access for Atlantic City Boardwalk. The lessee will: determine priority projects in collaboration with the representatives for the property owner; use already available plans or develop plans appropriate to the identified project, and submit plans for review by BOEM and representatives of the property owner; take necessary steps to ensure the project is carried out by qualified contractors, including staff who meet SOI Professional Qualifications for Architecture or Architectural History, who will execute plans; and take necessary steps to ensure planned work is completed.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
14	Within 90 days of initiating C	Mitigation to resolve adverse effects on 14 historic properties	Lessee will contribute funding to a mitigation fund to resolve visual adverse effects to the following 15 historic properties: Brigantine Hotel, Brigantine City; Atlantic City Convention Hall, Atlantic City; Ritz-Carlton Hotel, Atlantic City; Haddon Hall/Resorts Casino Hotel, Atlantic City; Riviera Apartments, Atlantic City; Vassar Square Condominiums, Ventnor City; House at 114 South Harvard Avenue, Ventnor City; Great Egg Coast Guard Station, Longport Borough; Ocean City Boardwalk, Ocean City; Ocean City Music Pier, Ocean City; Hereford Lighthouse, North Wildwood; North Wildwood Life Saving Station, North Wildwood; U.S. Lifesaving Station #35, Stone Harbor Borough; Flanders Hotel, Ocean City; and Little Egg Harbor U.S. Life Saving Station #23 (U.S. Coast Guard Station #119), Little Egg Harbor Township. Funding from the lessee will be deposited into a compensatory mitigation fund to be managed by a third-party administrator for the purpose of providing grants in support of preservation, interpretation, or commemoration of historic sites, buildings, or events.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
15	Prior to C	Phased Identification	If Alternative B-1, B-2, C-1, C-2, or D is selected, BOEM will implement steps for phased identification and evaluation of historic properties within the Marine APE in accordance with BOEM's existing Guidelines for Providing Archaeological and Historic Property Information Pursuant to Title 30 Code of Federal Regulations Part 585. The final identification and evaluation of historic properties within the APE may occur after publication of the Final EIS, but prior to the initiation of construction.	Cultural Resources	BOEM, BSEE, USACE, NJDEP

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
16	C and post-C	Comply with the stipulations of the Section 106 MOA	The lessee will comply with the stipulations included in the executed Memorandum of Agreement developed with consulting parties during Section 106 consultation.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
BOEM-proposed Mitigation and Monitoring Measures in the NMFS BA as Amended					
1	C and post-C	Incorporate LOA requirements	The measures required by the final MMPA LOA would be incorporated into COP approval, and BOEM and/or BSEE will monitor compliance with these measures.	Marine Mammals	BOEM and BSEE
2	C, post-C monitoring	PAM Plan	BOEM, BSEE, and USACE would ensure that Ocean Wind prepares a PAM Plan that describes all proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the required use of PAM for monitoring.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
3	C	Pile driving monitoring plan	BOEM would ensure that Ocean Wind prepare and submit a *Pile Driving Monitoring Plan* to NMFS and BSEE (at OSWsubmittals@bsee.gov) for review and concurrence at least 90 days before start of pile driving. The plan would detail all plans and procedures for sound attenuation as well as for monitoring ESA-listed whales and sea turtles during all impact and vibratory pile driving. The plan would also describe how BOEM, BSEE, and Ocean Wind would determine the number of whales exposed to noise above the Level B harassment threshold during pile driving with the vibratory hammer to install the cofferdam at the sea to shore transition. Ocean Wind would obtain NMFS' concurrence with this plan prior to starting any pile driving.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
4	C	PSO Coverage	BOEM, BSEE, and USACE would ensure that PSO coverage is sufficient to reliably detect whales and sea turtles at the surface in clearance and shutdown zones to execute any pile driving delays or shutdown requirements. If, at any point prior to or during construction, the PSO coverage that is included as part of the proposed action is determined not to be sufficient to reliably detect ESA-listed whales and sea turtles within the clearance and shutdown zones, additional PSOs and/or platforms would be deployed. Determinations prior to construction would be based on review of the *Pile Driving Monitoring Plan*. Determinations during construction would be based on review of the weekly pile driving reports and other information, as appropriate.	Marine Mammals, Sea Turtles	BOEM, BSEE, and USACE
5	C	Shutdown zones	BOEM, BSEE, and USACE would ensure that if the clearance and/or shutdown zones are expanded, PSO coverage is sufficient to reliably monitor the expanded clearance and/or shutdown zones. Additional observers would be deployed on additional platforms for every 1,500 m that a clearance or shutdown zone is expanded beyond the distances modeled prior to verification.	Marine Mammals, Sea Turtles	BOEM, BSEE, and USACE
6	C	Sound field verification	BOEM, BSEE, and USACE may consider reductions in the pre-start clearance and/or shutdown zones based on the sound field verification measurements. BOEM and BSEE would ensure that Ocean Wind submits a Sound Field Verification Plan for review and approval at least 90 days prior to the planned start of pile driving.	Marine Mammals, Sea Turtles	BOEM, BSEE, and USACE
7	C	UXO detonations – Atlantic sturgeon	Ocean Wind would extend the APM seasonal restriction of UXO detonations (January to April) to include months of increased Atlantic sturgeon presence in the offshore wind area. No UXOs can be detonated from November to April in the offshore areas greater than 3 nautical miles (state waters). UXO surveys are expected in Fall of 2022 which defines the exact location and size of UXO.	ESA-listed Fish	BOEM, BSEE, and NMFS
8	C	Monitoring zone for sea turtles	BOEM, BSEE, and USACE would ensure that Ocean Wind monitors the full extent of the area where noise would exceed the 175 dB rms threshold for 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.	Sea Turtles	BOEM, BSEE, and USACE
9	C, O&M, D	Look out for sea turtles and reporting	Between June 1 and November 30, Ocean Wind would have a trained lookout posted on all vessel transits during all phases of the project to observe for sea turtles. The trained lookout would communicate any sightings, in real time, to the captain so that the requirements in (e) below can be implemented. a. The trained lookout would monitor https://seaturtlesightings.org/ prior to each trip and report any observations of sea turtles in the vicinity of the planned transit to all vessel operators/captains and lookouts on duty that day. b. The trained lookout would maintain a vigilant watch and monitor a Vessel Strike Avoidance Zone (500 m) at all times to maintain minimum separation distances from ESA-listed species. Alternative monitoring technology (e.g., night vision, thermal cameras, etc.) would be available to ensure effective watch at night and in any other low visibility conditions. If the trained lookout is a vessel crew member, this would be their designated role and primary responsibility while the vessel is transiting. Any designated crew lookouts would receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. c. If a sea turtle is sighted within 100 m or less of the operating vessel's forward path, the vessel operator would slow down to 4 knots (unless unsafe to do so) and then proceed away from the turtle at a speed of 4 knots or less until there is a separation distance of at least 100 m at which time the vessel may resume normal operations. If a sea turtle is sighted within 50 m of the forward path of the	Sea Turtles	BOEM, BSEE, and USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			operating vessel, the vessel operator would shift to neutral when safe to do so and then proceed away from the turtle at a speed of 4 knots. The vessel may resume normal operations once it has passed the turtle. d. Vessel captains/operators would avoid transiting through areas of visible jellyfish aggregations or floating sargassum lines or mats. In the event that operational safety prevents avoidance of such areas, vessels would slow to 4 knots while transiting through such areas. e. All vessel crew members would be briefed in the identification of sea turtles and in regulations and best practices for avoiding vessel collisions. Reference materials would be available aboard all project vessels for identification of sea turtles. The expectation and process for reporting of sea turtles (including live, entangled, and dead individuals) would be clearly communicated and posted in highly visible locations aboard all project vessels, so that there is an expectation for reporting to the designated vessel contact (such as the lookout or the vessel captain), as well as a communication channel and process for crew members to do so. f. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements on an emergency basis. If any such incidents occur, they must be reported to NMFS and BSEE within 24 hours. g. If a vessel is carrying a PSO or trained lookout for the purposes of maintaining watch for North Atlantic right whales, an additional lookout is not required and this PSO or trained lookout must maintain watch for whales and sea turtles.		
10	C, post-C monitoring	Sampling gear	All sampling gear would be hauled at least once every 30 days, and all gear would be removed from the water and stored on land between survey seasons to minimize risk of entanglement.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM and BSEE
11	C, post-C monitoring	Gear identification	To facilitate identification of gear on any entangled animals, all trap/pot gear used in the surveys would be uniquely marked to distinguish it from other commercial or recreational gear. Using yellow and black striped duct tape, place a 3-foot-long mark within 2 fathoms of a buoy. In addition, using black and white paint or duct tape, place 3 additional marks on the top, middle and bottom of the line. These gear marking colors are proposed as they are not gear markings used in other fisheries and are therefore distinct. Any changes in marking would not be made without notification and approval from NMFS.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
12	C, post-C monitoring	Lost survey gear	If any survey gear is lost, all reasonable efforts that do not compromise human safety would be undertaken to recover the gear. All lost gear would be reported to NMFS (nmfs.gar.incidental-take@noaa.gov) and BSEE (OSWIncidentReporting@bsee.gov) within 24 hours of the documented time of missing or lost gear. This report would include information on any markings on the gear and any efforts undertaken or planned to recover the gear.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
13	C, O&M, D	Marine debris awareness training	The Lessee would ensure that vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP complete marine trash and debris awareness training annually. The training consists of two parts: (1) viewing a marine trash and debris training video or slide show (described below); and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. The marine trash and debris training videos, training slide packs, and other marine debris related educational material may be obtained at https://www.bsee.gov/debris or by contacting BSEE. The training videos, slides, and related material may be downloaded directly from the website. Operators engaged in marine survey activities would continue to develop and use a marine trash and debris awareness training and certification process that reasonably assures that their employees and contractors are in fact trained. The training process would include the following elements: • Viewing of either a video or slide show by the personnel specified above; • An explanation from management personnel that emphasizes their commitment to the requirements; • Attendance measures (initial and annual); and • Recordkeeping and the availability of records for inspection by DOI. By January 31 of each year, the Lessee would submit to DOI an annual report that describes its marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year. The Lessee would send the reports via email to BOEM (at renewable_reporting@boem.gov) and to BSEE (at marinedebris@bsee.gov).	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM and BSEE
14	C, post-C monitoring	Training	At least one of the survey staff onboard the trawl surveys and ventless trap surveys would have completed NEFOP observer training (within the last 5 years) or other training in protected species identification and safe handling (inclusive of taking genetic samples from Atlantic sturgeon). Reference materials for identification, disentanglement, safe handling, and genetic sampling procedures would be available on board each survey vessel. BOEM and BSEE would ensure that Ocean Wind prepares a training plan that addresses how this requirement would be met and that the plan is submitted to NMFS in advance of any trawl or trap surveys. This requirement is in place for any trips where gear is set or hauled.	ESA-listed Fish	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
15	C, post-C monitoring	Sea turtle disentanglement	Vessels deploying fixed gear (e.g., pots/traps) would have adequate disentanglement equipment (i.e., knife and boathook) onboard. Any disentanglement would occur consistent with the Northeast Atlantic Coast STDN Disentanglement Guidelines at https://www.reginfo.gov/public/do/DownloadDocument?objectID=102486501 and the procedures described in "Careful Release Protocols for Sea Turtle Release with Minimal Injury" (NOAA Technical Memorandum 580; https://repository.library.noaa.gov/view/noaa/3773).	Sea Turtles	BOEM, BSEE, and NMFS
16	C, post-C monitoring	Sea turtle/Atlantic sturgeon identification and data collection	Any sea turtles or Atlantic sturgeon caught and/or retrieved in any fisheries survey gear would first be identified to species or species group. Each ESA-listed species caught and/or retrieved would then be properly documented using appropriate equipment and data collection forms. Biological data, samples, and tagging would occur as outlined below. Live, uninjured animals should be returned to the water as quickly as possible after completing the required handling and documentation. a. The Sturgeon and Sea Turtle Take Standard Operating Procedures would be followed (https://media.fisheries.noaa.gov/dammigration/sturgeon_&_sea_turtle_take_sops_external.pdf). b. Survey vessels would have a passive integrated transponder (PIT) tag reader onboard capable of reading 134.2 kHz and 125 kHz encrypted tags (e.g., Biomark GPR Plus Handheld PIT Tag Reader) and this reader be used to scan any captured sea turtles and sturgeon for tags. Any recorded tags would be recorded on the take reporting form (see below). c. Genetic samples would be taken from all captured Atlantic sturgeon (alive or dead) to allow for identification of the DPS of origin of captured individuals and tracking of the amount of incidental take. This would be done in accordance with the Procedures for Obtaining Sturgeon Fin Clips (https://media.fisheries.noaa.gov/dammigration/sturgeon_genetics_sampling_revised_june_2019.pdf). i. Fin clips would be sent to a NMFS approved laboratory capable of performing genetic analysis and assignment to DPS of origin. To the extent authorized by law, BOEM is responsible for the cost of the genetic analysis. Arrangements would be made for shipping and analysis in advance of submission of any samples; these arrangements would be confirmed in writing to NMFS within 60 days of the receipt of this ITS. Results of genetic analysis, including assigned DPS of origin would be submitted to NMFS within 6 months of the sample collection. ii. Subsamples of all fin clips and accompanying metadata forms would be held and submitted to a tissue repository (e.g. the Atlantic Coast Sturgeon Tissue Research Repository) on a quarterly basis. The Sturgeon Genetic Sample Submission Form is available for download at: https://www.fisheries.noaa.gov/new-england-midatlantic/consultations/section-7-take-reporting-programmaticsgreater-atlantic). d. All captured sea turtles and Atlantic sturgeon would be documented with required measurements and photographs. The animal's condition and any marks or injuries would be described. This information would be entered as part of the record for each incidental take. A NMFS Take Report Form would be filled out for each individual sturgeon and sea turtle (download at: https://media.fisheries.noaa.gov/2021-41507/Take%20Report%20Form%2007162021.pdf?null) and submitted to NMFS as described below.	ESA-listed Fish, Sea Turtles	BOEM, BSEE, and NMFS
17	C, post-C monitoring	Sea turtle/Atlantic sturgeon handling and resuscitation guidelines	Any sea turtles or Atlantic sturgeon caught and retrieved in gear used in fisheries surveys would be handled and resuscitated (if unresponsive) according to established protocols and whenever at-sea conditions are safe for those handling and resuscitating the animal(s) to do so. Specifically: a. Priority would be given to the handling and resuscitation of any sea turtles or sturgeon that are captured in the gear being used, if conditions at sea are safe to do so. Handling times for these species should be minimized (i.e., kept to 15 minutes or less) to limit the amount of stress placed on the animals. b. All survey vessels would have copies of the sea turtle handling and resuscitation requirements found at 50 CFR 223.206(d)(1) prior to the commencement of any on-water activity (download at: https://media.fisheries.noaa.gov/dammigration/sea_turtle_handling_and_resuscitation_measures.pdf). These handling and resuscitation procedures would be carried out any time a sea turtle is incidentally captured and brought onboard the vessel during the proposed actions. c. If any sea turtles that appear injured, sick, or distressed, are caught and retrieved in fisheries survey gear, survey staff would immediately contact the Greater Atlantic Region Marine Animal Hotline at 866-755-6622 for further instructions and guidance on handling the animal, and potential coordination of transfer to a rehabilitation facility. If unable to contact the hotline (e.g., due to distance from shore or lack of ability to communicate via phone), the USCG should be contacted via VHF marine radio on Channel 16. If required, hard-shelled sea turtles (i.e., non-leatherbacks) may be held on board for up to 24 hours following handling instructions provided by the Hotline, prior to transfer to a rehabilitation facility. d. Attempts would be made to resuscitate any Atlantic sturgeon that are unresponsive or comatose by providing a running source of water over the gills as described in the Sturgeon Resuscitation Guidelines (https://media.fisheries.noaa.gov/dammigration-miss/Resuscitation-Cards-120513.pdf).	ESA-listed Fish, Sea Turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			e. Provided that appropriate cold storage facilities are available on the survey vessel, following the report of a dead sea turtle or sturgeon to NMFS, and if NMFS requests, any dead sea turtle or Atlantic sturgeon would be retained on board the survey vessel for transfer to an appropriately permitted partner or facility on shore as safe to do so. f. Any live sea turtles or Atlantic sturgeon caught and retrieved in gear used in any fisheries survey would ultimately be released according to established protocols and whenever at-sea conditions are safe for those releasing the animal(s) to do so.		
18	C, post-C monitoring	Take notification	GARFO PRD would be notified as soon as possible of all observed takes of sea turtles, and Atlantic sturgeon occurring as a result of any fisheries survey. Specifically: a. GARFO PRD would be notified within 24 hours of any interaction with a sea turtle or sturgeon (nmfs.gar.incidental-take@noaa.gov and BSEE at protectedspecies@bsee.gov). The report would include at a minimum: (1) survey name and applicable information (e.g., vessel name, station number); (2) GPS coordinates describing the location of the interaction (in decimal degrees); (3) gear type involved (e.g., bottom trawl, gillnet, longline); (4) soak time, gear configuration and any other pertinent gear information; (5) time and date of the interaction; and (6) identification of the animal to the species level. Additionally, the e-mail would transmit a copy of the NMFS Take Report Form (download at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null) and a link to or acknowledgement that a clear photograph or video of the animal was taken (multiple photographs are suggested, including at least one photograph of the head scutes). If reporting within 24 hours is not possible due to distance from shore or lack of ability to communicate via phone, fax, or email, reports would be submitted as soon as possible; late reports would be submitted with an explanation for the delay. b. At the end of each survey season, a report would be sent to NMFS that compiles all information on any observations and interactions with ESA-listed species. This report would also contain information on all survey activities that took place during the season including location of gear set, duration of soak/trawl, and total effort. The report on survey activities would be comprehensive of all activities, regardless of whether ESA-listed species were observed.	ESA-listed Fish, Sea Turtles	BOEM, BSEE, and NMFS
19	C, O&M, D	Monthly/annual reporting requirements	BOEM and BSEE would ensure that Ocean Wind submits regular reports (in consultation with NMFS) necessary to document the amount or extent of take that occurs during all phases of the proposed action. Details of reporting would be coordinated between Ocean Wind, NMFS, BOEM and BSEE. All reports would be sent to: nmfs.gar.incidental-take@noaa.gov and BSEE at OSWsubmittals@bsee.gov.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
20	O&M	BOEM/NMFS meeting requirements for sea turtle take documentation	To facilitate monitoring of the incidental take exemption for sea turtles, through the first year of operations, BOEM and NMFS would meet twice annually to review sea turtle observation records. These meetings/conference calls would be held in September (to review observations through August of that year) and December (to review observations from September to November) and would use the best available information on sea turtle presence, distribution, and abundance, project vessel activity, and observations to estimate the total number of sea turtle vessel strikes in the action area that are attributable to project operations. These meetings would continue on an annual basis following year 1 of operations. Upon mutual agreement of NMFS and BOEM, the frequency of these meetings can be changed.	Sea Turtles	BOEM, BSEE, and NMFS
21	C, O&M, D	Data Collection BA BMPs	BOEM would ensure that 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 Ocean Wind project as applicable.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
22	C	Alternative Monitoring Plan (AMP) for Pile Driving	The Lessee must not conduct pile driving operations at any time when lighting or weather conditions (e.g., darkness, rain, fog, sea state) prevent visual monitoring of the full extent of the clearance and shutdown zones. The Lessee must submit an AMP to BOEM and NMFS for review and approval at least 6 months prior to the planned start of pile-driving. This plan may include deploying additional observers, alternative monitoring technologies such as night vision, thermal, and infrared technologies, or use of PAM and must demonstrate the ability and effectiveness to maintain all clearance and shutdown zones during daytime as outlined below in Part 1 and nighttime as outlined in Part 2 to BOEM's and NMFS's satisfaction. The AMP must include two stand-alone components as described below: • Part 1 – Daytime when lighting or weather (e.g., fog, rain, sea state) conditions prevent visual monitoring of the full extent of the clearance and shutdown zones. Daytime being defined as one hour after civil sunrise to 1.5 hours before civil sunset. • Part 2 – Nighttime inclusive of weather conditions (e.g., fog, rain, sea state). Nighttime being defined as 1.5 hours before civil sunset to one hour after civil sunrise. If a protected marine mammal or sea turtle is observed entering or found within the shutdown zones after impact pile-driving has commenced, the Lessee would follow the shutdown procedures outlined in Section 2.4.2.5.4 of the Protected Species Mitigation Monitoring Plan (PSMMP). The Lessee would notify BOEM and NMFS of any shutdown occurrence during piling driving operations with 24 hours of the occurrence unless otherwise authorized by BOEM and NMFS.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			The AMP should include, but is not limited to the following information: • Identification of night vision devices (e.g., mounted thermal/IR camera systems, hand-held or wearable NVDs, IR spotlights), if proposed for use to detect protected marine mammal and sea turtle species. • The AMP must demonstrate (through empirical evidence) the capability of the proposed monitoring methodology to detect marine mammals and sea turtles within the full extent of the established clearance and shutdown zones (i.e., species can be detected at the same distances and with similar confidence) with the same effectiveness as daytime visual monitoring (i.e., same detection probability). Only devices and methods demonstrated as being capable of detecting marine mammals and sea turtles to the maximum extent of the clearance and shutdown zones will be acceptable. • Evidence and discussion of the efficacy (range and accuracy) of each device proposed for low visibility monitoring must include an assessment of the results of field studies (e.g., Thayer Mahan demonstration), as well as supporting documentation regarding the efficacy of all proposed alternative monitoring methods (e.g., best scientific data available). • Procedures and timeframes for notifying NMFS and BOEM of Ocean Wind's intent to pursue nighttime pile-driving. • Reporting procedures, contacts and timeframes. BOEM may request additional information, when appropriate, to assess the efficacy of the AMP.		
23	O&M	Periodic Underwater Surveys, Reporting of Monofilament and Other Fishing Gear Around WTG Foundations	The Lessee must monitor indirect impacts associated with charter and recreational fishing gear lost from expected increases in fishing around WTG foundations by surveying at least 10 of the WTGs located closest to shore in the Ocean Wind 1 Lease Area (OCS-A 0498) annually. Survey design and effort may be modified with review and concurrence by DOI. The Lessee may conduct surveys by remotely operated vehicles, divers, or other means to determine the frequency and locations of marine debris. The Lessee must report the results of the surveys to BOEM (at renewable_reporting@boem.gov) and BSEE (at marinedebris@bsee.gov) in an annual report, submitted by April 30, for the preceding calendar year. Annual reports must be submitted in Word format. Photographic and videographic materials must be provided on a portable drive in a lossless format such as TIFF or Motion JPEG 2000. Annual reports must include survey reports that include: the survey date; contact information of the operator; the location and pile identification number; photographic and/or video documentation of the survey and debris encountered; any animals sighted; and the disposition of any located debris (i.e., removed or left in place). Annual reports must also include claim data attributable to the Ocean Wind 1 project from Ørsted's corporate gear loss compensation policy and procedures. Required data and reports may be archived, analyzed, published, and disseminated by BOEM	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
24	C, O&M, D	PDC Minimize Vessel Interactions with Listed Species (from HRG Programmatic)	All vessels associated with survey activities (transiting [i.e., travelling between a port and the survey site] or actively surveying) must comply with the vessel strike avoidance measures specified below. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements. • If any ESA-listed marine mammal is sighted within 500 meters of the forward path of a vessel, the vessel operator must steer a course away from the whale at <10 knots (18.5 km/hr) until the minimum separation distance has been established. Vessels may also shift to idle if feasible. • If any ESA-listed marine mammal is sighted within 200 meters of the forward path of a vessel, the vessel operator must reduce speed and shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 500 meters. If stationary, the vessel must not engage engines until the large whale has moved beyond 500 meters.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
25	O&M	Operational Sound Field Verification Plan	BOEM would require the Lessee to develop an operational sound field verification plan to determine the operational noises emitted from the Offshore Wind Area. The plan would be reviewed and approved by BOEM and NMFS.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
BOEM-proposed Mitigation and Monitoring Measures in the NMFS EFH Assessment					
1	C and post-C	Live and Hard Bottom Impact Monitoring	The Lessee would develop and implement a monitoring plan for live and hard-bottom features that may be affected by proposed activities. The monitoring plan would also include assessing the recovery time for these sensitive habitats. BOEM recommends that all monitoring reports classify substrate conditions following the Coastal and Marine Ecological Classification Standards (CMECS), including live bottoms (e.g., submerged aquatic vegetation and corals and topographic features). The plan would also include a means of recording observations of any increased coverage of invasive species in the affected hard-bottom areas.	EFH	BOEM, BSEE, and NMFS
2	C, O&M, D	Live and Hard Bottom Mapping and Avoidance	Vessel operators would be provided with maps of sensitive hard-bottom habitat in OSW project area, as well as a proposed anchoring plan that would avoid or minimize impacts on the hard-bottom habitat to the greatest extent practicable. These plans would be provided for all anchoring activity, including construction, maintenance, and decommissioning.	EFH	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
3	C, O&M	Intake Screens on Pump Intakes for In-shore Hydraulic Dredges	All hydraulic dredge intakes should be covered with a mesh screen or screening device that is properly installed and maintained to minimize potential for impingement or entrainment of fish species. The screening device on the dredge intake should prevent the passage of any material greater than 1.25" in diameter, with a maximum opening of 1.25"x 6". Water intakes should be positioned at an appropriate depth to avoid or minimize the entrainment of eggs and larvae. Intake velocity should be limited to less than 0.5 ft/sec.	EFH	BOEM, BSEE, and NMFS
4	C	Scour and Cable Protection	To the extent technically and economically feasible, the Lessee must ensure that all materials used for scour and cable protection consist of natural or engineered stone that does not inhibit epibenthic growth. The materials selected for protective purposes should mirror the natural environment and provide similar habitat functions.	EFH	BOEM, BSEE, and NMFS
EFH Conservation Recommendations[3] BOEM and USACE Intend to Adopt or Partially Adopted					
EFH Conservation Recommendations for Activities within the OCS - BOEM					
CR #1	C	WTG Removal and Relocation	Avoid installing WTGs in high relief sand ridge and trough complex areas and areas [on small to medium spatial scales] of high habitat heterogeneity (diversity of structural elements, including bathymetric features) and complexity. Specifically, the following eight (8) WTGs should be removed: a. A06; B07; A07; A09; B09; C09; D09, which are included in the Sand Ridge and Trough Avoidance Alternative (D) area; b. D10, which was not included in the original 15 potential WTGs for removal, but meets the intent and purpose of the alternative, as it is located in the broad sand ridge and trough complex area (east portion of the lease area). i. Should D10 not be removed, it should be shifted (microsited) the maximum allowable distance1 west-southwest to avoid the habitats described above.	EFH	BOEM, BSEE, and NMFS
CR #2	C	Micrositing of WTGs or Rerouting of IACS: B08, E07, F07, G09, G03, J03, D02, B06/B05 IAC, F01, D10/Z01 IAC, F09/F08 IAC, F07/F06 IAC, G09/G08 IAC, J03-I03 IAC	Microsite WTGs and interarray and export cables to avoid high relief sand ridge and trough complex area and/or areas of high habitat heterogeneity (diversity of structural elements, including bathymetric features) and complexity. Specifically, the following WTG and inter-array should be microsited: a. B08 should be shifted the maximum allowable distance east or east-northeast. b. E07 should be shifted north or northeast. c. F07 should be shifted the maximum allowable distance south. d. G09 should be shifted the maximum allowable distance north or northwest. e. G03 should be shifted the maximum allowable distance south. f. J03 should be shifted the maximum allowable distance north-northeast. g. D02 should be shifted south to fulfill the goals mentioned above and to minimize impacts to the New Jersey Prime Fishing Ground known as "Triple Lumps." h. B06 should be shifted east or east-southeast and B05 should be shifted east or east-northeast to fulfill the goals mentioned above and to minimize impacts to the N.J. Prime Fishing Ground known as "Atlantic City Bluefish Lump." i. F01 should be shifted the maximum allowable distance south or southeast to fulfill the goals mentioned above and to minimize impacts to the N.J. Prime Fishing Ground known as "The Ham." j. The inter-array cable connecting B06 to B05 should be re-routed to avoid intersection/overlap with "Atlantic City Bluefish Lump." k. The inter-array cable connecting D10 to substation ZO1 should be re-routed to fulfill the goals mentioned above, including benthic features found in the seafloor disturbance footprint area of D09. l. The inter-array cable connecting F09 to F08 should be re-routed to fulfill the goals mentioned above; the cable should avoid areas of complex habitat ("NOAA Complexity Category" displayed on various maps/online viewers). When avoidance is not feasible, the cable should cross these areas perpendicularly and at the narrowest point (s). m. The inter-array cable connecting F07 to F06 should be re-routed first west then east (in an arc) of the current route to avoid bathymetric features and areas of high rugosity/bottom heterogeneity that occur in the proposed west-northwest linear route. The cable should avoid areas of complex habitat ("NOAA Complexity Category"). When avoidance is not feasible, the cable should cross these areas perpendicularly and at the narrowest point(s).	EFH	BOEM, BSEE, and NMFS

[3] NMFS EFH Consultation letter dated February 24, 2023 provided EFH Conservation Recommendations for activities under BOEM's jurisdiction and activities under USACE's jurisdiction.

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			n. The inter-array cable connecting G09 to G08 should be re-routed to fulfill the goals mentioned above; the cable should avoid areas of complex habitat ("NOAA Complexity Category"). When avoidance is not feasible, the cable should cross these areas perpendicularly and at the narrowest point(s). o. The inter-array cable connection J03 to I03 should be re-routed to fulfill the goals mentioned above; the cable should avoid areas of complex habitat ("NOAA Complexity Category"). When avoidance is not feasible, the cable should cross these areas perpendicularly and at the narrowest point(s).		
CR #3	C	Inter-array and Export Cable Micrositing Plan	For cables not mentioned above (in #2), an inter-array and export cable micrositing plan should be developed to avoid long-term to permanent adverse impacts to complex habitats and benthic features within the lease area. Cables should be microsited around all identified large boulders/habitat elements (i.e., >/= 0.5 m in diameter) and into low multibeam backscatter return areas without benthic features (i.e., sand ripples, waves). a. At a minimum, the micrositing plan should include: 1) depictions of the microsited cables (i.e., include a figure depicting large boulder locations, multibeam backscatter returns, and the proposed microsited cable); 2) information describing how the microsited locations were selected (i.e., what information other than multibeam backscatter and boulder locations was used to determine the cable path); and 3) for any cables that are identified to be infeasible to be fully microsited around large boulders and within low multibeam backscatter areas, detailed information supporting the feasibility issues encountered, calculated impact areas of large boulders and/or medium to high multibeam backscatter area, and impact minimization measures to be used should be provided. b. The micrositing plan should be submitted for our review and comment (including comments that may change the plan and on-the-ground activities) at least 120 days prior to in-water site-preparation activities. BOEM should provide a response to NMFS comments and an updated copy of the plan at least 30 days before in-water work begins.	EFH	BOEM, BSEE, and NMFS
CR #4	C	Scour Protection and Scour Protection Plan	In order to minimize permanent adverse impacts from the elimination/conversion of existing habitats from scour protection, the project should: a. Avoid and minimize the use of scour protection by fully burying cables (this can be done by siting cables in appropriate substrates) and using the minimum amount of scour protection to accomplish the purpose/intent of the scour protection; b. Use natural, rounded stone of consistent grain size in the entirety of the sand ridge and trough complex area and any areas of complex habitat; c. Avoid the use/placement of engineered stone (e.g., riprap; cut, crushed, or graded stone; etc.) or concrete mattresses within complex habitats or the sand ridge and trough complex area. If the use of engineered stone or concrete mattresses is required within these areas, the impact should be mitigated through the addition of a natural, rounded stone veneer. At a minimum, the exposed surface layer should be designed and selected to provide three-dimensional structural complexity that creates a diversity of crevice sizes (e.g., mixed stone sizes, natural rounded stone veneer) and rounded edges (e.g., tumbled stone, or natural round stone veneer); d. Develop a scour and cable protection plan for all complex habitat areas. At a minimum, the plan should include: 1) a clear depiction of the location and extent of proposed scour or cable protection within complex habitat (i.e., figures displaying existing areas with large boulders and/or medium to high multibeam backscatter returns and the extent of scour or cable protection proposed within each area); 2) all available habitat information for each identified areas (e.g., plan view imagery, video transects); and 3) detailed information on the proposed scour or cable protection materials for each area. e. The scour and cable protection plan should be submitted to NMFS for our review and comment (including comments that may change the plan and on-the-ground activities) at least 120 days prior to in-water work. BOEM should provide a response to NMFS comments and an updated copy of the plan at least 30 days before in-water work begins.	EFH	BOEM, BSEE, and NMFS
CR #5	C, O&M, D	Anchoring Plan	Avoid anchoring in complex habitats and areas of high habitat heterogeneity and complexity during all phases of the project including any area where large boulders (>/= 0.5 m in diameter), medium to high multibeam backscatter returns occur, or large benthic features occur (not inclusive of ripples/megaripples): a. If anchoring is necessary in complex habitats and areas of high habitat heterogeneity during cable installation, extend the anchor lines to the extent practicable to minimize the number of times the anchors must be raised and lowered to reduce the amount of habitat disturbance. This should not be done if the anchor chain sweep area includes benthic features that will be impacted. b. An anchoring plan should be developed to demonstrate how anchoring will be avoided and minimized in these habitats during all phases of the project. . c. For any area where large boulders or medium to high multibeam backscatter returns occur and vessels must remain stationary, dynamic positioning systems (DPS) or mid-line buoys on anchor chains should be required.	EFH	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			d. At a minimum, the anchoring plan to be developed should include: 1) depictions of the lease and export cable areas that clearly identify areas, using GPS location coordinates, where large boulders and/or medium to high backscatter returns occur, and either: a) DPS, or b) mid-lines buoys are required for anchoring; 2) information describing the operations and number of vessels that will be necessary to maintain vessel position using DPS or mid-line buoys within complex areas (i.e., large boulder and medium to high multibeam backscatter areas); and 3) for any complex habitat area that is identified for it to be infeasible to be fully avoid anchoring within or using mid-line buoys, detailed information supporting the feasibility issues encountered, calculated impact areas of large boulders and/or medium to high multibeam backscatter area, and impact minimization measures to be used should be provided. e. A copy of the anchoring plan, with complex habitat coordinates, should be provided to all vessel operators. f. The anchoring plan should be submitted to NMFS for our review and comment (including comments that may change the plan and on-the-ground activities) at least 120 days prior to in-water work. BOEM should provide a response to NMFS comments and an updated copy of the plan at least 30 days before in-water work begins.		
CR #6	C	Boulder Relocation	For boulder/cobble removal/relocation activities, boulders and cobble should be moved as close to the impact area as practicable in areas immediately adjacent to existing similar complex bottom and placed in a manner that does not hinder navigation or impede commercial fishing and avoids impacts to existing complex habitats: a. In order to minimize impacts to complex habitats, boulders that will be relocated using boulder "pick" methods should be relocated outside the area necessary to clear and placed along the edge of existing complex habitats such that the placement of the relocated boulders will result in a marginal expansion of complex habitats into soft-bottom habitats (i.e., boulders should be placed outside the relocation area and in an area of low multibeam backscatter return immediately adjacent to medium or high return areas) and reduce risk to navigation and fishing operations in the area. b. A boulder relocation plan should be developed that identifies where boulders will be removed from and where they will be placed. We recommend resource agencies and the fishing industry be consulted in preparation of the boulder relocation plan. The plan should identify all areas where a boulder plow will be used during site-preparation. At a minimum, the plan should include: 1) a clear depiction (i.e., figures) of the location of boulder relocation activities specified by activity type (e.g., pick or plow, removal or placement) and overlaid on multibeam acoustic backscatter data; 2) a detailed methodology for each type of boulder relocation activity and technical feasibility constraints; 3) any proposed measures to minimize impacts to attached epifaunal assemblages on boulder surfaces; 4) measures taken to avoid further adverse impacts to complex habitat and fishing operations; and 5) a summary of any consultation with resources agencies and the fishing industry in development of the plan. c. The boulder relocation plan should be submitted to NMFS for our review and comment (including comments that may change the plan and on-the-ground activities) at least 120 days prior to in-water work. BOEM should provide a response to NMFS comments and an updated copy of the plan at least 30 days before in-water work begins.	EFH	BOEM, BSEE, and NMFS
CR #7	C and post-C	Benthic Feature Removal/Clearance Avoidance or Remediation	In all offshore/nearshore areas where seafloor preparation activities will occur, benthic feature removal/clearance (i.e., sand wave clearance) via dredging, plowing, use of mass flow excavators, or other methods should be avoided through micrositing WTGs and re-routing cables. Where plows, jets, grapnel runs or other similar methods are used, post-construction surveys capable of detecting bathymetry changes of 0.5 ft. or less should be completed to determine the height and width of any created berms. In any area where the berm height exceeds one foot above the existing grade, the created berm should be restored to match that of the existing grade/pre-construction conditions.	EFH	BOEM, BSEE, and NMFS
CR #8	C	Noise Mitigation Measures	Noise mitigating measures should be required during construction, such as soft start procedures and the deployment of noise dampening equipment such as bubble curtains. BOEM should require the development of a specific plan outlining noise mitigation procedures in consultation with the resource agencies prior to any construction activities (BOEM's documents outline potential noise mitigation options but does not currently specify which will be used): a. The noise mitigation plan should be filed with BOEM for approval before construction commences. This should include a minimum of 90 days for the resource agencies to review and provide comments. BOEM should provide a response to NMFS comments and an updated copy of the plan at least 30 days before in-water work begins. The noise mitigation plan should include a process for notifying resource agencies within 24 hours if any evidence of a fish kill during construction activity is observed, and contingency plans to resolve issues. b. Additional noise dampening/mitigation measures, beyond what is currently proposed, should be used during pile installation for WTGs and OSSs near discrete, specific sensitive sites, such as known artificial reef sites to avoid and minimize potential impacts. c. For WTGs and OSSs—including most WTGs of Rows 1 through 8 and OSSs 1 and 2—with the potential to impact artificial reefs and species using those reefs within the Atlantic City Reef and Great Egg Harbor artificial reef sites, additional noise dampening devices	EFH	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			that result in greater noise dampening should be included to avoid and minimize impacts to habitats and species. Devices may include, but are not limited to isolation casings, isolation casings with bubble curtains inside, and double-walled isolation casings.		
CR #9	Prior to C, C, O&M	Benthic Habitat Monitoring Plan	The Benthic Habitat Monitoring Plan should be revised to address our concerns (expressed in various RAI requests mentioned above) related to the adequacy of the proposed methods to detect changes in the existing benthic community structure in the offshore and inshore project areas. The plan should be required to address potential changes to macrobenthic communities across and within each habitat type in the project area, including the artificial substrates to be constructed. a. The plan should include pre-construction/baseline monitoring data, which should be collected for a minimum of three years for each survey conducted. b. The plan should include post-construction monitoring of the existing, natural soft and hard bottom benthic community structure within the lease and export cable corridor, post-construction benthic community development and invasive species (e.g., Didemnum vexillum) growth on: 1) constructed habitats, 2) natural habitats within the expected area of project impacts, and 3) within adjacent areas outside the area of impact. c. The monitoring plan should also include measures to evaluate: 1) physical changes to the benthic habitat including depth, hardness, rugosity, slope, and other morphometrics through the regular collection of acoustic data (bathymetry and backscatter), 2) demersal juvenile fish species response to habitat impacts, 3) shellfish and SAV responses to habitat impacts, and 4) invasive species distribution and abundance with associated plans for removing/managing invasives. d. The applicant should consult with the resource agencies in the revision and refinement of this plan and give the resource agencies a minimum of 90 days to review and comment on the plan. The applicant should ultimately file the plan with BOEM for approval. BOEM should ensure that the applicant's filing addresses, and includes, all resource agency comments, as well as the applicant's response to those comments.	EFH	BOEM, BSEE, and NMFS
CR #10	Prior to C, C, O&M	Fisheries Monitoring Plan	The Fisheries Monitoring Plan should be revised to address our concerns expressed in our September 10, 2021, letter that have not yet been resolved, including examining specific impact producing factors, addressing survey design issues, assessing early life history stages (e.g. eggs, larvae, juveniles) composition and distribution, and ensuring sufficient baseline data are collected (e.g., the trawl survey has yet to begin). We also recommend the examination of stomach contents to assess dietary changes that may result from habitat conversion and changes to predator/prey relationships. Note regarding surveys: a. The plan should state clear hypotheses and the specific experimental approaches and analytical methods planned to address each hypothesis. b. Baseline monitoring data should be collected for a minimum of three years for each survey conducted. c. Data should be collected using standardized methods that are consistent with those used by regional surveys. d. Control locations should be sited outside of the likely zone of impact from wind development and have similar habitat types as the project area. e. Experimental designs capable of detecting effects of impact producing factors should be used. f. Specific studies on early life history stages (e.g., eggs, larvae, and juveniles), including transport and settlement, should be included in the plan. g. Potential changes to inshore-offshore transport and settlement of larvae and juveniles (e.g., through altered hydrodynamics) should be evaluated through monitoring. It is important to note that the large, highly productive estuarine system of Great Bay and Little Egg Harbor/Inlet are adjacent to the export cable and wind farm area. h. Response variables should include changes in abundance and distribution, size distribution, condition, and stomach contents. i. Transparent protocols for data storage, access, and sharing should be part of the plan.	EFH	BOEM, BSEE, and NMFS
CR #12	Pre-D	Decommissioning	The EFH consultation should be reinitiated prior to decommissioning turbines to ensure that the impact to EFH as a result of the decommissioning activities have been fully evaluated and minimized to the extent practicable.	EFH	BOEM, BSEE, and NMFS
EFH Conservation Recommendations - USACE jurisdiction					
CR #1	C and post-C	Benthic Feature Removal/Clearance Avoidance or Remediation	In all nearshore areas where seafloor preparation activities will occur, benthic feature removal/clearance (i.e., sand wave clearance) via dredging, plowing, use of mass flow excavators, or other methods should be avoided through micrositing and re-routing cables. Where plows, jets, grapnel runs or other similar methods are used, post-construction surveys capable of detecting bathymetry changes of 0.5 ft. or less should be completed to determine the height and width of any created berms. In any area where the berm height exceeds one foot above the existing grade, the created berm should be restored to match that of the existing grade/pre-construction conditions.	EFH	USACE and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
CR #3	C	Winter Flounder Time-of-Year Restriction	Dredging, plowing, or other extractive or turbidity/sediment-generating activities should be avoided in Barnegat Bay/estuarine areas from January 1 to May 31 of any given year to avoid and minimize impacts to EFH for winter flounder early life stages (eggs, larvae).	EFH	USACE and NMFS
CR #4	C and post-C	HDD, Micrositing, and Re-routing to Avoid/Minimize SAV, Shellfish Bed and Benthic Feature Impacts	In all inshore/estuarine areas (i.e. Barnegat Bay, Great Egg Harbor Bay) where seafloor preparation and cable installation activities will occur, impacts to SAV, shellfish beds, and benthic features should be avoided and minimized through the use of horizontal directional drilling (HDD), micrositing and re-rerouting, to the maximum extent practicable. a. All disturbed areas should be restored to pre-construction conditions, inclusive of bathymetry, contours, and sediment types. b. Pre-construction surveys to determine bathymetry, contours and sediment types and post-construction surveys should be conducted to verify restoration has occurred. Survey results should be provided to NMFS.	EFH	USACE and NMFS
CR #5	C	Floating Vessels	All vessels should float at all stages of the tide.	EFH	USACE and NMFS
CR #6	Pre-C	Inadvertent Return Contingency Plans	Detailed frac-out plans should be developed for all areas where HDD is proposed to be used. These plans should be shared with us at a minimum 60 days prior to construction.	EFH	USACE and NMFS
CR #7	C	Open Trenching Restoration	Avoid trenching in open waters, especially areas supporting SAV and shellfish, and wetlands. a. If open trenching is used, excavated materials should not be sidecast or placed in the aquatic environment. All materials should be stored on uplands and placed back into the trench to restore the excavated areas, or removed to a suitable upland disposal site. Trenched areas should be restored to pre-construction conditions with native and/or clean, compatible material.	EFH	USACE and NMFS
CR #8	Pre-C, C and post-C	SAV Surveys, Impact Avoidance, and Mitigation	Avoid cable installation, dredging or other construction activities in submerged aquatic vegetation (SAV), particularly in Barnegat Bay. a. Post-construction surveys should be conducted to document the recovery of areas temp b. Barges should not be moored in SAV or SAV habitat. Maps derived from updated surveys should be provided to vessels/captains to ensure SAV is avoided; c. Dredging, plowing, or other extractive or turbidity/sediment-generating activities should be avoided during the growing season (April 15 to October 15) of any given year to avoid and minimize impacts to SAV. d. Should the applicant need to dredge/plow during the growing season of any given year, a minimum 500-ft. buffer between dredging/plowing area(s) and the edge of any SAV bed should be maintained between April 15 and October 15 of any year. The appropriate buffer is 250-ft. if the sediments are greater than 95% sand. Sequencing of dredging/plowing can be used to accommodate this buffer. e. Provide compensatory mitigation for all areas of SAV impacted by construction activities including cable installation and dredging at a minimum ratio of 3:1. Based upon the information in various plans, documents, GIS viewing tools, the area of unavoidable SAV impact appears to be at least 2.9 acres (minimum). However, we are not yet certain that is accurate given the various export cable alignments.	EFH	USACE and NMFS
CR #9	Pre-C, C and post-C	Shellfish Surveys and Mitigation	Avoid installing cables, dredging, or other construction activities in high and moderate densities of shellfish in Barnegat and Great Egg Harbor Bay and surrounding estuarine waters. Project-specific surveys should be conducted to complement existing NJDEP mapping efforts. a. Systematic visual pre-construction surveys should be conducted to document occurrence and abundance/density of shellfish. Three years of pre-construction surveys are recommended to account for yearly variations in SAV presence. However, at a minimum, one survey should be done during the growing season in the same calendar year construction commences (i.e., if cable installation is scheduled to begin July 1, 2023, surveys should take place in 2023, prior to June 30). Visual surveys should be conducted within 5,000 ft. (2,500 ft. on both sides of cable centerline or 2,500 ft. of a unified centerline between both cables) of any area to be dredged/plowed/jetted. b. Provide compensatory mitigation for impacts to areas of soft clams, oysters, and high and moderate densities of hard clams that cannot be avoided. Mitigation should be coordinated with the New Jersey Department of Environmental Protection's Bureau of Shellfisheries.	EFH	USACE and NMFS
CR #10	Pre-C, C and post-C	Shellfish and SAV Monitoring Plan	An inshore/estuarine shellfish and SAV-specific monitoring plan should be developed to monitor potential construction-related (trenching/sedimentation) and operational impacts (heat, EMF) to SAV and shellfish in Barnegat Bay. At a minimum, monitoring should be conducted within 5,000 ft. (2,500 ft. on both sides of cable centerline or 2,500 ft. of a unified centerline between both cables) of any area to be dredged/plowed/jetted. A before–after-gradient (BAG) survey design should be employed for any monitoring. This monitoring can be included in Benthic Habitat or Fisheries Monitoring plans (mentioned above).	EFH	USACE and NMFS
CR #11	C	HDD Wetlands	Use horizontal directional drilling in areas where the export cable crosses wetlands.	EFH	USACE and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
CR #12	C	Equipment Staging	Do not stage equipment in wetlands.	EFH	USACE and NMFS
CR #13	C	Construction Mats	Use construction mats if work in wetlands is unavoidable.	EFH	USACE and NMFS
CR #14	C and post-C	Wetland Restoration and Monitoring	Restore all impacted wetlands to pre-construction conditions and monitor the restored areas for a minimum of five years to ensure successful restoration. a. Provide NMFS with a copy of the restoration plan for review and comment at least 60 days prior to the issuance of a DA permit. b. The restoration plan should be approved prior to the issuance of the DA permit and be included as a special condition of the permit.	EFH	USACE and NMFS
CR #15	C	Compensatory Wetland Mitigation	Provide compensatory mitigation for all permanent impacts to wetlands and short-term/temporary impacts lasting more than 12 months. a. Quantify all permanent and short-term/temporary impacts and provide project plans delineating the areas impacted prior to the issuance of the DA permit. b. Compensatory mitigation ratios should be as follows: i. A minimum 3:1 ratio if the mitigation is the enhancement or restoration/rehabilitation of existing wetlands. ii. A minimum 2:1 ratio if the mitigation is the creation of wetlands from uplands or the restoration/rehabilitation of areas that are currently uplands but were once wetlands.	EFH	USACE and NMFS
CR #16	Pre-C	Compensatory Mitigation Plan	Compensatory mitigation should be provided for any unavoidable direct, indirect and individual, cumulative, synergistic impacts to SAV, shellfish, and wetlands. A compensatory mitigation plan that satisfies each element of a complete compensatory mitigation plan as identified in the published regulations 33 CFR Parts 325 and 332 "Compensatory Mitigation for Losses of Aquatic Resources," (Mitigation Rule) should be provided for NMFS review prior to project authorization. This plan should be included as a special condition of the permit. a. Compensatory mitigation should occur prior to, or concurrently with, the impacts. b. The compensatory mitigation plans should be made special conditions of the DA permit.	EFH	USACE and NMFS
FWCA #2	Pre-C, C and post-C	Communication Plan	A communication plan identifying the locations of relocated boulders and any cable protection measures (i.e., concrete mattresses) should be developed to help inform marine users, including, but not limited to the fishing industry and entities conducting scientific surveys, of potential gear obstructions.	EFH	USACE and NMFS
FWCA #3	C and post-C	Artificial Reef Impact Avoidance and Monitoring	Impacts to the Atlantic City and Great Egg harbor artificial reefs should be avoided due to their importance as habitat for a variety of federally and state managed species in addition to strong recreational fisheries. a. Additional noise attenuating devices such as isolation casings should be used during pile driving of WTGs and OSSs that may impact these artificial reef areas through elevated underwater noise. b. Conduct in-situ monitoring of artificial reefs pre-, during, and post-construction to evaluate temporary, short-term and permanent impacts to these habitats and the species (e.g., black sea bass, tautog, weakfish, scup) that use them: i. Hydrophones should be used to monitor/ directly measure noise at various reefs throughout the broader Atlantic City and Great Egg Harbor reef sites. This monitoring will provide insights (validations) on the expected noise levels and distances described in the EFH assessment and other documents and will enable comparisons of "observed" (real world) versus "expected" (modeled/predicted). Monitoring should establish ambient noise levels (pre-construction) and determine noise levels from pile installation activities(during) and operation (post-construction) of the WTGs and farm; ii. Camera systems (e.g., GoPro's) and other relevant methods (e.g., direct observation via divers) should be used to monitor fish behavior. iii. Traps and camera systems should be used to monitor fish species occurrence, community composition, and density/abundance. iv. Monitoring data should be analyzed using statistically rigorous methods to evaluate the potential impacts of elevated underwater noise from pile installation and WTG and wind farm operation on artificial reefs.	EFH	USACE and NMFS
Reasonable and Prudent Measures and Terms and Conditions from the NMFS Biological Opinion Issued April 3, 2023					
RPM 1	C	Pile Driving	Effects to ESA-listed whales and sea turtles must be minimized during pile driving. This includes adherence to the mitigation measures specified in the final MMPA ITA.	ESA-listed marine mammals, sea turtles	BOEM, BSEE, and NMFS
RPM 2	C	UXO Detonation	Effects to ESA-listed whales and sea turtles must be minimized during UXO detonation. This includes adherence to the mitigation measures specified in the final MMPA ITA.	ESA-listed marine mammals, sea turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
RPM 3	C, O&M, D	Vessel Operations	Vessels operated by Ocean Wind or under contract to Ocean Wind or its contractors must comply with the RPMs and Terms and Conditions relevant to vessel operations within the Delaware River and Delaware Bay included in the Incidental Take Statements provided with NMFS GARFO's July 19, 2022, Paulsboro Marine Terminal Biological Opinion and February 25, 2022, New Jersey Wind Port Biological Opinion, or any subsequently issued Opinions that replace those Opinions as a result of reinitiation.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
RPM 4	C, O&M, D	Reporting Requirements	Effects to, or interactions with, ESA-listed Atlantic sturgeon, whales, and sea turtles must be documented during all phases of the proposed action, and all incidental take must be reported to NMFS GARFO.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
RPM 5	C	Review of Plans	All required plans must be submitted to NMFS GARFO with sufficient time for review, comment, and approval.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
RPM 6	C, O&M, D	On-site Observation and Inspection	On-site observation and inspection must be conducted to gather information on the effectiveness and implementation of measures to minimize and monitor incidental take during activities described in this Opinion, including its Incidental Take Statement.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
T&C 1	C	Pile Driving and UXO Detonation	To implement the requirements of RPM 1 and 2, the measures required by the final MMPA ITA must be incorporated into any project authorizations/approvals, and the relevant Federal agency must monitor Ocean Wind's compliance with these measures: a. BOEM must require, through an enforceable condition of their approval of Ocean Wind's Construction and Operations Plan, that Ocean Wind comply with any measures in the final MMPA ITA that are revised from, or in addition to, measures included in the proposed ITA, which already have been incorporated into the proposed action. b. NMFS OPR must ensure that all mitigation measures as prescribed in the final ITA are implemented by Ocean Wind. c. The USACE must require, through an enforceable condition of any permit issued to Ocean Wind, compliance with any measures in the final MMPA ITA that are revised from, or in addition to, measures included in the proposed ITA, which have been incorporated into the proposed action.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
T&C 2	C	UXO Detonation	To implement the requirements of RPM 2, the following measures must be implemented by Ocean Wind: a. Establish a clearance zone for sea turtles extending 500 m around any planned UXO detonation. Maintain the clearance zone for at least 60 minutes prior to any UXO detonation. This requirement expands the size of the clearance zone identified by BOEM as part of the proposed action. Ocean Wind must ensure that there is sufficient PSO coverage to reliably document sea turtle presence within the clearance zone. In the event that a PSO detects a sea turtle outside the 500 m clearance zone, detonation will be delayed until the sea turtle has not been observed for 30 minutes. b. Provide NMFS GARFO with notification of planned UXO detonation as soon as possible but at least 48 hours prior to the planned detonation, unless this 48-hour notification would create delays to the detonation that would result in imminent risk of human life or safety. This notification must include the coordinates of the planned detonation, the estimated charge size, and any other information available on the characteristics of the UXO. NMFS GARFO will provide alerts to NMFS sea turtle and marine mammal stranding network partners consistent with best practices. Notification must be provided via email to nmfs.gar.incidental-take@noaa.gov and by phone to the NMFS GARFO Protected Resources Division (978-281-9328).	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
T&C 3	C, O&M, D	Vessel Operations	To implement the requirements of RPM 3, the following conditions must be implemented by vessels transiting to/from the Paulsboro Marine Terminal, consistent with the terms and conditions of the July 19, 2022 Paulsboro Biological Opinion and any subsequent Opinion or amended ITS: a. No later than March 1 of each year, report the number of vessel calls to the Paulsboro Marine Terminal in the previous year by month. This report must also include the type of vessel and its draft. Reports must be filed with the USACE Philadelphia District and NMFS GARFO (nmfs.gar.incidental-take@noaa.gov). (Reference: RPM 1, Term and Condition 1 of the 2022 Paulsboro Biological Opinion) b. Report any sturgeon observed with injuries or mortalities in the Paulsboro Marine Terminal Area to NMFS within 24 hours using the form available at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null. Submit forms to nmfs.gar.incidental-take@noaa.gov within 24 hours. (Reference: RPM 2, Term and Condition 2 of the 2022 Paulsboro Biological Opinion). c. Hold any dead sturgeon in cold storage until proper disposal procedures are discussed with NMFS GARFO. (Reference: RPM 3, Term and Condition 5 of the 2022 Paulsboro Biological Opinion).	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			d. Complete procedures for genetic sampling of any dead Atlantic sturgeon that are over 75 cm. (Reference RPM 4, Term and Condition 6 of the 2022 Paulsboro Biological Opinion). More information on submitting genetic samples is included in Term and Condition 6a below; these instructions are consistent with the requirements of the 2022 Paulsboro Opinion. e. In the event that the 2022 Paulsboro Opinion is replaced as a result of reinitiation, or its ITS is amended, comply with the requirements of any new Incidental Take Statement relevant to vessels transiting to/from the Paulsboro Marine Terminal. NMFS GARFO will strive to provide a copy of any new Opinions or amended ITSs to BOEM, BSEE, other action agencies, and Ocean Wind within three business days of their availability.		
T&C 4	C, O&M, D	Vessel Operations	To implement the requirements of RPM 3, the following conditions must be implemented by vessels transiting to/from the New Jersey Wind Port, consistent with the terms and conditions of the February 25, 2022 New Jersey Wind Port Biological Opinion and any subsequent Opinion or amended ITS: a. No later than March 1 of each year, report the number of vessel calls to the New Jersey Wind Terminal in the previous year by month. This report must also include the type of vessel and its draft. Reports must be filed with the USACE Philadelphia District and NMFS GARFO (nmfs.gar.incidental-take@noaa.gov). (Reference: RPM 1, Term and Condition 2 of the 2022 NJWP Biological Opinion) b. Report any sturgeon observed with injuries or mortalities in the Paulsboro Marine Terminal Area to NMFS within 24 hours using the form available at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null. Submit forms to nmfs.gar.incidental-take@noaa.gov within 24 hours. (Reference: RPM 3, Term and Condition 4 of the 2022 NJWP Biological Opinion). c. Hold any dead sturgeon in cold storage until proper disposal procedures are discussed with NMFS GARFO. (Reference: RPM 4, Term and Condition 7 of the 2022 NJWP Biological Opinion). d. Complete procedures for genetic sampling of any Atlantic sturgeon over 75 cm. (Reference: RPM 3, Term and Condition 8 of the 2022 NJWP Biological Opinion). More information on submitting genetic samples is included in Term and Condition 6a below; these instructions are consistent with the requirements of the 2022 NJWP Opinion. e. In the event that the 2022 NJWP Opinion is replaced as a result of reinitiation or its ITS is amended, comply with the requirements of any new Incidental Take Statement relevant to vessels transiting to/from the NJWP. NMFS GARFO will strive to provide a copy of any new Opinions or amended ITSs to BOEM, BSEE, other action agencies, and Ocean Wind within three business days of their availability.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
T&C 5	C	Reporting Requirements	To implement the requirements of RPM 4, Ocean Wind must file a report with NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) in the event that any ESA listed species is observed within the identified shutdown zone during active pile driving. This report must be filed within 48 hours of the incident and include the following: duration of pile driving prior to the detection of the animal, location of PSOs and any factors that impaired visibility or detection ability, time of detection of the animal, time the PSO called for shutdown, time the pile driving was stopped, and any measures implemented (e.g., reduced hammer energy) prior to shutdown. The report must also include the time that the animal was last detected and any PSO reports on the behavior of the animal. If shutdown was determined not to be feasible, the report must include an explanation for that determination and the measures that were implemented (e.g., reduced hammer energy).	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
T&C 6	C	Reporting Requirements	To implement the requirements of RPM 4, BOEM, BSEE, USACE, and Ocean Wind must implement the following reporting requirements necessary to document the amount or extent of take that occurs during all phases of the proposed action: i. All observations or collections of injured or dead whales, sea turtles, or sturgeon must be reported within 48 hours to NMFS GARFO Protected Resources Division by email (nmfs.gar.incidental-take@noaa.gov). Take reports should reference the Ocean Wind project and include the Take Report Form available on NMFS webpage (https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null). Reports of Atlantic sturgeon take must include a statement as to whether a fin clip sample for genetic sampling was taken. Fin clip samples are required in all cases with the only exception being when additional handling of the sturgeon would result in an imminent risk of injury to the fish or the PSO, we expect such incidents to be limited to capture and handling of sturgeon in extreme weather. Instructions for fin clips and associated metadata are available at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic, under the "Sturgeon Genetics Sampling" heading. ii. If a North Atlantic right whale is observed at any time by PSOs or personnel on any project vessels, during any project-related activity or during vessel transit, Ocean Wind or their contractors must immediately report sighting information to NMFS (866-755-6622), the U.S. Coast Guard via channel 16 and through the WhaleAlert app (http://www.whalealert.org/). iii. In the event of a suspected or confirmed vessel strike of a sea turtle or sturgeon by any project vessel in any location, including observation of any injured sea turtle/sturgeon or sea turtle/sturgeon parts, Ocean Wind or their contractors must report the incident to	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			NMFS GARFO (nmfs.gar.incidental-take@noaa.gov; and NMFS New England/Mid-Atlantic Regional Stranding Hotline (866-755-6622)) as soon as feasible. The report must include the following information: (A) Time, date, and location (latitude/longitude) of the incident; (B) Species identification (if known) or description of the animal(s) involved; (C) Vessel's speed during and leading up to the incident; (D) Vessel's course/heading and what operations were being conducted (if applicable); (E) Status of all sound sources in use; (F) Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike; (G) Environmental conditions (e.g., wind speed and direction, Beaufort scale, cloud cover, visibility) immediately preceding the strike; (H) Estimated size and length of animal that was struck; (I) Description of the behavior of the animal immediately preceding and following the strike; (J) Estimated fate of the animal (e.g., dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and (K) To the extent practicable, photographs or video footage of the animal(s). iv. In the event that an injured or dead marine mammal or sea turtle is sighted, Ocean Wind or their contractor must report the incident to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov), NMFS New England/Mid-Atlantic Regional Stranding Hotline (866-755-6622), and BSEE (protectedspecies@bsee.gov) as soon as feasible, but no later than 24 hours from the sighting. The report must include the following information: (A) Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable); (B) Species identification (if known) or description of the animal(s) involved; (C) Condition of the animal(s) (including carcass condition if the animal is dead); (D) Observed behaviors of the animal(s), if alive; (E) If available, photographs or video footage of the animal(s); and (F) General circumstances under which the animal was discovered. Staff responding to the hotline call will provide any instructions for handling or disposing of any injured or dead animals, which may include coordination of transport to shore, particularly for injured sea turtles. v. Ocean Wind must compile and submit weekly reports during pile driving that document the start and stop of all pile driving daily, the start and stop of associated observation periods by the PSOs, details on the deployment of PSOs, and a record of all observations of marine mammals and sea turtles. These weekly reports must be submitted to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov), BOEM, and BSEE directly from the PSO providers and can consist of raw data. Weekly reports are due on Wednesday for the previous week (Sunday – Saturday). vi. Ocean Wind must compile and submit reports following any UXO detonation that provide details on the UXO that was detonated (e.g., charge size), location of the detonation, the start and stop of associated observation periods by the PSOs, details on the deployment of PSOs, and a record of all observations of marine mammals and sea turtles. This must include any observations of dead or injured fish or other marine life in the post detonation monitoring period. These reports must be submitted to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and BOEM directly from the PSO providers and can consist of raw data. Reports must be submitted within one week of the detonation, with reports of dead or injured ESA listed species required to be submitted immediately, but no later than 24 hours following the observation. vii. Ocean Wind must compile and submit monthly reports that include a summary of all project activities carried out in the previous month, including trawl surveys, vessel transits (number, type of vessel, and route), and piles installed, and all observations of ESA listed whales, sea turtles, and sturgeon. These reports must be submitted to NMFS GARFO (nmfs.gar.incidental-take@Noaa.gov) and are due on the 15th of the month for the previous month.		
T&C 7	O&M	BOEM/NMFS meeting requirements for sea turtle take documentation	To implement the requirements of RPM 4 and to facilitate monitoring of the incidental take exemption for sea turtles, BOEM, BSEE, USACE, and NMFS must meet twice annually to review sea turtle observation records. These meetings/conference calls will be held in September (to review observations through August of that year) and December (to review observations from September to November) and will use the best available information on sea turtle presence, distribution, and abundance, project vessel activity, and observations to estimate the total number of sea turtle vessel strikes in the action area that are attributable to project operations.	Sea Turtles	BOEM, BSEE, and NMFS
T&C 8	C	Review of Plans	To implement RPM 5, within 10 business days of BSEE issuing a no objection to the complete Facility Design Report (FDR)/Fabrication and Installation Report (FIR) (but at least 30 calendar days prior to the initiation of pile driving) or the soonest time the relevant information is available, BOEM and/or BSEE must provide NMFS GARFO with the following information: number and size of foundations to be installed to support wind turbine generators and offshore substations, installation method for each of the seven planned cofferdams (i.e., gravity cell or sheet pile), the proposed construction schedule (i.e., months when pile driving is planned), and information that has become available on the ports identified for foundation fabrication and load out, WTG preassembly and load out, and cable staging. If at that time the amount or extent of incidental take is likely to exceed the maximum amount for each source and type of take considered in this ITS, consultation may need to be reinitiated. NMFS and BOEM will each endeavor to notify the other of the need to reinitiate consultation within 30 calendar days of BOEM's submission to NMFS, and NMFS' receipt, of the requested information.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
T&C 9	C	Review of Plans	To implement RPM 5, BOEM, BSEE and/or Ocean Wind must submit the PSO Training Plan for Trawl Surveys as soon as possible after issuance of this Opinion but no later than 7 calendar days prior to the start of trawl surveys. BOEM, BSEE, and Ocean Wind must obtain NMFS GARFO's concurrence with this plan prior to the start of any trawl surveys. As described in Table 3.1.1, at least one of the survey staff onboard the trawl survey vessels must have completed NMFS Northeast Fisheries Observer Program training within the last 5 years or other training in protected species identification and safe handling (inclusive of taking genetic samples from Atlantic sturgeon). If Ocean Wind will deploy non-NEFOP trained observers, BOEM, BSEE, and/or Ocean Wind must submit a plan to NMFS describing the training that will be provided to the survey observers.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
T&C 10	C	Review of Plans	To implement RPM 5, the plans identified below must be submitted to NMFS GARFO by BOEM, BSEE and/or Ocean Wind at nmfs.gar.incidental-take@noaa.gov. For each plan, within 45 calendar days of receipt of the plan, NMFS GARFO will provide comments to BOEM, BSEE, and Ocean Wind, including a determination as to whether the plan is consistent with the requirements outlined in this ITS and/or in Table 3.3.1 of this Opinion. If the plan is determined to be inconsistent with these requirements, BOEM, BSEE and/or Ocean Wind must resubmit a modified plan that addresses the identified issues at least 15 calendar days before the start of the associated activity; at that time, BOEM, BSEE and NMFS will discuss a timeline for review and approval of the modified plan. BOEM, BSEE and Ocean Wind must receive NMFS GARFO's concurrence with these plans before the identified activity is carried out: a. Passive Acoustic Monitoring Plan. BOEM, BSEE and/or Ocean Wind must submit this Plan to NMFS GARFO at least 180 calendar days before impact pile driving is planned. BOEM, BSEE, and Ocean Wind must obtain NMFS GARFO's concurrence with this plan prior to the start of any pile driving. The Plan must include a description of all proposed PAM equipment, address how the proposed passive acoustic monitoring will follow standardized measurement, processing methods, reporting metrics, and metadata standards for offshore wind (Van Parijs et al., 2021). The plan must describe all proposed PAM equipment, procedures, and protocols including information to support that it will be able to detect vocalizing right whales within the clearance and shutdown zones. The plan must also incorporate the following requirements: If a North Atlantic right whale (NARW) is detected via real-time PAM, data shall be submitted by BOEM, BSEE and/or Ocean Wind to nmfs.pacmdata@noaa.gov using the NMFS Passive Acoustic Reporting System Metadata and Detection data spreadsheets (https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reportingsystem-templates as soon as feasible but no longer than 24 hours after the detection. BOEM, BSEE, and/or Ocean Wind must submit the completed data templates to nmfs.pacmdata@noaa.gov; the full acoustic species Detection data, Metadata and GPS data records, from real-time data, must be submitted within 90 calendar days via the ISO standard metadata forms available on the NMFS Passive Acoustic Reporting System website (https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reportingsystem-templates). BOEM, BSEE, and/or Ocean Wind must submit the completed data templates to nmfs.pacmdata@noaa.gov; the full acoustic recordings from real-time systems must be sent to NCEI for archiving within 90 calendar days after pile-driving has ended and instruments have been pulled from the water. b. Marine Mammal and Sea Turtle Monitoring Plan – Pile Driving and UXO Detonation. BOEM, BSEE, and/or Ocean Wind must submit this Plan to NMFS GARFO at least 90 calendar days before impact or vibratory pile driving or UXO detonation is planned. BOEM, BSEE, and/or Ocean Wind must obtain NMFS GARFO's concurrence with this plan prior to the start of any pile driving or carrying out any UXO detonation. The plan must include a description of all monitoring equipment and PSO protocols (including number and location of PSOs) for all pile driving and UXO detonations. The plan must detail all plans and procedures for sound attenuation as well as for monitoring ESA-listed whales and sea turtles during all impact and vibratory pile driving and UXO detonation. The plan would also describe how BOEM, BSEE, and Ocean Wind would determine the number of whales exposed to noise above the Level B harassment threshold during pile driving with the vibratory hammer to install cofferdams. c. Cofferdam Installation and Removal Monitoring Plan. BOEM, BSEE, and/or Ocean Wind must submit this Plan to NMFS GARFO at least 90 calendar days before vibratory pile driving is planned to begin. BOEM, BSEE, and Ocean Wind must obtain NMFS GARFO's concurrence with this plan prior to the start of any pile driving or the start of any cofferdam installation or removal with a vibratory hammer. This plan must include a description of how BOEM, BSEE, and Ocean Wind would determine the number of whales exposed to noise above the Level B harassment threshold during pile installation and removal with the vibratory hammer. This plan may be stand-alone or a component of the Pile Driving and Marine Mammal and Sea Turtle Monitoring Plan. d. Alternative Monitoring Plan/Night Time Pile Driving Monitoring Plan. BOEM, BSEE, and/or Ocean Wind must submit this Plan to NMFS GARFO at least 90 calendar days before impact pile driving is planned to begin. BOEM, BSEE, and Ocean Wind must obtain NMFS GARFO's concurrence with this plan prior to the start of pile driving. This plan must contain a thorough description of how Ocean Wind plans to monitor pile driving activities at night including proof of the efficacy of their night vision devices (e.g., mounted thermal/IR camera systems, hand-held or wearable night vision devices (NVDs), infrared (IR) spotlights) in detecting ESA listed marine mammals and sea turtles over the full extent of the required clearance and shutdown zones, including demonstration that the full extent of the minimum visibility zones (1,650 m May-November, 2,500 m December) can be effectively and reliably monitored. The	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			Plan must identify the efficacy of the technology at detecting marine mammals and sea turtles in the clearance and shutdowns under all the various conditions anticipated during construction, including varying weather conditions, sea states, and in consideration of the use of artificial lighting. If the plan does not include a full description of the proposed technology, monitoring methodology, and data demonstrating to NMFS GARFO's satisfaction that marine mammals and sea turtles can reliably and effectively be detected within the clearance and shutdown zones for monopiles and pin piles before and during impact pile driving, nighttime pile driving (unless a pile was initiated 1.5 hours prior to civil sunset) may not occur. e. Sound Field Verification Plan. BOEM, BSEE, and/or Ocean Wind must submit to NMFS GARFO at least 180 calendar days before impact pile driving or UXO detonation is planned to begin. BOEM, BSEE, and Ocean Wind must obtain NMFS GARFO's concurrence with this plan prior to the start of pile driving or UXO detonation activities. The plan must describe how Ocean Wind would ensure that the first three monopile and pin pile installation sites and each UXO/MEC detonation site selected for SFV are representative of the rest of the monopile and pin pile installation and UXO/MEC sites. In the case that these sites are not determined to be representative of all other monopile and pin pile installation sites and UXO/MEC detonation locations, Ocean Wind must include information on how additional sites would be selected for SFV. The plan must also include methodology for collecting, analyzing, and preparing SFV data for submission to NMFS GARFO. The plan must describe how the effectiveness of the sound attenuation methodology would be evaluated based on the results. Ocean Wind must also provide, as soon as they are available but no later than 48 hours after each installation, the initial results of the SFV measurements to NMFS GARFO in an interim report after each monopile for the first 3 piles and pin pile installation for the first full jacket foundation (16 pin piles). f. North Atlantic Right Whale Vessel Strike Avoidance Plan. BOEM, BSEE, and/or Ocean Wind must submit to NMFS GARFO at least 90 calendar days prior to commencement of vessel use, with the exception of vessels deployed for the fisheries surveys. The plan must provide details on the vessel-based observer protocols on transiting vessels. If Ocean Wind plans to implement the Alternative Plan for vessel strike avoidance (i.e., implement PAM in the Atlantic City to lease area transit lane to allow vessel transit above 10 knots from May 1 – October 31) the plan must describe how PAM, in combination with visual observations, will be conducted to ensure the transit corridor is clear of North Atlantic right whales. Consistent with the requirements of the proposed MMPA ITA, unless and until the Plan is approved by NMFS (OPR and GARFO), all vessels transiting between the O&M facility and the lease area, year round, must comply with the 10-knot speed restriction.		
T&C 11	C, O&M, D	On-site Observation and Inspection	To implement the requirements of RPM 6, BOEM and BSEE must exercise their authorities to assess the implementation of measures to minimize and monitor incidental take of ESA-listed species during activities described in this Opinion. If any term and condition(s) is/are not being complied with, BOEM and/or BSEE, as appropriate, must immediately take effective action to ensure prompt implementation.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
T&C 12	C, O&M, D	On-site Observation and Inspection	To implement the requirements of RPM 6, Ocean Wind must consent to on-site observation and inspections by Federal agency personnel (including NOAA personnel) during activities described in the Biological Opinion, for the purposes of evaluating the effectiveness and implementation of measures designed to minimize or monitor incidental take.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
Conservation Measures and Reasonable and Prudent Measures and Terms and Conditions from the USFWS Biological Opinion Issued May 12, 2023					
Conservation Measures					
1	Project design, O&M	Turbine Configuration	Turbine Configuration: a. The WTG design provides a wind turbine air gap (minimum blade tip elevation to the sea surface) to minimize collision risk to marine birds (e.g., roseate terns) that may fly close to the ocean surface (BA Table 2-2, Measure BIRD-06). b. To minimize attracting birds (e.g., roseate terns) to operating turbines, Ocean Wind must install bird perching-deterrent devices where such devices can be safely deployed on WTGs and OSSs (BA Table 2-3, Measure 3a). Ocean Wind must submit for BOEM and Service approval a plan to deter perching on offshore infrastructure by roseate terns and other marine birds. The plan must include the type(s) and locations of bird perching-deterrent devices, include a maintenance plan for the life of the project, allow for modifications and updates as new information and technology become available, and track the efficacy of the deterrents. The plan will be based on best available science regarding the effectiveness of perching deterrent devices on minimizing collision risk. The location of bird-deterrent devices must be proposed by Ocean Wind based on best management practices applicable to the appropriate operation and safe installation of the devices. Ocean Wind must confirm the locations of bird perching-deterrent devices as part of the documentation it must submit with the Facility Design Report. (BA Table 2-3, Measure 3a).	Birds	BOEM, BSEE, and USFWS
2	O&M	Offshore Lighting	To aid safe navigation, Ocean Wind must comply with all Federal Aviation Administration (FAA), U.S. Coast Guard (USCG), and BOEM lighting, marking and signage requirements. Ocean Wind will comply with all applicable requirements while minimizing impacts through appropriate application, including directional aviation lights, that minimize visibility from shore. (BA Table 2-2, Measure GEN-07).	Birds	BOEM, BSEE, and USFWS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			a. Ocean Wind will use lighting technology that minimizes impacts on avian species to the extent practicable (BA Table 2-2, Measure BIRD-04). b. Ocean Wind will implement an aircraft detection lighting system (ADLS) on WTGs (BA Table 2-2, Measure GEN-07). Ocean Wind must use an FAA-approved vendor for the ADLS, which will activate the FAA hazard lighting only when an aircraft is in the vicinity of the wind facility to reduce visual impacts at night. Ocean Wind must confirm the use of an FAA-approved vendor for ADLS on WTGs and OSSs in the Fabrication and Installation Report. (BA Table 2-3, Measure 3b). c. Ocean Wind is required to light each WTG and OSS in a manner that is visible by mariners in a 360-degree arc around the structure. To minimize the potential of attracting migratory birds, the top of each USCG-required marine navigation light will be shielded to minimize upward illumination (conditional on USCG approval). (BA Table 2-3, Measure 3c). Coordination with USCG regarding maritime navigation lighting occurs post-COP approval, generally at least 120 calendar days prior to installation. The Service will be afforded an opportunity to review a copy of Ocean Wind's application to USCG to establish Private Aids to Navigation (PATON), which includes a lighting, marking, and signaling plan. The PATON application will include design specifications for maritime navigation lighting. Following approval of the PATON by the USCG, BOEM and the Service will work together to evaluate the USCG-approved navigation lighting system, in order to characterize the color, intensity, and duration of any light from maritime lanterns that is likely to reach the typical flight heights of listed birds, and will assess the degree to which the light is likely to attract or disorient listed birds. This information will be considered, as appropriate, in future estimates of project collision levels (see Conservation Measure 4, below), in any future updates to the incidental take statement accompanying this BO, and in future iterations of the Compensatory Mitigation Plan (see Conservation Measure 7, below).		
3	O&M	Collision Risk Model Support	BOEM has funded the development of a Stochastic Collision Risk Assessment for Movement (SCRAM), which builds on and improves earlier collision risk modeling frameworks. The Service fully supports SCRAM as a scientifically sound method for integrating best available information to assess collision risk for the three listed bird species. The first generation of SCRAM was released in early 2023 and still reflects a number of consequential data gaps and uncertainties. BOEM has already committed to funding Phase 2 of the development of SCRAM. We expect that the current limitations of SCRAM will decrease substantially over time as more and more tracking data get incorporated into the model (e.g., from more individual birds tagged in more geographic areas, improved bird tracking capabilities, and emerging tracking technologies), and as modeling methods and computing power continue to improve. Via this Conservation Measure, 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. This commitment is subject to the allocation of sufficient funds to BOEM from Congress. This commitment will remain in effect until one of the following occurs: i. the OW1 turbines cease operation; ii. the Service concurs that a robust weight of evidence has demonstrated that collision risks to all three listed birds from OW1 turbine operation are negligible (i.e., the risk of take from WTG operation is found to be discountable); or iii. the Service concurs that further development of SCRAM (or its successor) is unlikely to improve the accuracy or robustness of collision mortality estimates.	Birds	BOEM, BSEE, and USFWS
4	O&M	Collision Risk Model Utilization	BOEM will work cooperatively with the Service to re-run the SCRAM model (or its successor) for the OW1 project according to the following schedule: • At least annually for the first 3 years of WTG operation. • At least every other year for years 4 to 10 of WTG operation (i.e., years 4, 6, 8, and 10). • At least every 5 years between year 10 and the termination of WTG operation (i.e., years 15, 20, 25, and 30). Between these regularly scheduled model runs, BOEM will also re-run the SCRAM model (or its successor) within 90 days of each major model release or update, and at any time upon request by the Service or Ocean Wind, and at any time as desired by BOEM. Prior to each model run, BOEM and the Service will reach agreement on model inputs based on best available science, and the agencies may opt for multiple model runs using a range of inputs to reflect uncertainties in the inputs. The above schedule may be altered upon the mutual agreement of BOEM and the Service. The schedule is subject to sufficient allocation of funds to BOEM from Congress. This commitment will remain in effect until one of the following occurs: i. the OW1 turbines cease operation; ii. the Service concurs that a robust weight of evidence has demonstrated that collision risks to all three listed birds from OW1 turbine operation are negligible (i.e., the risk of take from WTG operation is found to be discountable); or iii. the Service concurs that further model runs are unlikely to improve the accuracy or robustness of collision mortality estimates.	Birds	BOEM, BSEE, and USFWS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			BOEM is currently undertaking a programmatic analysis of proposed offshore wind activities in the New York Bight, including activity on leases contiguous with Ocean Wind's Lease OCS-A 0498. To account for potential additive and synergistic effects of offshore wind infrastructure buildout across this section of the coast, BOEM will consider collision mortality estimates for OW1 in its assessment of overall collision risk for the New York Bight. The periodic updating of collision mortality estimates for OW1, according to the above schedule, may eventually be integrated into a regional or coastwide adaptive monitoring and impact minimization framework.		
5	C, O&M, D	Monitoring and Data Collection	An avian species monitoring plan for ESA-listed species and/or other priority species or groups will be developed and coordinated with the New Jersey Department of Environmental Protection (NJDEP) and the Service and implemented as required (BA Table 2-2, Measure BIRD-02 and Appendix B). BOEM will require that Ocean Wind develops and implements an Avian and Bat Post-Construction Monitoring Plan based on the Avian and Bat Post-Construction Monitoring Framework (COP Appendix AB) in coordination with the Service, NJDEP, and other relevant regulatory agencies. Annual monitoring reports will be used to determine the need for adjustments to monitoring approaches, consideration of new monitoring technologies, and/or additional periods of monitoring. (BA Table 2-3, Measure 5) Prior to or concurrent with offshore construction activities, Ocean Wind must submit an Avian and Bat Post-Construction Monitoring Plan for BOEM and Service review. BOEM and the Service will review the Avian and Bat Post-Construction Monitoring Plan and provide any comments on the plan within 30 calendar days of its submittal. Ocean Wind must resolve all comments on the Avian and Bat Post-Construction Monitoring Plan to the satisfaction of BOEM and the Service before implementing the plan (BA Table 2-3, Measure 5) and prior to the start of WTG operations. The objectives of the monitoring plan will be: (1) to advance understanding of how the target species utilize the offshore airspace and do (or do not) interact with the wind farm; (2) to improve the collision estimates from SCRAM (or its successor) for the three listed bird species; and (3) to inform any efforts aimed at minimizing collisions (see Conservation Measure 7, below) or other project effects on target species. a. Monitoring. Ocean Wind must conduct monitoring as outlined in the Avian and Bat Post-Construction Monitoring Framework (COP Appendix AB), which will include . . . use of radio-tags to monitor movement of ESA-listed birds in the vicinity of the project (BA Table 2-3, Measure 5). The Avian and Bat Post-Construction Monitoring Plan will allow for changing methods over time (see Conservation Measure 5.d, below) in order to regularly update and refine collision estimates for listed birds. The plan will include an initial monitoring phase involving deployment of Motus Wildlife Tracking System (Motus) radio tags on listed birds in conjunction with installation and operation of Motus receiving stations on turbines in the Lease Area following offshore Motus recommendations. The initial phase may also include deployment of satellite-based tracking technologies (e.g., GPS or Argos tags). b. Annual Monitoring Reports. Ocean Wind must submit to BOEM (at renewable_reporting@boem.gov), the Service, and the Bureau of Safety and Environmental Enforcement (BSEE) (at OSWSubmittals@bsee.gov) a comprehensive report after each full year of monitoring (pre- and post-construction) within 12 months of completion of the last avian survey. The report must include all data, analyses, and summaries regarding ESA-listed and non-ESA-listed birds and bats. BOEM, the Service, and BSEE will use the annual monitoring reports to assess the need for reasonable revisions (based on subject matter expert analysis) to the Avian and Bat Post-Construction Monitoring Plan. BOEM, BSEE, and the Service reserve the right to require reasonable revisions to the Avian and Bat Post-Construction Monitoring Plan and may require new technologies as they become available for use in offshore environments. (BA Table 2-3, Measure 5) (see Conservation Measure 5.d, below). c. Post-Construction Quarterly Progress Reports. Ocean Wind must submit quarterly progress reports during the implementation of the Avian and Bat Post-Construction Monitoring Plan to BOEM (at renewable_reporting@boem.gov) and the Service by the 15th day of the month following the end of each quarter during the first full year that the Project is operational. The progress reports must include a summary of all work performed, an explanation of overall progress, and any technical problems encountered. (BA Table 2-3, Measure 5). d. Monitoring Plan Revisions. Within 30 calendar days of submitting the annual monitoring report (pursuant to Conservation Measure 5.b, above), Ocean Wind must meet with BOEM, BSEE, the Service, and NJDEP to discuss the following: the monitoring results; the potential need for revisions to the Avian and Bat Post-Construction Monitoring Plan, including technical refinements or additional monitoring; and the potential need for any additional efforts to reduce impacts. If, based on this annual review meeting, BOEM and the Service jointly determine that revisions to the Avian and Bat Post-Construction Monitoring Plan are necessary, BOEM will require Ocean Wind to modify the Avian and Bat Post-Construction Monitoring Plan. If the projected collision levels, as informed by monitoring results, deviate substantially from the effects analysis included in this BO, Ocean Wind must transmit to BOEM recommendations for new mitigation measures and/or monitoring methods. (BA Table 2-3, Measure 5). The frequency, duration, and methods for various monitoring efforts in future revisions of the Avian and Bat Post-Construction Monitoring Plan will be determined adaptively based on current technology and the evolving weight of evidence regarding the likely levels of collision mortality for each	Birds	BOEM, BSEE, and USFWS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			listed bird species. The effectiveness and cost of various technologies/methods will be key considerations when revising the plan. Grounds for revising the Avian and Bat Post-Construction Monitoring Plan include, but are not limited to: (i) greater than expected levels of collision of listed birds; (ii) evolving data input needs (as determined by BOEM and the Service) for SCRAM (or its successor); (iii) changing technologies for tracking or otherwise monitoring listed birds in the offshore environment that are relevant to assessing collision risk; (iv) new information or understanding of how listed birds utilize the offshore environment and/or interact with wind farms; and (v) a need (as determined by BOEM and the Service) for enhanced coordination and alignment of tracking, monitoring, and other data collection efforts for listed birds across multiple wind farms/leases on the OCS. BOEM will require Ocean Wind to continue implementation of appropriate monitoring activities for listed birds (under the current and future versions of the Avian and Bat Post-Construction Monitoring Plan) until one of the following occurs: (i) the OW1 turbines cease operation; (ii) the Service concurs that a robust weight of evidence has demonstrated that collision risks to all three listed birds from OW1 turbine operation are negligible (i.e., the risk of take from WTG operation is found to be discountable); or (iii) the Service concurs that further data collection is unlikely to improve the accuracy or robustness of collision mortality estimates and is unlikely to improve the ability of BOEM and Ocean Wind to reduce or offset collision mortality (see Conservation Measure 7, below). e. Operational Reporting (Operations). Ocean Wind must submit to BOEM (at renewable_reporting@boem.gov) and BSEE (at OSWSubmittals@bsee.gov) an annual report summarizing monthly operational data calculated from 10-minute supervisory control and data acquisition (SCADA) data for all turbines together in tabular format: the proportion of time the turbines were actually spinning each month, the average rotor speed (monthly revolutions per minute [rpm]) of spinning turbines plus 1 standard deviation, and the average pitch angle of blades (degrees relative to rotor plane) plus 1 standard deviation. BOEM and BSEE will use this information as inputs for avian collision risk models to assess whether the results deviate substantially from the effects analysis included in this BO. (BA Table 2-3, Measure 5). f. Raw Data. Ocean Wind must store the raw data from all avian and bat surveys and monitoring activities according to accepted archiving practices. Such data must remain accessible to BOEM, BSEE and the Service, upon request for the duration of the lease. Ocean Wind must work with BOEM to ensure the data are publicly available. (BA Table 2-3, Measure 5). All avian tracking data (i.e., from radio and satellite transmitters) will be stored, managed, and made available to BOEM and the Service following the protocols and procedures outlined in the agency document entitled *Guidance for Coordination of Data from Avian Tracking Studies*, or its successor.		
6	C, O&M, D	Incidental Mortality Reporting	Ocean Wind must provide an annual report to BOEM and the Service documenting any dead (or injured) birds or bats found on vessels and structures or in the ocean during construction, operations, and decommissioning. The report must contain the following information: the name of species (if possible), date found, location, a picture to confirm species identity (if possible), and any other relevant information. Carcasses with federal or research bands must be reported to the United States Geological Survey's (USGS) Bird Banding Laboratory (BBL). Any occurrence of a dead ESA-listed bird or bat must be reported to BOEM, BSEE, and the Service as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours after the sighting, and, if practicable, the dead specimen will be carefully collected and preserved in the best possible state, contingent on the acquisition of any necessary wildlife permits and compliance with Ocean Wind 1 health and safety standards. (BA Table 2-3, Measure 6).	Birds	BOEM, BSEE, and USFWS
7	Pre-O&M and O&M	Compensatory Mitigation	To minimize population-level effects on listed birds, BOEM will require Ocean Wind to provide appropriate compensatory mitigation as needed to offset projected levels of take of listed birds from WTG collision. Compensatory mitigation will be consistent with the conservation needs of listed species as identified in Service documents including, but not limited to, listing documents, Species Status Assessments, Recovery Plans, Recovery Implementation Strategies (RISs), and 5-Year Reviews. Compensatory mitigation will preferentially address priority actions, activities, or tasks identified in a Recovery Plan, RIS, or 5-Year Review, for each of the listed bird species; however, research, monitoring, outreach, and other recovery efforts that do not materially offset birds lost to collision mortality will not be considered compensatory mitigation. Compensatory mitigation may include, but is not limited to: restoration or management of lands, waters, sediment, vegetation, or prey species to improve habitat quality or quantity for listed birds; efforts to facilitate habitat migration or otherwise adapt to sea level rise; predator management; management of human activities to reduce disturbance to listed birds; and efforts to curtail other sources of direct human-caused bird mortality such as from vehicles, collision with other structures (e.g., power lines, terrestrial wind turbines), hunting, oil spills, and harmful algal blooms. Geographic considerations may include, but are not limited to: (a) any listed species recovery unit(s) or other management unit(s) determined to be disproportionally affected by or vulnerable to collision mortality; and/or (b) those portions of a species' range where compensatory mitigation is most likely to be effective in offsetting collision mortality. Compensatory mitigation for OW1 may be combined with mitigation associated with other offshore wind projects, but in no case will compensatory mitigation be double counted as applying to more than one offshore wind project. BOEM will require Ocean Wind to prepare a Compensatory Mitigation Plan prior to the start of WTG operation. At a minimum, the Plan will provide compensatory mitigation actions to offset projected levels of take of listed birds for the first 5 years of WTG operation at a ratio	Birds	BOEM, BSEE, and USFWS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
			of 1:1. At its discretion, Ocean Wind may include actions to offset projected take over a longer time period and/or at a higher ratio. The Plan will include: a) detailed description of one or more specific mitigation actions; b) the specific location for each action; c) a timeline for completion; d) itemized costs; e) a list of necessary permits, approvals, and permissions; f) details of the mitigation mechanism (e.g., mitigation agreement, applicant-proposed mitigation); g) best available science linking the compensatory mitigation action(s) to the projected level of collision mortality as described in this BO; h) a schedule for completion; and i) monitoring to ensure the effectiveness of the action(s) in offsetting the target level of take. Plan development and implementation will occur according to the following schedule: • At least 180 days before the start of WTG operation Ocean Wind will distribute a draft Plan to BOEM, the Service, the NJDEP, and other identified stakeholders or interested parties for a 60-day review period. • At least 90 days before the start of WTG operation, Ocean Wind will transmit a revised Plan for approval by BOEM and the Service, along with a record of comments received on the draft. Ocean Wind will rectify any outstanding agency comments or concerns before final approval by BOEM and the Service. • Before or concurrent with the start of WTG operation, Ocean Wind will provide documentation to BOEM and the Service showing financial, legal, or other binding commitment(s) to Plan implementation. BOEM will require Ocean Wind to prepare and implement a new Plan every 5 years for the life of the project, according to a schedule developed by BOEM and approved by the Service. Compensatory mitigation actions included in each new Plan will reflect: a) the level and effectiveness of mitigation previously provided by Ocean Wind, to date; b) the level of take over the next 5 years as projected by SCRAM (or its successor) (see Conservation Measure 4); c) current information regarding any effects of offshore lighting (see Conservation Measure 2); and d) the effectiveness of any minimization measures that have been implemented as required by the reasonable and prudent measures included in this BO.		
Reasonable and Prudent Measures and Terms and Conditions					
1	Pre-O&M and O&M	Collision Minimization Report	Periodically review current technologies and methods for minimizing collision risk of listed birds. a) Prior to the start of WTG operations at OW1, BOEM must extract from existing project documentation (e.g., the BA, other consultation documents, the final Environmental Impact Statement, the COP) a stand-alone summary of technologies and methods that were evaluated by BOEM to reduce or minimize bird collisions at the OW1 WTGs. b) Within 5 years of the start of WTG operation, and then every 5 years for the life of the project, BOEM must prepare a Collision Minimization Report, reviewing best available scientific and commercial data on technologies and methods that have been implemented, or are being studied, to reduce or minimize bird collisions at WTGs. The review must be global in scope and include both offshore and onshore WTGs. c) BOEM must distribute a draft Collision Minimization Report to the Service, Ocean Wind, NJDEP, and NJBPU for a 60-day review period. BOEM must address all comments received during the review period, and issue the final report within 60 days of the close of the review period. d) Within 60 days of issuing the final Collision Minimization Report, BOEM must convene a meeting with the Service and Ocean Wind. Meeting participants will discuss the report and seek consensus on whether implementation of any technologies/methods are reasonable and prudent. However, if consensus cannot be reached, the Service will make the final determination of whether any minimization measures are reasonable and prudent (i.e., necessary or appropriate to minimize the amount or extent of incidental take), after considering input from BOEM, Ocean Wind, the NJDEP, and the NJBPU.	Birds	BOEM, BSEE, and USFWS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-2. Description of Mitigation and Monitoring Measures Resulting from Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[2]
2	O&M	Implementation of Collision Minimization Technologies/Methods	Implement those technologies and methods deemed reasonable and prudent. a) BOEM will require Ocean Wind to adopt and deploy such minimization technologies/methods as deemed reasonable and prudent. BOEM will specify the Service-approved timeframe in which any required minimization measure(s) must be implemented, as well as any requirements to monitor, maintain, or adapt the measure(s) over time. b) BOEM will require Ocean Wind to provide periodic reporting on the implementation of any minimization measure(s) according to a schedule developed by BOEM and approved by the Service.	Birds	BOEM, BSEE, and USFWS

Table H-3 Additional Mitigation and Monitoring Measures

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[4]
Radar Systems Mitigations Resulting from NOAA IOOS Reviews					
2	O&M	Mitigation for oceanographic high frequency radars	BOEM will require that Ocean Wind coordinates with the radar operators and the Surface Currents Program of NOAA Integrated Ocean Observing System (IOOS) Office to assess if the Project causes radar interference to the degree that radar performance is no longer within the specified radar system's operation parameters or fails to meet mission objectives. If either is the case, the lessee must notify BOEM, make publicly available via NOAA IOOS the near real-time accurate numerical telemetry of surface current velocity, wave height, wave period, wave direction, and other oceanographic data measured at Project locations selected by the Lessee in coordination with the affected radar operators and the NOAA IOOS Surface Currents Program; and, if requested by the affected radar operators or the NOAA IOOS Surface Currents Program, share with them accurate numerical time-series data of blade rotation rates, nacelle bearing angles, and other information about the operational state of each turbine in the wind development area to aid interference mitigation.	Other Uses – Radar	BOEM and BSEE
NMFS-proposed Measures					
1	C, O&M	Vessel speed restriction	All vessels, regardless of size, would comply with a 10-knot speed restriction in any SMA, DMA, or Slow Zone.	Marine Mammals, Sea Turtles	BOEM and BSEE
2	C, O&M	Recreational fishing	The lessee shall develop a construction schedule that minimizes overlap with recreational fishing tournaments and other important seasonal recreational fishing events.	Recreation and Tourism	BOEM, BSEE, USACE, and NJDEP
3	C	Anadromous fish time of year restriction	Avoid construction activities during anadromous fish migration and spawning activity from March 1 through June 30 of each year within Barnegat Bay.	Finfish	USACE and NJDEP
NPS-proposed Measures					
1	C, O&M	Adopt sustainable lighting practices	Adopt NPS-recommended sustainable lighting practices for outdoor lighting at onshore facilities (e.g., onshore substation and O&M facility). Sustainable outdoor lighting specifications include use of LEDs in warm colors, recessed and fully shielded lights, fixtures that include timers, motion detectors, hue adaptors, and dimmers, reducing light intensity, and proper installation of lights (see https://www.nps.gov/subjects/nightskies/sustainable-outdoor-lighting.htm).	Scenic and Visual	BOEM, BSEE, and NJDEP
NJDEP-proposed Measures					
1	C	Revegetation	Areas of temporary disturbance on Island Beach State Park should be re-seeded or replanted with species native to New Jersey barrier islands, efforts to reduce soil erosion and sediment control should not include application of fertilizer or lime, and only native vegetation should be allowed to become re-established in other disturbed areas.	Coastal Habitat and Fauna	NJDEP
2	C	Vibration monitoring/structure monitoring	Vibration monitoring/structure monitoring be implemented for the onshore construction activities including but not limited to infrastructure, bridges, businesses, homes, and drainage structure.	Land Use and Coastal Infrastructure	NJDEP
NYSDOS-proposed Measures					
1	C	Cable protection	Avoid the use of concrete mattresses as cable protection (in all areas, but most critically within sand ridge/trough habitat features and the NJ to NY Connector Fairway) to the extent possible.	Benthic Resources	BOEM, BSEE, USACE, and NJDEP
2	C	Navigation safety plan	BOEM and BSEE would ensure that Ocean Wind coordinates with the U.S. Coast Guard in advance of export cable installation to develop a navigation safety plan, which may include: establishing a safety zone around the cable laying vessel(s); monitoring plan; mitigation plan; schedule; private aids to navigation; and, local notice to mariners.	Navigation and Vessel Traffic	BOEM and BSEE
3	O&M	Cable maintenance plan	BOEM and BSEE would ensure that Ocean Wind develops a cable maintenance and monitoring plan that outlines a process for identifying when cable burial depths reach unacceptable risks, requires prompt remediation of exposed and shallow-buried cable segments, and includes review to address repeat exposures. The cable maintenance and monitoring plan would also describe methods for providing an accessible graphic/geo-referenced repository of locations where target burial depths were not achieved and/or cable protection was installed, and mariner notification for monitoring and remedial burial activities.	Navigation and Vessel Traffic	BOEM and BSEE
4	Pre-C, C, O&M	Mariner Communication and Outreach Plan	Develop and implement a Mariner Communication and Outreach Plan that covers all project phases from pre-construction to decommissioning. There is a proposed fisheries outreach plan (See ID CFHFISH-02), and this should be expanded to include	Navigation and Vessel Traffic	BOEM and BSEE

[4] Enforcement by BOEM and BSEE will be conducted in accordance with Reorganization of Title 30 – Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf final rule, 88 *Federal Register* 6376.

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[4]
			coordination with other mariners, including the commercial shipping industry and other recreational users who would also benefit from this coordination and may not be captured in the currently proposed fisheries plan.		
BOEM-proposed Measure					
1	Pre-C, C, O&M, D	Coordination with federally recognized tribal nations	No later than 90 calendar days after COP approval, the Lessee would contact the federally recognized tribal nations in government-to-government consultations with BOEM for the Project in order to solicit their interest in participating as active monitors on board vessels during construction and/or maintenance activities, participate in postmortem examinations of mortality events as a result of these activities, or have open access to the following: reports generated as a result of the Fisheries Monitoring Plan; reports of NARW sightings; injured or dead protected species reporting (sea turtles and NARW); NARW PAM monitoring; PSO reports (e.g., pile-driving reports); pile driving schedules and changes to them. At a minimum, the Lessee must offer access to the following federally recognized tribal nations: Delaware Nation; Delaware Tribe of Indians; Stockbridge-Munsee Community Band of Mohican Indians; and Wampanoag Tribe of Gay Head (Aquinnah). The Lessee must provide, in a manner suitable to the tribal nations, access to non-proprietary, non-confidential business information to any federally recognized tribal nation no later than 30 days after the information becomes available.	Cultural Resources	BOEM and BSEE
2	C, O&M, D	Brigantine Wilderness Area Air Quality Related Values (AQRV) Mitigation Framework	BOEM, BSEE, USFWS, and Ocean Wind 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 preventative 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 Ocean Wind to USFWS; and, reporting to demonstrate completion of implementation.	Air Quality	BOEM and BSEE
3	C, O&M, D	SF6 leak rate monitoring and detection	Leak detection and monitoring requirements of less than 1% would be required, in line with IEC and USEPA guidance.	Air Quality	BOEM and BSEE
4	C, O&M	Shoreside seafood business analysis	In addition to the Direct Compensation Fund proposed by the Lessee, BOEM would require the Lessee to ensure that the Direct Compensation Fund includes losses to shoreside businesses. The Lessee shall analyze the impacts to shoreside seafood businesses adjacent to ports listed in Table 3.9-10. The shoreside seafood business analysis would be used to further supplement funds available for settling claims of lost (unrecovered) economic activity as a result of the Ocean Wind 1 project. The Lessee must submit to BOEM a report that includes (1) a description of the structure of the Fund and its consistency with BOEM's draft Guidance and (2) an analysis of the impacts of the Project on shoreside businesses for review and comment. The Lessee must then submit to BOEM evidence of the implementation of the Fund, including: • A description of any implementation details not covered in the report to BOEM regarding the mechanism established to compensate for losses to commercial and for-hire recreational fishermen and related shoreside businesses resulting from all phases of the project development on the Lease Area (pre-construction, construction, operation, and decommissioning); • The Fund charter, including the governance structure, audit and public reporting procedures, and standards for paying compensatory mitigation for impacts to fishers and related shoreside businesses from lease area development; and • Documentation regarding the funding account, including the dollar amount, establishment date, financial institution, and owner of the account.	Commercial and For-Hire Recreational Fisheries	BOEM and BSEE
5	C, O&M	Sand Wave Leveling, Boulder Clearance and Relocation	Sand wave leveling and boulder clearance and relocation should be limited and micrositing should be used to avoid these areas to the extent practicable. The Lessee must develop and implement a boulder relocation plan to ensure potential impacts to essential fish habitat and commercial and recreational fisheries are adequately minimized.	Commercial and For-Hire Recreational Fisheries	BOEM and BSEE
6	C, O&M	Mobile Gear–Friendly Cable Protection Measures	Cable protection measures should reflect the pre-existing conditions at the site. This mitigation measure chiefly ensures that seafloor cable protection does not introduce new hangs for mobile fishing gear. Thus, the cable protection measures should be trawl-friendly with tapered/sloped edges. If cable protection is necessary in "non-trawlable" habitat, such as rocky habitat, then the lessee should consider using materials that mirror the benthic environment.	Commercial and For-Hire Recreational Fisheries	BOEM and BSEE
USCG-proposed Measure					
1	C, O&M	Safety zones	Establishing safety zones should not be used as the key mitigating factor when considering risks and impacts. Commander, USCG Fifth District, may consider safety zones in the lease area, but safety zones will not be granted for the sole purpose of keeping project construction on track.	Navigation and Vessel Traffic	USCG

Table H-4 Lessee Authorization and Permit Conditions

#	Table H-4. Description of Lessee Authorization and Permit Conditions
NJDEP Federal Consistency Conditions Issued April 27, 2023[5]	
1	Ocean Wind LLC and the State of NJ shall execute a Memorandum of Understanding (MOU) to provide appropriate compensation measures for fisheries resources and fishing industry uses impacted by the authorized project.
2	Ocean Wind LLC shall implement all protective and mitigative measures as outlined in BOEM's Final EIS and Record of Decision for protection of fisheries, aquatic and benthic resources.
3	Prior to commencement of project construction, an Ocean Wind Offshore Wind Project Memorandum of Agreement shall be executed among the Section 106 consulting parties for the avoidance, minimization, and mitigation of project adverse effects on historic properties, pursuant to Section 106 of the National Historic Preservation Act.
4	Ocean Wind LLC shall develop a Project Mitigation Plan that is informed by public engagement, consultation with the appropriate state, federal (National Oceanic and Atmospheric Administration (NOAA Fisheries)), and regional, non-government organizations (i.e. the Regional Wildlife Science Collaborative for Offshore Wind and the Responsible Offshore Science Alliance). The Plan shall summarize the expected impacts; describe and provide technical details for each mitigation measure (including the type of impact to which it relates and the conditions under which it is required); identify policies and standards to be used and complied with; and, be responsive to impacts detected in project monitoring and other monitoring and research studies and initiatives, including Ocean Wind Fisheries Monitoring Plan, Ocean Wind Benthic Monitoring Plan, and the New Jersey Research and Monitoring Initiative for Offshore Wind.
5	If avoidance and minimization to Prime Fishing Areas identified on NOAA and NJDEP's publicly available GIS layer depicting previously identified Prime Fishing Areas (see https://gisdata-njdep.opendata.arcgis.com/) is not feasible, then Ocean Wind LLC shall provide the Division of Land Resource Protection with information that clearly shows any permanent changes to the bathymetry, including but not limited to flattening sand waves, filling, and relocation of boulders, post-construction. This shall include the location and extent of modification of the pre-existing bathymetry (figures and GIS shapefiles with locations and dimensions of these features within the project area should be provided), which structures were installed within these areas, and the avoidance and minimization measures which were implemented to reduce the area permanently modified.
6	For Wind Turbine Generators (WTGs) and Off Shore Substations (OSSs) – including most WTGs of Rows 1 through 8 and OSSs 1 and 2 – with the potential to impact artificial reefs and species using those reefs within the Atlantic City Reef and Great Egg Harbor artificial reef sites, additional noise dampening devices that result in greater noise dampening shall be utilized to avoid and minimize impacts to habitats and species. Devices may include, but are not limited to isolation casings, isolation casings with bubble curtains inside, and double-walled isolation casings.
7	If any military munitions and explosives of concern (MECs) or unexploded ordinances (UXOs) are encountered during project construction, Ocean Wind LLC shall immediately notify the United States Coast Guard (USCG) of the munition and its location.
NJDEP Permits Issued April 27, 2023[7]	
1	**Coastal Permit Conditions** 1. This permit is issued subject to compliance with N.J.A.C 7:7-27.2, Conditions that apply to all coastal permits. 2. The permittee shall obtain all applicable Federal, State, and local approvals prior to commencement of regulated activities authorized under a permit. Approvals include, but are not limited to, authorization from the US Army Corps of Engineers to conduct work below the high tide line and a Section 408 approval. 3. Additional development or other related construction will require either a modification to this permit #0000-21-0008.2 LUP220001 & LUP230001 or, a new permit depending on the size and scope of the proposed development as well as the activity status of the existing permit. 4. Prior to any construction or site preparation, the permittee must receive new Tidelands licenses for the electric transmission cables and installation of the cables below the mean high water line authorized by this permit. The applications for new Tidelands licenses are pending under file# 0000-21-0008.2 TDI220001, TDI220002, TDI220003 & TDI220004. Failure to comply with this condition will result in fines up to $1000 plus $100 per day, a higher fee for the conveyance and possible prosecution by the Attorney General's office to remove unauthorized structures and to pay use and occupancy charge. 5. No activities authorized in Barnegat Bay under this permit may commence until a monetary contribution has been made to the Department's account for Shellfish Habitat Mitigation. This contribution is based upon the area of shellfish habitat impacted by the electric transmission cable installations, the documented shellfish density, and the commercial value of the shellfish resource. The formula for assessing the monetary contribution is as follows: [see Permit for formula]. The impacted area of shellfish habitat is 29.077 acres (1,266,594.12 square feet). Using the above formula, a monetary contribution of $7,504.570.16 is required. This contribution must be made to the Department's account for Shellfish Habitat Mitigation within 90 days of the issuance date of this permit. An invoice will be forwarded to the permittee in the amount of $7,504,570.16. This contribution is based upon the impact acreage provided by the Applicant utilizing worst case scenario impacts. The Division reserves the right to modify the contribution amount if information is provided by the Applicant which demonstrates a reduction of the specified 29.077 acres of impact to shellfish habitat and the Division concurs the impacts have been reduced. 6. Prior to any construction activities in Barnegat Bay authorized by this permit, the permittee shall perform a submerged aquatic vegetation ("SAV") habitat pre-construction survey of the work area no more than six (6) months prior to construction and submit the survey results to the Department for review. The pre-construction survey methodology must be included in any SAV mitigation plan and be approved by the Department prior to execution. The pre-construction survey must be performed within the growing season window of mid-April through early November, but avoiding July, August, and early September may be necessary to avoid macroalgae blooms that can adversely affect survey results. Upon completion of the pre-construction survey, the permittee shall coordinate with the Department to develop a mitigation plan for the impacts to SAV. The Department must be provided with a mitigation plan at least 30 days prior to a planned start date for the pre-construction survey. Implementation of the required mitigation for impacts to SAV habitat shall be defined in the Department approved mitigation plan. 7. Prior to the commencement of site preparation, inclusive of site clearing, project staging, onsite storage of materials, pre-construction earth movement, other site disturbance, and all authorized activities, and within 90 days of the issuance of this permit authorization, the Permittee shall complete mitigation for the direct loss of Critical Wildlife Habitat: a. To the NJDEP Watershed and Land Management Program, Endangered & Threatened Species Unit, the Permittee shall first submit a proposal of mitigation for direct impacts to 16.119 acres of stopover habitat for migratory birds. After the mitigation proposal is accepted by the Division in writing, the Permittee shall then proceed with the placement of a conservation restriction over the approved mitigation site. The Permittee shall record the conservation restriction on the deed, and shall file the restriction with the appropriate County Clerk's Office (the Registrar of Deeds and Mortgages). The conservation restriction shall run with the land and be binding upon all successive owners. A copy of the recorded conservation restriction shall be forwarded to and received by the Division. No project site preparation and authorized activities may commence until the required conservation

[5] NJDEP Federal Consistency Certification and NJDEP State Permits are available on NJDEP's website: https://dep.nj.gov/offshorewind/projects/

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	restriction has been recorded and a signed copy has been received by the Division of Land Resource Protection. Any activities undertaken on the site before a copy of the recorded restriction is received by the Division will be considered a violation of the Coastal Area Facility Review Act. b. Within 90 days of the issuance of this permit authorization, the Permittee shall develop and submit a proposed "Barn Owl Breeding Habitat Mitigation Proposal" ("proposal") designed to address disturbance of barn owl breeding habitat in the vicinity of the authorized limit of disturbance on the B.L. England Generating Station property. An approvable proposal will include the installation and stewardship of two barn owl nest boxes on the B.L. England Generating Station property and will demonstrate that nest box structure, design, and locations have been vetted by the NJDEP Division of Fish & Wildlife. No component of the required barn owl breeding habitat mitigation effort may take place until the required proposal has been approved in writing by the Division of Watershed Protection and Restoration Endangered and Threatened Species Unit, indicating that the Permittee is authorized to commence with the installation of the nest box structures. No component of project site preparation, clearing, grading, or disturbance associated with the authorized activity(-ies) may take place until after the Permittee has demonstrated to the Department that the barn owl breeding habitat mitigation effort has been completed. Any regulated activities, including site preparation, undertaken on the site before proof of mitigation completion has been received by the Department will be considered a violation of the Coastal Area Facility Review Act. 8. Prior to any construction or site preparation, the permittee shall provide to the Department for review and approval a final, formal proposal outlining in detail the proposed offsite public access improvements which will be designed, permitted, and constructed by the permittee. The Department-approved public access improvements must be constructed prior to or concurrent with construction of the project authorized under this permit. 9. Concurrent with the construction of the offsite public access improvements, the permittee in conjunction with the property owner shall file a conservation restriction dedicating the improvements for public access. The permittee shall include the conservation restriction on the deed and shall file the restriction with the Ocean County and Cape May County Clerk's Office (the Registrar of Deeds and Mortgages). Said restriction shall run with the land and be binding upon all successive owners. The conservation restriction shall conform, verbatim, to the format and content of the model Declaration of Restriction for Public Access to the Waterfront on the Division's website at www.nj.gov/dep/landuse/forms.html. A copy of the recorded conservation restriction shall be emailed to the Division's Project Manager, Lindsey Davis, at Lindsey.Davis@dep.nj.gov within 30 days of filing of the conservation restriction. 10. To avoid impacts to Northern Long-eared Bat, Tricolored Bat (proposed federal listing), and nesting migratory bird species, the Permittee shall adhere to a seasonal restriction on the clearing of all woody vegetation from April 1 through September 30 of each calendar year. 11. To protect sensitive habitat for the State-listed Osprey, the permittee shall adhere to a seasonal restriction on the use of heavy construction equipment/machinery within 300 meters (1000 feet) of all active osprey nests along the project limit of disturbance from April 1 through August 31 of each calendar year. The initiation and implementation of work which generates disturbance (e.g., sound levels, visual interruption) that is out of character with what currently exists at or surrounding the anticipated work area during the restricted time period recommended above may result in the permittee being in violation of the "take" clause within State of New Jersey Endangered and Nongame Species Conservation Act (N.J.S.A. 23:2A-1). Please note that adherence to this seasonal restriction shall also be applied if nest building and nest occupancy is observed at any given osprey nest location during the months of March and April of the given calendar year of work. 12. No sediment generating activities (e.g. pile-driving, sheet driving, dredging, etc.) shall occur within State waters, including the Atlantic Ocean inlets and/or any tidal waterway, between March 1st and June 30th of each calendar year to protect anadromous fish and spawning activities during migration for diadromous fish. 13. The Permittee shall adhere to the provisions of the City of Ocean City Beach Management Plan For the Protection of Federally & State-Listed Species (dated January 2016 unless superseded by the most current edition) adopted by the Borough and created in coordination with the United States Department of the Interior Fish & Wildlife Service New Jersey Field Office and the New Jersey Department of Environmental Protection Division of Fish and Wildlife Endangered and Nongame Species Program. Particular attention must be given to provisions within "Protected" and "Precautionary" Zones outlined within the Beach Management Plan. 14. If activity of rare beach-nesting shorebird species (i.e. State- or federally listed threatened or endangered species, or migratory shorebird species of special concern), or a State-/Federally listed endangered beach plant population, is discovered at or near the permitted limit of disturbance, work and recreational use of the area shall cease until the Permittee has coordinated with, and guidance on habitat management practices can be issued by, the New Jersey Department of Environmental Protection and, potentially, the US Fish & Wildlife Service. Please note that this coordination may result in the need for the Permittee's adherence to provisions as necessary to protect this sensitive habitat (e.g., seasonal restriction on regulated activities). The Department reserves the right to suspend all regulated activities onsite should it be determined that the Permittee has not taken proper precautions to ensure continuous compliance with these conditions. 15. Prior to commencement of project construction, there shall be an executed Ocean Wind Offshore Project Memorandum of Agreement among the Section 106 consulting parties, which includes the permitttee, for the avoidance, minimization, and mitigation of project adverse effects on historic properties, pursuant to Section 106 of the National Historic Preservation Act. 16. The permittee shall notify the Department's Bureau of Marine Water Monitoring 30 days prior to the start of construction and/or site preparation for the work within Barnegat Bay and Peck Bay/Crook Horn Creek. Notification shall be made via email to the following addresses: lisa.dielmo@dep.nj.gov, debbie.watkins@dep.nj.gov, sarah.gentile@dep.nj.gov, and robert.schuster@dep.nj.gov. The permittee shall abide by any restrictions put in place by the Bureau of Marine Water Monitoring during construction and/or site preparation. 17. If any military munitions and explosives of concern (MECs) or unexploded ordinances (UXOs) are encountered during project construction, the permittee shall immediately notify the United States Coast Guard (USCG) of the munition and its location. 18. Any necessary remediation activities shall be conducted in accordance with all applicable regulations and under the supervision of a Licensed Site Remediation Professional. 19. Any work within the limits of the Great Egg Harbor Inlet and Pecks Beach or Great Egg Harbor Inlet to Townsends Inlet beach nourishment projects inshore of the 2,500-foot limit as measured from project baseline and/or at or below -35 feet NAVD88 within the US Army Corps of Engineers beach and dune design template (including slopes) is subservient to the to the construction, operation, maintenance, repair, rehabilitation and replacement of the Federal beachfill project and is subject to removal prior to future project-related construction. 20. The permittee shall conduct and provide to the Department pre-construction topographic and bathymetric surveys that capture the entire profile of the existing conditions between the HDD pit located at 35th Street in Ocean City and the offshore HDD pit before commencing construction. 21. The permittee shall conduct and provide to the Department post-construction topographic and bathymetric surveys that capture the entire profile of the existing conditions between the HDD pit located at 35th Street in Ocean City and the offshore HDD pit within 30 days of the completion of construction of the entry and exit HDD pits. 22. No excavation or grading of a beach or dune is authorized by this permit. 23. No disturbance to dune vegetation or dune fencing is authorized by this permit.

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	24. No disturbance to dune crossovers, including but not limited to split rail fencing, subsurface geotextile base matting, compacted I-5 surface, etc., within the City of Ocean City is authorized by this permit. 25. Beach berm elevations and widths shall not be lowered or lessened during temporary occupation within the limits of the Federal beach template during construction. 26. All occupations within the limits of the Federal beach template shall maintain and not alter any public access without the pre-approval of all local, State and Federal agencies including the USACE, the NJDEP's OCE, and NJDEP's Division of Land Resource Protection. 27. The permittee shall provide to the NJDEP's OCE as-built surveys for the entire length of the cable installed from the HDD pits in the Atlantic Ocean to the State's 3 nautical mile (nm) jurisdictional limit. 28. Prior to electric transmission cable installation, the permittee shall establish a hotline with contact information, including an email and a phone number. Protocols regarding unintended interaction with the cables and proposed nearby construction activities should be included with the hotline information. Coordination of the development of these protocols shall occur with NJDEP's OCE, the USACE, and the US Coast Guard. 29. Barges and other vessel hauls shall not rest on the bay bottom to the maximum extent practicable to eliminate the potential for scour. 30. Any landscaping of the properties shall be done with native plants to maximum extent practicable. The use of plastic or other impervious material under newly landscaped or gravel areas is prohibited. All sub-surface liners must be made of filter cloth or other permeable material. 31. Vegetation within a riparian zone shall only be disturbed in the areas specifically shown on the approved drawing(s). No other vegetation within a riparian zone shall be disturbed for any reason. 32. Upon completion of the project, all temporarily disturbed areas within a riparian zone shall be restored to original topography and replanted with indigenous, non-invasive vegetation in accordance with N.J.A.C. 7:13-11.2(z). 33. All excavated material must be lawfully disposed of outside any flood plain, open water, freshwater wetlands or transition area. 34. All debris generated from the construction is to be disposed of at an approved disposal site. Oyster Creek Federal Channel Maintenance Dredging Condition 1. Prior to dredging the Oyster Creek federal navigation channel, the permittee shall apply for a modification to this permit and submit: 1. Sediment sampling results obtained in accordance with a sampling plan approved by the Office of Dredging and Sediment Technology, 2. Current hydrographic survey including a calculation of the quantity of sediment to be dredged, and, 3. Written consent from the proposed dredged material management site to accept the specified quantity of dredged material. Cable Installation Conditions – West Coast of IBSP in Barnegat Bay (Prior Channel) 1. Prior to trenching and open-cut activities in the Prior Channel, the permittee shall apply for a modification to this permit and submit: 1. Sediment sampling results obtained in accordance with a sampling plan approved by the Office of Dredging and Sediment Technology, 2. Current hydrographic survey including a calculation of the quantity of sediment to be dredged, and, 3. Written consent from the proposed dredged material management site to accept the specified quantity of dredged material. 2. Prior to in-water construction activities in the Prior Channel within Barnegat Bay, the permittee shall submit a Sediment Containment Plan for review and approval. Said plan shall detail the specific turbidity control methods and measures that will be utilized during construction to demonstrate that turbidity associated with cable installation will be minimized. Questions regarding the requirements of the Sediment Containment Plan should be directed to katherine.todoroff@dep.nj.gov. 3. Prior to the installation of the sheet pile for construction of open-cut areas, the area must be enclosed with a full-depth turbidity curtain and anchored. This sediment control measure shall be maintained for the duration of sheet pile installation and removal. In the instance where a turbidity curtain cannot be installed in shallow water, the applicant shall propose another measure of turbidity control and provide details in the sediment containment plan, specified in Prior Channel Condition No. 2 above. 4. The sheet pile cofferdam proposed for open-cut areas must extend 100' waterward of sediment core DS007. The open-end of the sheet pile enclosure must be enclosed with a full-depth turbidity curtain and anchored. This sediment control measure shall be maintained for the duration of sheet pile installation and removal. 5. Prior to jetting operations, an anchored, full-depth turbidity curtain must be installed in parallel along the entire length of the Prior Channel within Barnegat Bay. This sediment control measure shall be maintained for the duration of jetting operations. 6. Prior to trenching operations, the work area must be enclosed by a full-depth turbidity curtain and anchored. This sediment control measure shall be maintained for the duration of trenching within that specific area. 7. Open-cut areas supported by trenches are limited to thirty feet (30') in length, five feet (5') in width, and six and one-half feet (6.5') in depth below the mudline. 8. Sediment removal in open-cut areas shall be limited to approximately seventy-two cubic yards (72 yds3). 9. Trenching shall be restricted to the limits as depicted on the authorized plans. The depth of trenching shall be limited to a maximum depth of eleven and one-half feet below mean lower low water (-11.5' MLLW). 10. Sediment removal in proposed trench areas shall be limited to approximately fifty-two thousand six hundred seventy-five cubic yards (52,675 CY). Cable Installation Conditions - Holtec Landfall in Barnegat Bay 1. Prior to trenching or open-cut activities for the Holtec Landfall, the permittee shall apply for a modification to the permit and submit: 1. Sediment sampling results obtained in accordance with a sampling plan approved by the Office of Dredging and Sediment Technology, 2. Current hydrographic survey including a calculation of the quantity of sediment to be dredged, and, 3. Written consent from the proposed dredged material management site to accept the specified quantity of dredged material. 2. Prior to in-water construction activities associated with the Holtec Landfall, the permittee shall submit a Sediment Containment Plan for review and approval. Said plan shall detail the specific turbidity control methods and measures that will be utilized during construction to demonstrate that turbidity associated with cable installation will be minimized. Questions regarding the requirements of the Sediment Containment Plan should be directed to H-55atherine.todoroff@dep.nj.gov. 3. Prior to the installation of the sheet pile for construction of open-cut areas, the area must be enclosed with a full-depth turbidity curtain and anchored. This sediment control measure shall be maintained for the duration of sheet pile installation and removal. In the instance where a turbidity curtain cannot be installed in shallow water, the applicant shall propose another measure of turbidity control and provide details in the sediment containment plan, specified in condition Holtec Property Landing No. 2 above.

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	4. Prior to jetting operations, an anchored, full-depth turbidity curtain must be installed in parallel along the entire length of the Holtec route. This sediment control measure shall be maintained for the duration of jetting operations. 5. Prior to trenching operations, the work area must be enclosed by a full-depth turbidity curtain and anchored. This sediment control measure shall be maintained for the duration of trenching within that specific area. 6. Open-cut areas supported by trenches are limited to fifty feet (50') in length, five feet (5') in width, and six and one-half feet (6.5') in depth below the mudline. 7. Sediment removal in open-cut areas shall be limited to approximately one hundred and twenty cubic yards (120 yds^3). 8. Trenching shall be restricted to the limits as depicted on the authorized plans. The depth of trenching shall be limited to a maximum of depth of twelve and one-half feet below mean lower low water (- 12.5' MLLW). 9. Sediment removal in proposed trench areas shall be limited to approximately twenty-eight thousand five hundred sixty-eight cubic yards (28,568 CY). Cable Installation Conditions – Ocean City, 35th Street HDD Landfall 1. The single HDD pit in the Atlantic Ocean is limited to two hundred forty-three feet (243') in length, one hundred thirty- four feet (134') in width, and ten feet (10') in depth below the mudline. 2. Sediment removal in the HDD pit in the Atlantic Ocean shall be limited to approximately two thousand cubic yards (2000 yds^3). Cable Installation Conditions: IBSP Oceanfront HDD Landfall 1. The two HDD pits in the Atlantic Ocean are limited to two hundred fifty feet (250') in length, one hundred fifty feet (150') in width, and thirteen feet (13') in depth below the mudline. 2. Sediment removal in the HDD pits in the Atlantic Ocean shall be limited to approximately three thousand six hundred yards per pit for an approximate total of seven thousand two hundred yards (7200 yds^3). In-Water Cable Installation & Maintenance Dredging Conditions – Sediment Removal 1. Side casting of dredge material is prohibited. 2. Use and/or location of all vessels, barges, equipment, etc. utilized for cable installations and maintenance dredging shall be properly coordinated with the U.S. Coast Guard. 3. Jetting shall be restricted to the limits as depicted on the authorized plans. The depth of cable burial installed by jetting technology shall be at least 4 feet (4') minimum below the seabed. 4. The applicant shall exercise caution and employ all reasonable controls to minimize the release of sedimentation into the adjacent waters during the dredging and deposition process. 5. All sediments from this project shall be removed using a closed clamshell environment bucket. 6. The dredge shall be operated to control the rate of descent of the bucket so as to maximize the vertical cut of the clamshell bucket while not penetrating the sediment beyond the vertical dimension of the open bucket (i.e. overfilling the bucket). This will reduce the amount of free water in the dredged material, will avoid overfilling the bucket, and minimize the number of dredge bucket cycles needed to complete the dredging contract. The dredging contractor shall use appropriate software and sensors on the dredging equipment to ensure consistent compliance with this condition during the entire dredging operation. The independent dredging inspector shall monitor the operation of the software and sensors during the inspections as specified in the below conditions. Any malfunction of the software and sensors on the dredge at any time shall be immediately reported to the independent dredging inspector and the permittee by the dredging contractor and shall be immediately repaired to working order. 7. The closed clamshell environmental bucket shall be equipped with sensors to ensure complete closure of the bucket before lifting the bucket. Said sensors shall be operational during the entire dredging operation. 8. The closed clamshell environmental bucket shall be lifted slowly through the water, at a rate of 2 feet per second or less. 9. Dredged material shall be placed deliberately in the barge in order to prevent spillage of material overboard. 10. The discharge (i.e. "overflow") of water from the barge/scow into which dredged material is placed is prohibited. 11. All barges or scows used to transport sediment shall be of solid hull construction or be sealed with concrete. 12. The gunwales of the dredge scows shall not be rinsed or hosed during dredging except to the extent necessary to ensure the safety of workers maneuvering on the dredge scow. 13. All decant water holding scows shall be water tight and of solid hull construction. 14. Decant water from this project may only be discharged within the area of Barnegat Bay from where the sediments originated, in close proximity to the dredging contract area. Discharge to another receiving waterbody requires prior approval from the Department and may require a New Jersey Discharge Pollutant Elimination System/Discharge to Surface Water (NJDPES/DSW) permit. 15. All decant water shall be held in the decant holding scow a minimum of 24 hours after the last addition of water to the decant holding scow. Said water contained in the decant holding scow may only be discharge after this mandatory 24-hour retention time. 16. During pumping of the decant water from the holding scow, great care shall be taken to avoid re-suspending or pumping sediment which has settled in the decant holding scow. 17. Dewatering on land must be completed within a secured watertight container. 18. REPORTING REQUIREMENTS: At the completion of the project, the permittee shall submit the following information to the Department. This information shall be submitted within three months of completion of dredging. 1. Start and finish date of work order(s). 2. Post-dredge hydrographic survey. 3. Completed "Notice of Completion of Dredging" attached for each work order(s)/completion of project. Barnegat Bay In-Water Backfill Conditions 1. All backfill must be sourced from clean material and/or over 90% sand. 2. Trenches must be backfilled with a clamshell bucket. The bucket shall remain closed until it reaches the bottom of the trench.
2	Freshwater Wetland Conditions 1. This permit is issued subject to compliance with N.J.A.C 7:7A-9.3, Conditions applicable to an individual permit.

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	2. Prior to the commencement of site clearing, grading, or construction onsite, the permittee shall install a sediment barrier at the limits of disturbance authorized herein, which is sufficient to prevent the sedimentation of the remaining freshwater wetlands and transition areas and shall serve as a physical barrier protecting these areas from encroachment by construction vehicles or other soil-disturbing activities. All sediment barriers and soil erosion control measures shall be kept in place and maintained throughout the duration of construction, until such time that the site is stabilized. 3. The permittee shall ensure that the authorized activities do not interfere with the natural hydraulic characteristics of any wetlands, transition area, or State open water. 4. Access through wetlands and transition areas shall be only as depicted on the above-referenced plans. 5. This authorization for a Freshwater wetland Individual Permit (FWIP) is valid for a term not to exceed five (5) years from the date of this letter. If the permittee wishes to continue an activity covered by the permit after the expiration date of the permit, the permittee must apply for and obtain a permit extension or a new permit, prior to the permit's expiration. 6. The total amount of disturbance associated with this authorization shall not exceed a combined total of 7.118 acres to state open waters, wetlands and transition areas. The wetlands affected by this permit authorization are of exceptional intermediate, and ordinary resource value. The standard transition area required adjacent to exceptional wetlands is 150ft. The standard transition area required adjacent to intermediate wetlands is 50ft. There is no transition area associated with ordinary resource value wetlands. Any additional disturbance of freshwater wetlands, State open waters and/or transition areas besides that shown on the approved plans shall be considered a violation of the Freshwater Wetlands Protection Act rules unless the activity is exempt or a permit is obtained from the Department prior to the start of the proposed disturbance.
3	Engineering Conditions 1. This permit is issued subject to compliance with N.J.A.C 7:13-5.6, Conditions that apply to an issued or reissued verification and N.J.A.C. 7:13-10.3 Conditions applicable to an individual permit. 2. Recording of Permit: This permit shall be recorded in its entirety in the office of the County Clerk or the Registrar of Deeds and Mortgages for each county where this project is located. Verified notice of this action shall be forwarded to the Division immediately thereafter. NOTE: The following information is to be submitted to the clerk for all Flood Hazard Area Verifications: a. The Department file number for the verification; b. The approval and expiration dates of the verification; c. A metes and bounds description of any flood hazard area limit and/or floodway limit approved under the verification; d. The flood hazard area design flood elevation, or range of elevations if variable, approved under the verification; and e. The width and location of any riparian zone approved under the verification; and f. The following statement: "The State of New Jersey has determined that all or a portion of this lot lies in a flood hazard area. Certain activities in flood hazard areas are regulated by the New Jersey Department of Environmental Protection and some activities may be prohibited on this site or may first require a permit. Contact the Division of Land Use Regulation at (609) 777-0454 for more information prior to any construction onsite." 3. The Department has approved this permit because the project satisfies the requirements of the Flood Hazard Area Control Act Rules and Coastal Rules. The Department has not reviewed the proposed structure/s to determine compliance with the International Building Code or any other local construction codes or flood ordinances. The proposed building/s may therefore not fully comply with any such requirements. Please contact your municipal construction official for further information. 4. All foundations, slabs, footings and walls of the proposed structure/s shall be designed to resist uplift, flotation, collapse and displacement due to hydrostatic and hydrodynamic forces resulting from flooding up to an elevation of one foot above the flood hazard area design flood elevation as shown on the approved plan sheets. Furthermore, all structural components shall be designed to resist the same forces. 5. The floor elevation labeled "12.0'" on the approved drawing(s) is the elevation of the lowest finished floor of the proposed building(s) at the B.L. England Substation project site. The construction of any habitable area below this elevation, such as a basement, is prohibited. 6. The Department has determined that this project meets the requirements of the Stormwater Management rules at N.J.A.C. 7:8. Any future expansion or alteration of the approved stormwater management system, which would affect water quality, increase the rate or volume of stormwater leaving the site, affect the infiltration capacity on the site, or alter the approved low impact site design, shall be reviewed and approved by the Department prior to construction. This includes any proposed changes to the discharge characteristics of any basin, the construction of new inlets or pipes that tie into the storm sewer network and/or the replacement of existing inlets or pipes with structures of different capacity. 7. The applicant shall make specific arrangements to ensure the continuous maintenance and efficient operation of all proposed stormwater management measures onsite. This includes the inspection (and cleaning where necessary) of any and all constructed swales, basins, inlets, and mechanical treatment devices at least four times per year and after every major storm totaling 1 inch of rainfall or more, the use of appropriate soil conservation practices onsite, and any other reasonable effort required to maintain the stormwater management system in good working order. 8. Prior to the start of any construction onsite, the applicant/owner shall record a deed notice for all stormwater management measures authorized under this permit which shall be recorded in the Office of the County Clerk or the registrar of deeds and mortgages of the county in which the development, project, project site, or mitigation area containing the stormwater management measure is located. A form of deed notice shall be submitted to the Watershed and Land Management Program (Program) for approval prior to filing. The deed notice shall contain a description of the stormwater management measure(s) used to meet the green infrastructure, groundwater recharge, stormwater runoff quality, and stormwater runoff quantity standards at N.J.A.C. 7:8-5.3, 5.4, 5.5, and 5.6 and shall identify the location of the stormwater management measure(s) in NAD 1983 State Plane New Jersey FIPS 2900 US Feet or Latitude and Longitude in decimal degrees. The deed notice shall also reference the maintenance plan required to be recorded upon the deed pursuant to N.J.A.C. 7:8- 5.8(d). Prior to the commencement of construction, proof that the above required deed notice has been filed shall be submitted to the Program. Proof that the required information has been recorded on the deed shall be in the form of either a copy of the complete recorded document or a receipt from the clerk or other proof of recordation provided by the recording office. However, if the initial proof provided to the Program is not a copy of the complete recorded document, a copy of the complete recorded document shall be provided to the Program within 180 calendar days of the authorization granted by the Program. 9. In accordance with N.J.A.C. 7:13-12.6(f), the deed for each lot on which the private roadway or parking area is constructed, as well as any lot served by the private roadway or parking area, and each lease or rental agreement for a unit within the multi-residence building served by a private roadway or parking area that lies below the flood hazard area design flood elevation shall be modified to: i. Explain that the private roadway or parking area is likely to be inundated by floodwaters, which may result in damage and/or inconvenience; and ii. Disclose the depth of flooding that the private roadway or parking area would experience during the FEMA 100-year flood, if available, and the flood hazard area design flood; and iii. The modified deeds are recorded in the Office of the County Clerk or the registrar of deeds and mortgages of the county in which the building is located, and proof that the modified deed has been recorded is provided to the Department prior to the sooner of either: 1) The start of any site disturbance (including pre-construction earth movement, removal of vegetation or structures, or construction of the project); or 2) The date that is 90 calendar days after the issuance of the permit. 10. Construction may only occur while the stream area is dry or in a de-watered condition. No work may be performed where the stream channel is wet.

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	11. De-watering of cofferdams must include properly sized temporary sediment basins or other filtering methods to reduce turbidity. The stream area to receive return water discharged from cofferdams must be encompassed by a turbidity barrier. The turbidity barrier must be located parallel to the stream banks and anchored to the shoreline to maintain freeflow of the stream center. In order to avoid obstruction of stream flows or fish passage, turbidity barriers must not be placed across the entire stream channel.
4	Mitigation Conditions Wetlands Permanent Impact Mitigation Conditions 1. The permittee shall mitigate for the permanent loss of 0.302 acres of forested and 1.519 acres of emergent wetlands with the purchase of 1.821 credits from a mitigation bank serving the appropriate watershed management area. 2. At this time, the following bank(s) are approved to serve the project area; additional banks may be approved at any time, so please contact the Mitigation unit for the most up to date service area information if you would like additional options. Within 60 days and prior to initiation of regulated activities, the permittee shall submit proof of purchase for the amount of mitigation credits listed above to the attention of the Mitigation Unit Supervisor, NJDEP, Division of Watershed Protection and Restoration at Mail Code 501-02A, P.O. Box 420, Trenton, NJ 08625-0420. Great Bay Wetland Mitigation Bank - Contact Mark Renna of Evergreen Environmental, LLC at (201)644-7302 (office) or 973-356-7164 or at mrenna@evergreenenv.com 3. If mitigation credits are no longer available from the above referenced mitigation bank, the permittee shall contact the Division of Watershed Protection and Restoration, Mitigation Unit to arrange for an alternative mitigation option prior to the initiation of regulated activities. Wetlands Temporary Impact Mitigation Conditions 1. The permittee shall mitigate for the temporary disturbance to 5.436 acres of emergent wetlands and 0.07 acres of open waters through an on-site restoration project. (N.J.A.C. 7:7A-11 et seq/N.J.A.C. 7:7-17.1) 2. Within 30 days of receipt of the permit, or at least 90 calendar days prior to the commencement of regulated activities authorized by the permit, the applicant shall submit to the Department for review a temporary restoration plan providing details regarding the number, type, size and location of restoration plantings and the contents of any seed mix, if applicable. 3. Regulated activities shall not commence until the temporary restoration plan has been reviewed and approved by the Department. (N.J.A.C. 7:7A-11.6(a)). 4. All mitigation shall be conducted immediately following completion of the activity that caused the disturbance and shall be continued to completion within six months after the end of the activity that caused the disturbance. 5. If the permittee fails to perform mitigation within the applicable time-period the activity shall be considered permanent and mitigation shall be required to replace the affected resource. (N.J.A.C. 7:7A-11.3(c)). 6. If the permittee is conducting a temporary restoration project, the following conditions shall apply: a. Prior to the initiation of regulated activities authorized by this permit the permittee shall submit a final design of the mitigation project for approval and include all of the items listed on the checklist entitled Checklist for Completeness: Creation, Restoration or Enhancement for a Coastal Wetland Mitigation Proposal located at http://www.nj.gov/dep/landuse/forms/index.html. b. The permittee shall obtain a secured bond or other financial surety acceptable to the Division from a firm licensed to provide such services in New Jersey. (N.J.A.C. 7:7-17.17) c. The permittee shall notify the Mitigation Unit at the Division of Watershed Protection and Restoration in writing at least 30 days prior to the start of construction of the wetland restoration project to arrange for an on-site pre-construction meeting among the permittee, the contractor, the consultant and the Division. d. To ensure the intent of the mitigation design and its predicted wetland hydrology is realized in the landscape, the mitigation designer shall be present on-site during all critical stages of mitigation construction and during the restoration of any temporarily impacted areas. Critical stages of construction include but are not limited to herbicide applications, earthmoving activities, planting, and inspections. e. The permittee shall be responsible for ensuring that best management practices are used throughout construction to control the spread and colonization of highly invasive plants. Specifically, all equipment, especially tracks and tires, must be thoroughly cleaned every time equipment or vehicles move from an area containing invasive plants or from off-site to the mitigation area. In addition, soil containing root fragments and above-ground vegetative material from invasive plants shall be carefully managed during earthmoving activities and disposed of at a suitable offsite location rather than mulched and reused or stockpiled elsewhere on the site. For information on the specific species that are considered to be invasive, please refer to the Invasive Plant Atlas at http://www.invasiveplantatlas.org/index.html. f. If changes to the mitigation design are necessary to ensure success of the project as a result of on-site conditions, the mitigation designer shall immediately notify the Division in writing and submit an alternative plan which achieves the proposed wetland conditions. Any modifications to the plan that are reviewed and approved by the Division must be shown on a signed and sealed revised plan. The As-Built plans required as a part of the Construction Completion Report may serve as the signed and sealed revised plan required to be submitted as part of the construction modification process described above if time constraints warrant such action and have been approved by the Division in writing. g. Within 30 days of final grading of the mitigation site and prior to planting, the permittee shall notify the Mitigation Unit at the Division of Watershed Protection and Restoration in writing to arrange a post-grading construction meeting among the permittee, contractor, consultant and the Division. h. Within 60 days following the completion of the mitigation project, the permittee shall submit a Construction Completion Report to the Division detailing as-built conditions (N.J.A.C. 7:7-17.11(h)). The Construction Completion Report shall contain, at a minimum, the following information: 1) A completed Wetland Mitigation Project Completion of Construction Form that certifies the mitigation project has been constructed as designed and that the proposed area of wetland restoration has been accomplished. This form is located at on the Division's website at: www.nj.gov/dep/landuse in the Mitigation tab of Forms & Checklists. 2) An as-built plan of the completed mitigation area showing grading and any structures included in the approved mitigation proposal; 3) Photographs, both pre- and post-construction, of the intertidal and subtidal shallows mitigation project including a photo location map as well as the GPS waypoints in NJ state plane coordinates NAD 1983; and 4) Any changes to the approved mitigation plan that were made during construction and an explanation for the deviation(s). i. Within 30 days following final planting of the mitigation project, the permittee shall post the mitigation area with permanent signs which identify the site as a wetland mitigation project and that all-terrain vehicle use, motorbike use, mowing, dumping, draining, cutting and/or removal of plant materials is prohibited and that violators shall be prosecuted and fined to the fullest extent under the law. The signs must also state the name of the permittee, a contact name and phone number, and the Department's permit number. j. The permittee shall monitor the mitigation for 5 full growing seasons beginning the year after the mitigation project has been completed. The permittee shall submit monitoring reports to the Division of Watershed Protection and Restoration no later than December 31st of each full monitoring year (N.J.A.C. 7:7-17.13(e)). All monitoring reports must include the standard items identified in the checklists entitled Wetland Mitigation Monitoring Project

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	Checklist and Tidal Wetland Mitigation Monitoring Checklist. The Wetland Mitigation Monitoring Project Checklist and Tidal Wetland Mitigation Monitoring Checklist are located at http://www.nj.gov/dep/landuse/forms/index.html. Please note: The monitoring period may be reduced if the restoration is successful more quickly. k. Once the required monitoring period has expired and the permittee has submitted the final monitoring report, the Division will make the finding that the mitigation project is either a success or a failure. In accordance with N.J.A.C. 7:7-17.11(k), the mitigation project will be considered successful if the permittee demonstrates all of the following: 1) A completed Wetland Mitigation Project Completion of Construction Form that certifies the mitigation project has been constructed as designed and that the proposed area of wetland creation, restoration or enhancement has been accomplished. This form is located at on the Division’s website at: www.nj.gov/dep/landuse in the Mitigation tab of Forms & Checklists. 2) An as-built plan of the completed mitigation area showing grading and any structures included in the approved mitigation proposal; 3) Photographs, both pre and post-construction, of the tidal wetland mitigation project including a photo location map as well as the GPS waypoints in NJ state plane coordinates NAD 1983; 4) The site has an 85 percent survival and 85 percent area coverage of the mitigation plantings or target hydrophytes, which are species native to the area and similar to ones identified on the mitigation planting plan. All plant species in the mitigation area must be healthy and thriving; and 5) The site has less than 10 percent coverage by invasive or noxious species. Please note: If the site is originally comprised of invasive species, the percent coverage and composition of invasive plants on the site shall be document in advance of the conduct of the activity. During restoration, the applicant shall make a good faith effort to avoid restoration with invasives, but the Department will consider the pre-construction site composition when determining whether this criteria has been satisfied. 7. The permittee is responsible for assuming all liability for any corrective work necessary to meet the success criteria established above (N.J.A.C. 7:7-17.13(h)). The Division will notify the permittee in writing if the mitigation project is considered to be a failure. Within 30 days of notification, the permittee shall submit a revised mitigation plan to meet the success criteria identified above for Division review and approval. The financial surety, if required, will not be released by the Division until such time that the permittee satisfies the success criteria as stipulated above.
5	Standard Conditions 1. The issuance of a permit shall in no way expose the State of New Jersey or the Department to liability for the sufficiency or correctness of the design of any construction or structure(s). Neither the State nor the Department shall, in any way, be liable for any loss of life or property that may occur by virtue of the activity or project conducted as authorized under a permit. 2. The issuance of a permit does not convey any property rights or any exclusive privilege. 3. The permittee shall obtain all applicable Federal, State, and local approvals prior to commencement of regulated activities authorized under a permit. 4. A permittee conducting an activity involving soil disturbance, the creation of drainage structures, or changes in natural contours shall obtain any required approvals from the Soil Conservation District or designee having jurisdiction over the site. 5. The permittee shall take all reasonable steps to prevent, minimize, or correct any adverse impact on the environment resulting from activities conducted pursuant to the permit, or from noncompliance with the permit. 6. The permittee shall immediately inform the Department of any unanticipated adverse effects on the environment not described in the application or in the conditions of the permit. The Department may, upon discovery of such unanticipated adverse effects, and upon the failure of the permittee to submit a report thereon, notify the permittee of its intent to suspend the permit. 7. The permittee shall immediately inform the Department by telephone at (877) 927-6337 (WARN DEP hotline) of any noncompliance that may endanger public health, safety, and welfare, or the environment. The permittee shall inform the Watershed & Land Management by telephone at (609) 777-0454 of any other noncompliance within two working days of the time the permittee becomes aware of the noncompliance, and in writing within five working days of the time the permittee becomes aware of the noncompliance. Such notice shall not, however, serve as a defense to enforcement action if the project is found to be in violation of this chapter. The written notice shall include: i. A description of the noncompliance and its cause; ii. The period of noncompliance, including exact dates and times; iii. If the noncompliance has not been corrected, the anticipated length of time it is expected to continue; and iv. The steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance. 8. Any noncompliance with a permit constitutes a violation of this chapter and is grounds for enforcement action, as well as, in the appropriate case, suspension and/or termination of the permit. 9. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the authorized activity in order to maintain compliance with the conditions of the permit. 10. The permittee shall employ appropriate measures to minimize noise where necessary during construction, as specified in N.J.S.A. 13:1G-1 et seq. and N.J.A.C. 7:29. 11. The issuance of a permit does not relinquish the State’s tidelands ownership or claim to any portion of the subject property or adjacent properties. 12. The issuance of a permit does not relinquish public rights to access and use tidal waterways and their shores. 13. The permittee shall allow an authorized representative of the Department, upon the presentation of credentials, to: i. Enter upon the permittee's premises where a regulated activity, project, or development is located or conducted, or where records must be kept under the conditions of the permit; ii. Have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit; iii. Inspect, at reasonable times, any facilities, equipment, practices, or operations regulated or required under the permit. Failure to allow reasonable access under this paragraph shall be considered a violation of this chapter and subject the permittee to enforcement action; and iv. Sample or monitor at reasonable times, for the purposes of assuring compliance or as otherwise authorized by the Federal Act, by the Freshwater Wetlands Protection Act, or by any rule or order issued pursuant thereto, any substances or parameters at any location. 14. The permittee shall not cause or allow any unreasonable interference with the free flow of a regulated water by placing or dumping any materials, equipment, debris or structures within or adjacent to the channel while the regulated activity, project, or development is being undertaken. Upon completion of the regulated activity, project, or development, the permittee shall remove and dispose of in a lawful manner all excess materials, debris, equipment, and silt fences and other temporary soil erosion and sediment control devices from all regulated areas. 15. The permittee and its contractors and subcontractors shall comply with all conditions, site plans, and supporting documents approved by the permit. 16. All conditions, site plans, and supporting documents approved by a permit shall remain in full force and effect, so long as the regulated activity, project, or development, or any portion thereof, is in existence, unless the permit is modified pursuant to the rules governing the herein approved permits. 17. The permittee shall perform any mitigation required under the permit in accordance with the rules governing the herein approved permits. 18. If any condition or permit is determined to be legally unenforceable, modifications and additional conditions may be imposed by the Department as necessary to protect public health, safety, and welfare, or the environment.

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	19. Any permit condition that does not establish a specific timeframe within which the condition must be satisfied (for example, prior to commencement of construction) shall be satisfied within six months of the effective date of the permit. 20. A copy of the permit and all approved site plans and supporting documents shall be maintained at the site at all times and made available to Department representatives or their designated agents immediately upon request. 21. The permittee shall provide monitoring results to the Department at the intervals specified in the permit. 22. A permit shall be transferred to another person only in accordance with the rules governing the herein approved permits. 23. A permit can be modified, suspended, or terminated by the Department for cause. 24. The submittal of a request to modify a permit by the permittee, or a notification of planned changes or anticipated noncompliance, does not stay any condition of a permit. 25. Where the permittee becomes aware that it failed to submit any relevant facts in an application, or submitted incorrect information in an application or in any report to the Department, it shall promptly submit such facts or information. 26. The permittee shall submit email notification to the Bureau of Coastal & Land Use Compliance & Enforcement at CLU_tomsriver@dep.nj.gov at least 3 days prior to commencement of site preparation and/or regulated activities, whichever comes first. The notification shall include proof of completion of all pre-construction conditions, including proof of recording of permits, approved plans and/or conservation easements, if required. The permittee shall allow an authorized Bureau representative on the site to inspect to ensure compliance with this permit. Additionally, the permittee shall notify the Department in writing (at the address listed on page one of this permit) within five working days prior to commencement of operation of a CAFRA individual permit. At this time, the permittee shall certify that all conditions of the permit that must be met prior to operation of the development have been met. 27. The permittee shall record the permit, including all conditions listed therein, with the Office of the County Clerk (the Registrar of Deeds and Mortgages, if applicable) of each county in which the site is located. The permit shall be recorded within 30 calendar days of receipt by the permittee, unless the permit authorizes activities within two or more counties, in which case the permit shall be recorded within 90 calendar days of receipt. Upon completion of all recording, a copy of the recorded permit shall be forwarded to Watershed & Land Management at the address listed on page one of this permit.
NMFS Proposed Incidental Take Regulations and Associated 5-year Letter of Authorization Issued October 26, 2022[6]	
1	**Training and Coordination** Prior to the onset of any in-water activities involving vessel use, pile driving, UXO/MEC detonation, and HRG surveys, and when new personnel join the work, Ocean Wind would conduct briefings for construction supervisors and crews, marine mammal observer and acoustic monitoring teams, and all Ocean Wind staff prior to the start of all pile driving, UXO/MEC detonation, and HRG survey activity, and when new personnel join the work, in order to explain responsibilities, communication procedures, and marine mammal mitigation, monitoring, and reporting requirements. More information on vessel crew training requirements can be found in the Vessel Strike Avoidance Measures section below. **North Atlantic Right Whale Awareness Monitoring** Ocean Wind must use available sources of information on North Atlantic right whale presence, including daily monitoring of the Right Whale Sightings Advisory System, monitoring of Coast Guard VHF Channel 16 throughout each day to receive notifications of any sightings, and information associated with any regulatory management actions (*e.g.,* establishment of a zone identifying the need to reduce vessel speeds). Maintaining daily awareness and coordination affords increased protection of North Atlantic right whales by understanding North Atlantic right whale presence in the area through ongoing visual and passive acoustic monitoring efforts and opportunities (outside of Ocean Wind's efforts), and allows for planning of construction activities, when practicable, to minimize potential impacts on North Atlantic right whales. **Protected Species Observers and PAM Operator Training** Ocean Wind would only employ NMFS-approved PSOs and PAM operators. The PSO field team and PAM team will have a lead member (designated as the “Lead PSO” or “PAM Lead”) who will have prior experience observing mysticetes, odontocetes and pinnipeds in the Northwestern Atlantic Ocean on other offshore projects requiring PSOs. Any remaining PSOs and PAM operators must have previous experience observing marine mammals during projects and must have the ability to work with all required and relevant software and equipment. New and/or inexperienced PSOs would be paired with an experienced PSO to ensure that the quality of marine mammal observations and data recording is kept consistent. All PSOs and PAM operators would be required to complete a Permits and Environmental Compliance Plan (PECP) training, as well as a two-day training and refresher session. These trainings will be held with the PSO provider and Project compliance representatives and will occur before the start of project activities related to the construction and development of the Ocean Wind 1 Offshore Wind Energy Facility. PSOs would be required during all foundation installation, cofferdam installation/removal, UXO/MEC detonation, and HRG surveys. More information on requirements during each activity can be found in the Proposed Monitoring and Reporting section.
2	**Vessel Strike Avoidance Measures** This proposed rule contains numerous vessel strike avoidance measures. Ocean Wind will be required to comply with these measures except under circumstances when doing so would create an imminent and serious threat to a person or vessel, or to the extent that a vessel is unable to maneuver and, because of the inability to maneuver, the vessel cannot comply (*e.g.,* due to towing, *etc.*). Vessel operators and crews will receive protected species identification training. This training will cover sightings of marine mammals and other protected species known to occur or which have the potential to occur in the project area. It will include training on making observations in both good weather conditions (*i.e.,* clear visibility, low wind, and low sea state) and bad weather conditions (*i.e.,* fog, high winds and high sea states, in glare). Training will not only include identification skills, but will also include information and resources available regarding applicable Federal laws and regulations for protected species. Ocean Wind will abide by the following vessel strike avoidance measures: • All vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course (as appropriate) and regardless of vessel size, to avoid striking any marine mammal. • During any vessel transits within or to/from the Ocean Wind project area, such as for crew transfers), an observer would be stationed at the best vantage point of the vessel(s) to ensure that the vessel(s) are maintaining the appropriate separation distance from marine mammals.

[6] NMFS Proposed Incidental Take Regulations and Associated 5-year Letter of Authorization are available on NMFS’s website: https://www.fisheries.noaa.gov/action/incidental-take-authorization-ocean-wind-lcc-construction-ocean-wind-1-wind-energy-facility

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	• Year-round, all vessel operators will monitor, the project's Situational Awareness System, WhaleAlert, US Coast Guard VHF Channel 16, and the Right Whale Sighting Advisory System (RWSAS) for the presence of North Atlantic right whales once every 4-hour shift during project-related activities. The PSO and PAM operator monitoring teams for all activities will also monitor these systems no less than every 12 hours. If a vessel operator is alerted to a North Atlantic right whale detection within the project area, they will immediately convey this information to the PSO and PAM teams. For any UXO/MEC detonation, these systems will be monitored for 24 hours prior to blasting. • Any observations of any large whale by any Ocean Wind staff or contractor, including vessel crew, must be communicated immediately to PSOs and all vessel captains to increase situational awareness. • All vessels would comply with existing NMFS regulations and speed restrictions and state regulations as applicable for North Atlantic right whales. • Between November 1st and April 30th, all vessels, regardless of size, would operate port to port (specifically from ports in New Jersey, New York, Maryland, Delaware, and Virginia) at 10 knots or less. • All vessels, regardless of size, would immediately reduce speed to 10 kts or less when any large whale, mother/calf pairs, or large assemblages of non-delphinid cetaceans are observed near (within 500 m) an underway vessel. • All vessels, regardless of size, would immediately reduce speed to 10 kts or less when a North Atlantic right whale is sighted, at any distance, by an observer or anyone else on the vessel. • If a vessel is traveling at greater than 10 kts, in addition to the required dedicated visual observer, real-time PAM of transit corridors must be conducted prior to and during transits. If a North Atlantic right whale is detected via visual observation or PAM within or approaching the transit corridor, all crew transfer vessels must travel at 10 kts or less for the following 12 hours. Each subsequent detection will trigger a 12-hour reset. A slowdown in the transit corridor expires when there has been no further visual or acoustic detection in the transit corridor in the past 12 hours. • All underway vessels (*e.g.,* transiting, surveying) must have a dedicated visual observer on duty at all times to monitor for marine mammals within a 180° direction of the forward path of the vessel (90° port to 90° starboard). Visual observers must be equipped with alternative monitoring technology for periods of low visibility (*e.g.,* darkness, rain, fog, *etc.*). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements in this proposed action. Visual observers may be third-party observers (*i.e.,* NMFS-approved PSOs) or crew members and must not have any other duties other than observing for marine mammals. Observer training related to these vessel strike avoidance measures must be conducted for all vessel operators and crew prior to the start of in-water construction activities to distinguish marine mammals from other phenomena and broadly to identify a marine mammal as a North Atlantic right whale, other whale (defined in this context as sperm whales or baleen whales other than North Atlantic right whales), or other marine mammals. Confirmation of the observers' training and understanding of the ITA requirements must be documented on a training course log sheet and reported to NMFS. • All vessel operators and crews, regardless of their vessel's size, must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course, as appropriate, to avoid striking any marine mammal. • All vessels must maintain a minimum separation distance of 500 m from North Atlantic right whales. If a whale is observed but cannot be confirmed as a species other than a North Atlantic right whale, the vessel operator must assume that it is a North Atlantic right whale and take appropriate action. • If underway, all vessels must steer a course away from any sighted North Atlantic right whale at 10 kts or less such that the 500-m minimum separation distance requirement is not violated. If a North Atlantic right whale, or a large whale that cannot be confirmed to species, is sighted within 500 m of an underway vessel, that vessel must shift the engine to neutral. Engines will not be engaged until the whale has moved outside of the vessel's path and beyond 500 m. • All vessels must maintain a minimum separation distance of 100 m from sperm whales and non-North Atlantic right whale baleen whales. If one of these species is sighted within 100 m of an underway vessel, that vessel must shift the engine to neutral. Engines will not be engaged until the whale has moved outside of the vessel's path and beyond 100 m. • All vessels must, to the maximum extent practicable, attempt to maintain a minimum separation distance of 50 m from all delphinoid cetaceans and pinnipeds, with an exception made for those that approach the vessel (*e.g.,* bow-riding dolphins). If a delphinoid cetacean or pinniped is sighted within 50 m of an underway vessel, that vessel must shift the engine to neutral, with an exception made for those that approach the vessel (*e.g.,* bow-riding dolphins). Engines will not be engaged until the animal(s) has moved outside of the vessel's path and beyond 50 m. • When a marine mammal(s) is sighted while a vessel is underway, the vessel must take action as necessary to avoid violating the relevant separation distances (*e.g.,* attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area. If a marine mammal(s) is sighted within the relevant separation distance, the vessel must reduce speed and shift the engine to neutral, not engaging the engine(s) until the animal(s) is clear of the area. This does not apply to any vessel towing gear or any situation where respecting the relevant separation distance would be unsafe (*i.e.,* any situation where the vessel is navigationally constrained. • All vessels underway must not divert or alter course in order to approach any marine mammal. Any vessel underway must avoid excessive speed or abrupt changes in direction. • For in-water construction heavy machinery activities other than impact or vibratory pile driving, if a marine mammal in on a path towards or comes within 10 m of equipment, Ocean Wind must cease operations until the marine mammal has moved more than 10 m on a path away from the activity to avoid direct interaction with equipment. • Individuals implementing the monitoring protocol will assess its effectiveness using an adaptive approach. All PSOs will use their best professional judgment throughout implementation and seek improvements to these methods when deemed appropriate. Any modifications to the protocol will be coordinated between NMFS and Ocean Wind. With the measures described herein, NMFS has prescribed the means of effecting the least practicable adverse impact on the affected marine mammal species and stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.
3	**Fisheries Monitoring Surveys** **Training** All crew undertaking the fishery survey activities would be required to receive protected species identification training prior to activities occurring. **During Vessel Use** During all fishery monitoring activities that require the use of a vessel as a platform, Ocean Wind would follow the *Vessel Strike Avoidance Measures,* described in the section above. • Vessels would also undertaking the following measures: • Specifically for trawl surveys, marine mammal monitoring will occur prior to, during, and after haul-back, and gear will not be deployed if a marine mammal is observed in the area;

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	• Trawl operations will only start after 15 minutes of no marine mammal sightings within 1 nm of the sampling station; and, • During daytime sampling for the research trawl surveys, Ocean Wind will maintain visual monitoring efforts during the entire period of time that trawl gear is in the water from deployment to retrieval. If a marine mammal is sighted before the gear is removed from the water, the vessel will slow its speed and steer away from the observed animal(s). **Gear-Specific Best Management Practices (BMPs)** Ocean Wind would be required to undertake BMPs to reduce risks to marine mammals during several types of activities. These include: • BRUV sampling and chevron trap usage, for example, would utilize specific mitigation measures to reduce impacts to marine mammals. These specifically include the breaking strength of all lines being less than 1,700 pounds (771 kg), limited soak durations of 90 minutes or less, no gear being left without a vessel nearby, and a delayed deployment of gear if a marine mammal is sighted nearby; • The permit number will be written clearly on buoy and any lines that go missing will be reported to NOAA Fisheries' Greater Atlantic Regional Fisheries Office (GARFO) Protected Resources Division as soon as possible; • If marine mammals are sighed near the proposed sampling location, chevron traps and/or BRUVs will not be deployed; • If a marine mammal is determined to be at risk of interaction with the deployed gear, all gear will be immediately removed; • Marine mammal monitoring would occur during daylight hours and begin prior to the deployment of any gear (*e.g.,* trawls, longlines) and continue until all gear has been retrieved; • If marine mammals are sighted in the vicinity within 15 minutes prior to gear deployment and it is determined the risks of interaction are present regarding the research gear, the sampling station will either move to another location or suspend activities until there are no marine mammal sightings for 15 minutes within 1 nm.
4	**WTG and OSS Foundation Installation** **Seasonal and Daily Restrictions** No foundation impact pile driving activities would occur January 1 through April 30. This seasonal restriction would minimize the potential for North Atlantic right whales to be exposed to pile driving noise. Based on the best available information (Roberts *et al.,* 2022), the highest densities of North Atlantic right whales in the project area are expected during the months of January through April. NMFS is requiring this seasonal restriction to minimize the potential for North Atlantic right whales to be exposed to noise incidental to impact pile driving of monopiles, which is expected to greatly reduce the number of takes of North Atlantic right whales. No more than two foundation monopiles would be installed per day. Monopiles would be no larger than 11-m in diameter, representing the larger end of the tapered 8/11-m monopile design. If jacket foundations are used for OSSs, pin piles would be no larger than 2.44-m in diameter. For all monopiles and pin piles, the minimum amount of hammer energy necessary to effectively and safely install and maintain the integrity of the piles must be used. Hammer energies must not exceed 4,000 kJ. Ocean Wind has requested authorization to initiate pile driving during nighttime when detection of marine mammals is visually challenging. To date, Ocean Wind has not submitted a plan containing the information necessary, including evidence, that their proposed systems are capable of detecting marine mammals, particularly large whales, at distances necessary to ensure mitigation measures are effective and, in general, the scientific literature on these technologies demonstrate there is a high degree of uncertainty in reliably detecting marine mammals at distances necessary for this project. Therefore, NMFS is not proposing, at this time, to allow Ocean Wind to initiate pile driving later than 1.5 hours after civil sunset or 1 hour before civil sunrise. We are, however, proposing to encourage and allow Ocean Wind the opportunity to further investigate and test advanced technology detection systems to support their request. NMFS is proposing to condition the LOA such that nighttime pile driving would only be allowed if Ocean Wind submits an Alternative Monitoring Plan to NMFS for approval that proves the efficacy of their night vision devices (*e.g.,* mounted thermal/IR camera systems, hand-held or wearable night vision devices (NVDs), infrared (IR) spotlights) in detecting protected marine mammals. If the plan does not include a full description of the proposed technology, monitoring methodology, and data supporting that marine mammals can reliably and effectively be detected within the clearance and shutdown zones for monopiles before and during impact pile driving, nighttime pile driving (unless a pile was initiated 1.5 hours prior to civil sunset) will not be allowed. The Plan should identify the efficacy of the technology at detecting marine mammals in the clearance and shutdowns under all the various conditions anticipated during construction, including varying weather conditions, sea states, and in consideration of the use of artificial lighting. **Noise Abatement Systems** Ocean Wind would employ noise abatement systems, also known as noise mitigation systems (NMS), during all impact pile driving (monopiles and pin piles) to reduce the sound pressure levels that are transmitted through the water in an effort to reduce ranges to acoustic thresholds and minimize any acoustic impacts resulting from pile driving. Ocean Wind would be required to employ a big double bubble curtain or a combination of two or more NMS during these activities, as well as the adjustment of operational protocols to minimize noise levels. Two categories of NMS exist: primary and secondary. A primary NMS would be used to reduce the level of noise produced by the pile driving activities at the source, typically through adjustments on to the equipment (*e.g.,* hammer strike parameters). Primary NMS' are still evolving and will be considered for use during mitigation efforts when the NMS has been demonstrated as effective in commercial projects. However, as primary NMS are not fully effective at eliminating, a secondary NMS would be employed. The secondary NMS is a device or group of devices that would reduce noise as it was transmitted through the water away from the pile, typically through a physical barrier that would reflect or absorb sound waves and, therefore reducing the distance the higher energy sound propagates through the water column. Together, these systems must reduce noise levels to the lowest level practicable with the goal of not exceeding measured ranges to Level A harassment and Level B harassment isopleths corresponding to those modeled assuming 10-dB sound attenuation, pending results of SFV (see the *Acoustic Monitoring for Sound Field and Harassment Isopleth Verification* section). Noise abatement systems, such as bubble curtains, are sometimes used to decrease the sound levels radiated from a source. Bubbles create a local impedance change that acts as a barrier to sound transmission. The size of the bubbles determines their effective frequency band, with larger bubbles needed for lower frequencies. There are a variety of bubble curtain systems, confined or unconfined bubbles, and some with encapsulated bubbles or panels. Attenuation levels also vary by type of system, frequency band, and location. Small bubble curtains have been measured to reduce sound levels but effective attenuation is highly dependent on depth of water, current, and configuration and operation of the curtain (Austin *et al.,* 2016; Koschinski and Lüdemann, 2013). Bubble curtains vary in terms of the sizes of the bubbles and those with larger bubbles tend to perform a bit better and more reliably, particularly when deployed with two separate rings (Bellmann, 2014; Koschinski and Lüdemann, 2013; Nehls *et al.,* 2016). Encapsulated bubble systems (*e.g.,* Hydro Sound Dampers (HSDs)), can be effective within their targeted frequency ranges, *e.g.,* 100-800 Hz, and when used in conjunction with a bubble curtain appear to create the greatest attenuation. The literature presents a wide array of observed attenuation results for bubble curtains. The variability in attenuation levels is the result of variation in design, as well as differences in site conditions and difficulty in properly installing and operating in-water attenuation devices. Secondary NMS that must be used by Ocean Wind include a big bubble curtain (BBC), a hydro-sound damper (HSD), or an AdBm Helmholz resonator (Elzinga *et al.,* 2019). See Section 2.8 of the ITA application (Appendix B, Protected Species Mitigation and Monitoring Plan (PSMMP)) for more information on these (Ocean Wind, 2022b). If a single system is used, it must be a double big bubble curtain (DBBC). Other systems (*e.g.,* noise mitigation screens) are not considered feasible for the Ocean Wind 1 project as they are

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	in their early stages of development and field tests to evaluate performance and effectiveness have not been completed. Should the research and development phase of these newer systems demonstrate effectiveness, as part of adaptive management, Ocean Wind may submit data on the effectiveness of these systems and request approval from NMFS to use them during pile driving. If a bubble curtain is used (single or double), Orsted would be required to maintain the following operational parameters: The bubble curtain(s) must distribute air bubbles using a target air flow rate of at least 0.5 m^3 /(min*m), and must distribute bubbles around 100 percent of the piling perimeter for the full depth of the water column. The lowest bubble ring must be in contact with the seafloor for the full circumference of the ring, and the weights attached to the bottom ring must ensure 100-percent seafloor contact; no parts of the ring or other objects should prevent full seafloor contact. Ocean Wind must require that construction contractors train personnel in the proper balancing of airflow to the bubble ring, and must require that construction contractors submit an inspection/performance report for approval by Ocean Wind within 72 hours following the performance test. Corrections to the attenuation device to meet the performance standards must occur prior to impact driving of monopiles. If Ocean Wind uses a noise mitigation device in addition to a BBC, similar quality control measures will be required. The literature presents a wide array of observed attenuation results for bubble curtains. The variability in attenuation levels is the result of variation in design, as well as differences in site conditions and difficulty in properly installing and operating in-water attenuation devices. Dähne *et al.* (2017) found that single bubble curtains that reduce sound levels by 7 to 10 dB reduced the overall sound level by approximately 12 dB when combined as a double bubble curtain for 6 m steel monopiles in the North Sea. Bellmann *et al.* (2020) provide a review of the efficacy of using bubble curtains (both single and double) as noise abatement systems in the German Exclusive Economic Zone (EEZ) of the North and Baltic Seas. For 8 m diameter monopiles, single bubble curtains achieved an average of 11 dB broadband noise reduction (Bellmann *et al.,* 2020). Ocean Wind would use a combination of two devices during impact pile driving. As previously discussed, the modeling of the sound fields for Ocean Wind's proposed activities demonstrated modeling assuming broadband attenuation levels of 0 dB, 6 dB, 10 dB, 15 dB, and 20 dB to gauge the effects on the ranges to threshold, given these various levels of sound attenuation. Ocean Wind anticipates, and NMFS agrees, that the use of a noise mitigation system will produce field measurements of the isopleth distances to the Level A harassment and Level B harassment thresholds that accord with those modeled assuming 10 dB of attenuation for both impact pile driving of monopiles and pin piles (refer back to the Estimated Take, Proposed Mitigation, and Proposed Monitoring and Reporting sections). **Use of PSOs and PAM Operators** As described above, Ocean Wind would be required to use PSOs and acoustic PSOs (*i.e.,* PAM operator) during all foundation installation activities. At minimum, four PSOs would be actively observing marine mammals before, during, and after pile driving. At least two PSOs would be stationed on the pile driving vessel and at least two PSOS would be stationed on a secondary, PSO-dedicated vessel. The dedicated PSO vessel would be located at the outer edge of the 2 km (in the summer; 2.5 km in the winter) large whale clearance zone (unless modified by NMFS based on SFV). These PSOs would be required to maintain watch at all times when impact pile driving of monopiles and/or pin piles is underway. Concurrently, at least one PAM operator would be actively monitoring for marine mammals before, during and after pile driving. More details on PSO and PAM operator requirements can be found in the Proposed Monitoring and Reporting section. Furthermore, all crew and personnel working on the Ocean Wind 1 project would be required to maintain situational awareness of marine mammal presence (discussed further above) and would be required to report any sightings to the PSOs. **Clearance and Shutdown Zones** NMFS is proposing to require the establishment of both clearance and shutdown zones during all impact pile driving of WTG and OSS foundation piles. Ocean Wind must use visual PSOs and PAM operators to monitor the area around each foundation pile before, during and after pile driving. Prior to the start of impact pile driving activities, Ocean Wind would clear the area of marine mammals, per Table 37, to minimize the potential for and degree of harassment. The purpose of “clearance” of a particular zone is to prevent potential instances of auditory injury, and more severe behavioral disturbance or, in the case of North Atlantic right whales, avoid and minimize behavioral disturbance to the maximum extent practicable (for North Atlantic right whales, the clearance and shutdown zones are set to any distance; see Table 37). By delaying the commencement of impact pile driving if marine mammals are detected within certain pre-defined distances from the pile being installed. PSOs would visually monitor for marine mammals for a minimum of 60 minutes while PAM operators would review data from at least 24 hours prior to pile driving and actively monitor hydrophones for 60 minutes prior to pile driving. Prior to initiating soft-start procedures, all clearance zones must be visually confirmed to be free of marine mammals for 30 minutes immediately prior to starting a soft-start of pile driving. If a marine mammal is observed entering or within the relevant clearance zone prior to the initiation of impact pile driving activities, pile driving must be delayed and will not begin until either the marine mammal(s) has voluntarily left the specific clearance zones and have been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections have occurred (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other marine mammal species). All distances to the perimeter of clearance zones are the radii from the center of the pile. Mitigation zones related to impact pile driving activities were created around two different seasonal periods to account for the different seasonal sound speed profiles that were used in JASCO's underwater sound propagation modeling, including summer (May through November) and winter (December) (Table 37). Ocean Wind would be required to implement these zones during foundation installation. While clearance and shutdowns would be monitored both visually and acoustically, NMFS is proposing to establish a minimum visibility zone close to the piles to ensure that marine mammals are detected prior to commencement of pile driving as visual and acoustic methods provide the most effective means of detection when combined (*e.g.,* VanParijs *et al.,* 2021). The minimum visibility zone would extend 1,650 m from the pile during summer months and 2,500 m during December (Table 37). These values correspond to the maximum LFC distance to Level A harassment thresholds assuming two monopiles are driven in a day. The entire minimum visibility zone must be visible (*i.e.,* not obscured by dark, rain, fog, *etc.*) for a full 30 minutes immediately prior to commencing impact pile driving. For North Atlantic right whales, there is an additional requirement that the clearance zone may only be declared clear if no confirmed North Atlantic right whale acoustic detections (in addition to visual) have occurred during the 60-minute monitoring period. Any large whale sighted by a PSO or acoustically detected by a PAM operator that cannot be identified as a non-North Atlantic right whale must be treated as if it were a North Atlantic right whale. The purpose of a shutdown is to prevent a specific acute impact, such as auditory injury or severe behavioral disturbance of sensitive species, by halting the activity. If a marine mammal is observed entering or within the respective shutdown zone (Table 37) after impact pile driving has begun, the PSO will request a temporary cessation of impact pile driving. In situations when shutdown is called for but Ocean Wind determines shutdown is not practicable due to imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk of injury or loss of life for individuals, reduced hammer energy must be implemented when the lead engineer determines it is practicable. Specifically, pile refusal or pile instability could result in not being able to shut down pile driving immediately. Pile refusal occurs when the pile driving sensors indicate the pile is approaching refusal, and a shut-down would lead to a stuck pile which then poses an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk for individuals. Pile instability occurs when the pile is unstable and unable to stay standing if

#	Table H-4. Description of Lessee Authorization and Permit Conditions

the piling vessel were to "let go." During these periods of instability, the lead engineer may determine a shut-down is not feasible because the shut-down combined with impending weather conditions may require the piling vessel to "let go" which then poses an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk for individuals.

After shutdown, impact pile driving may be reinitiated once all clearance zones are clear of marine mammals for the minimum species-specific periods, or, if required to maintain pile stability, at which time the lowest hammer energy must be used to maintain stability. If pile driving has been shut down due to the presence of a North Atlantic right whale, pile driving may not restart until the North Atlantic right whale is no longer observed or 30 minutes has elapsed since the last detection. Upon re-starting pile driving, soft start protocols must be followed.

The clearance and shutdown zone sizes vary by species and are shown in Table 37. Ocean Wind would be allowed to request modification to these zone sizes pending results of sound field verification (see Proposed Monitoring and Reporting section). Any changes to zone size would be part of adaptive management and would require NMFS' approval.

Table 37 -- Clearance and Shutdown Zones During Impact Pile Driving In Summer And Winter

Monitoring details	Zone Sizes for Impact Piling [a]				
	North Atlantic right whales	Large whales	Delphinids	Harbor porpoises	Seals
Minimum Visibility Zone	1,650 m (2,500 m)				
Clearance Zone	any distance	2,000 m (2,500 m)	100 m	1,100 m (1,450 m)	100 m
PAM Clearance Zone	3,500 m (3,800 m)	n/a	n/a	n/a	n/a
Shutdown Zone	any distance	1,800 m (2,500 m)	100 m	1,000 m (1,450 m)	100 m
PAM Shutdown Zone	1,650 m (2,500 m)	n/a	n/a	n/a	n/a

a - Winter (i.e., December) distances are presented in parentheses.

Soft-Start

The use of a soft start procedure is believed to provide additional protection to marine mammals by warning them, or providing them with a chance to leave the area prior to the hammer operating at full capacity. Soft start typically involves initiating hammer operation at a reduced energy level (relative to full operating capacity) followed by a waiting period. Ocean Wind must utilize a soft start protocol for impact pile driving of monopiles by performing 4-6 strikes per minute at 10 to 20 percent of the maximum hammer energy, for a minimum of 20 minutes. NMFS notes that it is difficult to specify a reduction in energy for any given hammer because of variation across drivers. For impact hammers, the actual number of strikes at reduced energy will vary because operating the hammer at less than full power results in "bouncing" of the hammer as it strikes the pile, resulting in multiple "strikes"; however, as mentioned previously, Ocean Wind will target less than 20 percent of the total hammer energy for the initial hammer strikes during soft start. Soft start will be required at the beginning of each day's monopile installation, and at any time following a cessation of impact pile driving of 30 minutes or longer. If a marine mammal is detected within or about to enter the applicable clearance zones, prior to the beginning of soft-start procedures, impact pile driving would be delayed until the animal has been visually observed exiting the clearance zone or until a specific time period has elapsed with no further sightings (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other species).

5

Cofferdam Installation and Removal

Seasonal and Daily Restrictions

Ocean Wind has proposed to construct the cofferdams from October to May within the first year of the effective period of the regulations and LOA, with some potential removal being necessary in April or May. However, NMFS is not requiring any seasonal restrictions in this proposed rule due to the relatively short duration of work (*i.e.,* low associated impacts) and although North Atlantic right whales do migrate in coastal waters, they do not typically migrate very close to shore off of New Jersey and/or within New Jersey bays where work would be occurring. Given the distance to the Level B harassment isopleth is conservatively modeled at approximately 10 km, any exposure to vibratory pile driving during cofferdam installation would be at levels closer to the 120 dB Level B harassment threshold and not at louder source levels. Ocean Wind would be required; however, to conduct vibratory pile driving associated with cofferdam installation during daylight hours only.

Noise Abatement Systems

Ocean Wind would install the cofferdams using vibratory pile driving. Given this and the short duration of work, NMFS is not proposing to require noise abatement systems during this activity.

Passive Acoustic Monitoring

PAM would not be required during the installation or removal of temporary cofferdams.

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	Clearance and Shutdown Zones Ocean Wind would establish clearance and shutdown zones for vibratory pile driving activities associated with cofferdam installation (Table 38). Prior to the start of vibratory pile driving activities, at least two PSOs will monitor the clearance zone for 30 minutes, continue monitoring during pile driving and for 30 minutes post pile driving. If a marine mammal is observed entering or is observed within the respective zones, piling will not commence or will be delayed until the animal has exited the zone or a specific amount of time has elapsed since the last sighting (*i.e.,* 30 minutes for large whales and 15 minutes for dolphins, porpoises, and pinnipeds). If a marine mammal is observed entering or within the respective shutdown zone after vibratory pile driving has begun, the PSO will call for a temporary cessation of vibratory pile driving. Ocean Wind must immediately cease pile driving upon orders of the PSO unless shutdown is not practicable due to imminent risk of injury or loss of life to an individual, pile refusal, or pile instability. Pile driving must not restart until either the marine mammal(s) has voluntarily left the specific clearance zones and have been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections have occurred (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other marine mammal species). Because a vibratory hammer can grip a pile without operating, pile instability should not be a concern and no caveat for re-starting pile driving due to pile instability is proposed.

Table 38 -- Distances to Harassment Thresholds and Mitigation Zones[1] During Vibratory Sheet Pile Driving

Marine Mammal Species	Level A harassment (SEL_{cum}) (m)	Level B harassment (m)	Clearance Zone[2] (m)	Shutdown Zone[3] (m)
Low-frequency cetaceans				
Fin whale*	86.7	10,000	150	100
Minke whale	86.7	10,000	150	100
Sei whale*	86.7	10,000	150	100
Humpback whale	86.7	10,000	150	100
North Atlantic right whale*	86.7	10,000	150	100
Blue whale*	86.7	10,000	150	100

#	Table H-4. Description of Lessee Authorization and Permit Conditions

Mid-frequency cetaceans				
Sperm whale*	7.7	10,000	150	100
Atlantic white-sided dolphin	7.7	10,000	150	50
Atlantic spotted dolphin	7.7	10,000	150	50
Common dolphin	7.7	10,000	150	50
Risso's dolphin	7.7	10,000	150	50
Bottlenose dolphin (offshore stock)	7.7	10,000	150	50
Bottlenose dolphin (coastal stock)	7.7	10,000	150	50
Long-finned pilot whale	7.7	10,000	150	50
Short-finned pilot whale	7.7	10,000	150	50
High-frequency cetaceans				
Harbor porpoise	128.2	10,000	150	150
Phocid Pinnipeds (in water)				
Gray seal	52.7	10,000	150	60
Harbor seal	52.7	10,000	150	60

* = denotes species listed under the Endangered Species Act.
Note: SEL_{cum} = cumulative sound exposure level; SPL_{pk} = peak sound pressure level.
1 - Zone sizes are based upon a practical spreading loss model and a source level of 165.0 dB re 1 μPa (JASCO, 2021).
2 - The clearance zones for large whales, porpoises, and seals are based upon the maximum Level A harassment zone (128.2 m) and rounded up for PSO clarity.
3 - The shutdown zones for large whales (including North Atlantic right whale) and porpoises are based upon the maximum Level A harassment zone for each group and rounded up for PSO clarity. Shutdown zones for other dolphins and pilot whales were set using precautionary distances.

6

UXO/MEC Detonations

While there would be no more than 10 detonations of UXOs/MECs, and these detonations are of very short duration (approximately 1 second), UXO/MEC detonations have a higher potential to cause mortality and injury than other activities proposed by Ocean Wind, and therefore have specific mitigation measures designed to minimize the likelihood of mortality and/or injury of marine mammals, including: (1) time of year/seasonal restrictions; (2) time of day

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	restrictions; (3) use of PSOs to visually observe for North Atlantic right whales; (4) use of PAM to acoustically detect North Atlantic right whales; (5) implementation of clearance zones; (6) use of noise mitigation technology; and, (7) post-detonation monitoring visual and acoustic monitoring by PSOs and PAM operators. **As Low as Reasonably Practicable (ALARP) Approach** For any UXOs/MECs that require removal, Ocean Wind would be required to implement the As Low as Reasonably Practicable (ALARP) process. This process would require Ocean Wind to undertake "life-and-shift", *i.e.,* physical removal and then lead up to in situ disposal, which would include low-order (deflagration) to high-order (detonation) methods of removal. Other approaches involve the cutting of the UXO/MEC to extract any explosive components. Implementing the ALARP approach would minimize potential impacts to marine mammals as UXOs/MECs would only be detonated as a last resort. **Seasonal and Daily Restrictions** There is no specific time of year that UXOs/MECs would be detonated as detonation would be considered on a case-by-case basis. However, Ocean Wind would be limited to detonating UXOs/MECs only between May 1st through October 31st to reduce impacts to North Atlantic right whales during peak migratory periods. Furthermore, UXO/MEC detonation would be limited to daylight hours only to reduce impacts on migrating species (such as North Atlantic right whales) and to ensure that visual PSOs can confirm appropriate clearance of the site prior to detonation events occurring. **Noise Abatement Systems** Ocean Wind would be required to use a dual noise abatement system during all UXO/MEC detonation events, as detonations are determined to be necessary during the construction. Although the exact level of noise attenuation that can be achieved by noise abatement systems is unknown, available data from Bellmann *et al.* (2020) and Bellmann and Betke (2021) provide a reasonable expectation that the noise abatement systems will be able to achieve at least 10 dB attenuation. SFV would be required for all detonation events to verify the modeled distances, assuming 10 dB attenuation, are representative of the sound fields generated during detonations. This level of noise reduction is substantial in reducing impact zones for low-frequency cetaceans such as the North Atlantic right whale. For example, assuming the largest UXO/MEC charge weight (454 kg; E12) at a depth of 45 m, a 10 dB reduces the Level A harassment isopleth from 229 km^2 to approximately 41 km^2 (Table 6-4 in the ITA application). The Level B harassment zone, given the same parameters, would decrease from 1,134 km^2 to 437 km^2 (Table 6-5 in the ITA application). However, and as previously stated in this document, Ocean Wind does not expect that all ten of the potential UXOs/MECs would constitute the largest charge weight; however, this weight was used as a conservative option in estimating exposures and take of marine mammals. **Use of PSOs and PAM Operators** Clearing the zone would require use of at least six visual PSOs and one PAM operator on at least two dedicated PSO vessels. An aerial survey must also be performed prior to detonation and immediately after detonation to monitor for marine mammals. This zone must be fully visible for at least 60 minutes and all marine mammal(s) must be confirmed to be outside of the clearance zone for at least 30 minutes prior to detonation. PAM must also be conducted for at least 60 minutes and the zone must be acoustically cleared during this time. **Clearance Zones** Prior to any detonation activities, Ocean Wind proposed to clear a zone encompassing a radius of 3.78 km around the detonation site using both visual and acoustic monitoring methods. This distance represents the modeled Level A (PTS) harassment threshold for low-frequency cetaceans (*i.e.,* large whales) rounded up to the nearest km assuming a 454 kg charge weight and use of a bubble curtain (Table 39). However, NMFS is proposing to require more protective zone sizes in order to ensure the least practicable adverse impact which includes minimizing the potential for TTS. It is currently not known how easily Ocean Wind will be able to identify UXO/MEC size in the field. For this reason, NMFS proposes to require Ocean Wind to clear a zone extending 10 km for large whales, 2 km for dolphins, 10 km for harbor porpoises, and 5 km for seals (Table 39). These zones are based on (but not equal to) the greatest TTS threshold distances from 454 kg charge at any site modeled. We note that harbor porpoise and seals are difficult to detect at great distances, but due to the UXO/MEC detonation time of year restrictions, their presence/abundance is likely to be relatively low. These zone sizes may be adjusted based on SFV and confirmation of UXO/donor charge sizes. Moreover, if Ocean Wind indicates to NMFS they will be able to easily identify charge weights in the field, NMFS would develop clearance zones in the final rule for each charge weight analyzed. The zones would be based on Table 39 below. If a marine mammal is observed entering or within the clearance zone prior to denotation, the activity would be delayed. Only when the marine mammals have been confirmed to have voluntarily left the clearance zones and been visually confirmed to be beyond the clearance zone, or when 60 minutes have elapsed without any redetections for whales (including the North Atlantic right whale) or 15 minutes have elapsed without any redetections of delphinids, harbor porpoises, or seals may detonation continue.

#	Table H-4. Description of Lessee Authorization and Permit Conditions

Table 39 -- Largest Modeled Clearance and Harassment Zones during UXO/MEC Detonation of E12 (454 kg) Charges Assuming 10 dB Noise Abatement

Marine Mammal Species		Distances to Zones for E12 (454 kg) UXO/MEC Charge Weight[1]		
		Level A Harassment Clearance zone (m)	Level B Harassment Zone (m)	Clearance Zones
Low-frequency cetaceans				
Fin whale*		3,780	11,900	10,000
Minke whale				
Sei whale*				
Humpback whale				
North Atlantic right whale*				
Blue whale*				
Mid-frequency cetaceans				
Sperm whale*		461	2,550	2,000
Atlantic white-sided dolphin				
Atlantic spotted dolphin				
Common dolphin (short-beaked)				
Risso's dolphin				
Bottlenose dolphin	Coastal			
	Offshore			
Long-finned pilot whale				
Short-finned pilot whale				
High-frequency cetaceans				

<table>
<tr><th>#</th><th>Table H-4. Description of Lessee Authorization and Permit Conditions</th></tr>
<tr><td></td><td>
<table>
<tr><td>Harbor porpoise</td><td>6,200</td><td>14,100</td><td>10,000</td></tr>
<tr><td colspan="3">Pinnipeds (in water)</td><td></td></tr>
<tr><td>Gray seal</td><td rowspan="2">1,600</td><td rowspan="2">7,020</td><td rowspan="2">5,000</td></tr>
<tr><td>Harbor seal</td></tr>
</table>
* = denotes species listed under the Endangered Species Act; kg = kilograms; m = meters; PK = peak pressure level; SEL = sound exposure level.
1 - At time of preparing this proposed rule, Ocean Wind has not provided NMFS evidence they will be able to reliably determine the charge weight of any UXO/MEC that must be detonated; therefore, NMFS assumes all UXO/MECs could be of the largest size modeled. If Ocean Wind provides information they can detect charge weights in the field prior to issuance of the final rule, if issued, NMFS may modify the clearance zone to ones based on charge weights distances to PTS and TTS. Distances to PTS and TTS thresholds have been identified by Ocean Wind in Appendix C of their application.
</td></tr>
<tr><td>7</td><td>
HRG Surveys
Ocean Wind would be required to implement several mitigation measures during all HRG survey activities using boomers, sparkers, and CHIRPs. The measures include shutdown, clearance, ramp-up, the use of PSOs, and vessel strike avoidance. There are no mitigation measures prescribed for sound sources greater than 180 kHz as these would be expected to fall outside of marine mammal hearing ranges and not result in harassment; however, all HRG survey vessels would be subject to the aforementioned vessel strike avoidance measures described earlier in this section. Furthermore, due to the frequency range and characteristics of some of the sound sources, shutdown, clearance, and ramp-up procedures are not proposed to be conducted during HRG surveys utilizing only non-impulsive sources (e.g., Ultra-Short BaseLine and other parametric sub-bottom profilers), with exception to usage of CHIRPS and other non-parametric sub-bottom profilers.
Seasonal and Daily Restrictions
Given the potential impacts to marine mammals from exposure to HRG survey noise sources are relatively minor (e.g., limited to Level B harassment) and that the distances to the Level B harassment isopleth is very small (maximum distance is 141 m), NMFS is not proposing to implement any seasonal or time-of-day restrictions for HRG surveys.
Although no temporal restrictions are proposed, NMFS would require Ocean Wind to deactivate acoustic sources during periods where no data is being collected, except as determined necessary for testing. Any unnecessary use of the acoustic source would be avoided.
Use of PSOs
Ocean Wind would be required to employ qualified, NMFS-approved PSOs during site characterization surveys related to the Ocean Wind 1 project. One PSO would be required to monitor during daylight hours and two would be required to monitor during nighttime hours, per vessel. Any PSO would have the authority to call for a delay or shutdown of survey activities. PSOs would begin visually monitoring 30 minutes prior to the initiation of the specified acoustic source (i.e., ramp-up, if applicable) through 30 minutes after the use of the specified acoustic source has ceased. PSOs would be required to establish and monitor the appropriate clearance and shutdown zones. These zones would be based around the radial distance from the acoustic source and not from the vessel.
Ocean Wind would be required to instruct all vessel personnel regarding the authority of the marine mammal monitoring team(s). For example, the vessel operator(s) would be required to immediately comply with any call for a shutdown by the Lead PSO. Any disagreement between the Lead PSO and the vessel operator would only be discussed after shutdown has occurred. All relevant vessel personnel and the marine mammal monitoring team would be required to participate in joint, onboard briefings that would be led by the vessel operator and the Lead PSO, prior to the beginning of survey activities. This would serve to ensure that all relevant responsibilities, communication procedures, marine mammal monitoring protocols, safety, operational procedures, and ITA requirements are clearly understood by all involved parties. The briefing would be repeated whenever new relevant personnel (e.g., new PSOs, acoustic source operators, relevant crew) join the survey operation before work commences.
Passive Acoustic Monitoring
PAM would not be required during HRG surveys. While NMFS agrees that PAM can be an important tool for augmenting detection capabilities in certain circumstances, its utility in further reducing impacts during HRG survey activities is limited. We have provided a thorough description of our reasoning for not requiring PAM during HRG surveys in several Federal Register notices (e.g.,87 FR 40796, July 8, 2022; 87 FR 52913, August 3, 2022; 87 FR 51356, August 22, 2022) which we adopt and those reasons continue to apply for this proposed action.
Clearance, Shutdown, and Vessel Separation Zones
Ocean Wind would be required to implement a 30-minute clearance period of the clearance zones (Table 40) immediately prior to the commencing of the survey or when there is more than a 30 minute break in survey activities and PSOs are not actively monitoring. The clearance zones would be monitored by PSOs, using the appropriate visual technology. If a marine mammal is observed within a clearance zone during the clearance period, ramp-up (as described further on) would not be allowed to begin until the animal(s) has been observed voluntarily exiting its respective clearance zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes and seals, and 30 minutes for all other species). In any case when the clearance process has begun in conditions with good visibility, including via the use of night vision equipment (IR/thermal camera), and the Lead PSO has determined that the clearance zones are clear of marine mammals, survey operations would be allowed to commence (i.e., no delay is required) despite periods of inclement weather and/or loss of daylight.
Once the survey has commenced, Ocean Wind would be required to shut down boomers, sparkers, and CHIRPs if a marine mammal enters a respective shutdown zone (Table 40). In cases when the shutdown zones become obscured for brief periods due to inclement weather, survey operations would be allowed to continue (i.e., no shutdown is required) so long as no marine mammals have been detected. The use of boomers, and sparkers, and CHIRPS would not be allowed to commence or resume until the animal(s) has been confirmed to have left the Level B harassment zone or until a full 15 minutes (for small odontocetes and seals) or 30 minutes (for all other marine
</td></tr>
</table>

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	mammals) have elapsed with no further sighting. Any large whale sighted by a PSO within 1,000 m of the boomers, sparkers, and CHIRPs that cannot be identified as a non-North Atlantic right whale would be treated as if it were a North Atlantic right whale. **Ocea**n Wind would be required to immediately shut down any boomer, sparker, or CHIRP sources if a marine mammal(s) is sighted entering or within its respective shutdown zone: • A 500 m zone for the North Atlantic right whale; and, • A 100 m zone for all other marine mammal species (with exception of specific delphinid species). The shutdown requirement would be waived for small delphinids of the following genera: *Delphinus, Stenella, Lagenorhynchus,* and *Tursiops.* Specifically, if a delphinid from the specified genera is visually detected approaching the vessel (*i.e.,* to bow-ride) or towed equipment, shutdown would not be required. Furthermore, if there is uncertainty regarding identification of a marine mammal species (*i.e.,* whether the observed marine mammal(s) belongs to one of the delphinid genera for which shutdown is waived), the PSOs would use their best professional judgment in making the decision to call for a shutdown. Additionally, shutdown is required if a delphinid that belongs to a genus other than those specified is detected in the shutdown zone. If a boomer, sparker, or CHIRP is shut down for reasons other than mitigation (*e.g.,* mechanical difficulty) for less than 30 minutes, it would be allowed to be activated again without ramp-up only if: (1) PSOs have maintained constant observation and (2) no additional detections of any marine mammal occurred within the respective shutdown zones. If a boomer, sparker, or CHIRP was shut down for a period longer than 30 minutes, then all clearance and ramp-up procedures would be required to be initiated, as previously described.

Table 40 -- Harassment Threshold Ranges and Mitigation Zones During HRG Surveys

Marine Mammal Species	Level B Harassment Zone (m)		Clearance Zone (m)	Shutdown Zone (m)
	Boomer/Sparker use	CHIRPs		
Low-frequency cetaceans				
Fin whale*	141	48	100	100
Minke whale			100	100
Sei whale*			100	100
Humpback whale			100	100
North Atlantic right whale*			500	500
Blue whale*			100	100

#	Table H-4. Description of Lessee Authorization and Permit Conditions

Mid-frequency cetaceans				
Sperm whale*	141	48	100	100
Atlantic white-sided dolphin			100	n/a
Atlantic spotted dolphin			100	n/a
Common dolphin			100	n/a
Risso's dolphin			100	100
Bottlenose dolphin (offshore stock)			100	n/a
Bottlenose dolphin (coastal stock)			100	n/a
Long-finned pilot whale			100	100
Short-finned pilot whale			100	100
High-frequency cetaceans				
Harbor porpoise	141	48	100	199
Phocid Pinnipeds (in water)				
Gray seal	141	48	100	100
Harbor seal				

Note: n/a = no shutdown zone mitigation will be applied
* = species is listed under the Endangered Species Act.

Ocean Wind to deactivate acoustic sources during periods where no data is being collected, except as determined necessary for testing. Any unnecessary use of the acoustic source would be avoided.

Ramp-Up

At the start or restart of the use of boomers, sparkers, and/or CHIRPs, a ramp-up procedure would be required unless the equipment operates on a binary on/off switch. A ramp-up procedure, involving a gradual increase in source level output, is required at all times as part of the activation of the acoustic source when technically feasible. Operators should ramp up sources to half power for 5 minutes and then proceed to full power. Prior to a ramp-up procedure starting, the operator would have to notify a PSO of the planned start of the ramp-up. This notification time would not be less than 60 minutes prior to the planned ramp-up activities as all relevant PSOs would need the appropriate 30 minute period to monitor prior to the initiation of ramp-up. Prior to ramp-up beginning, the operator must receive confirmation from the PSO that the clearance zone is clear of any marine mammals. All ramp-ups would be scheduled to

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	minimize the overall time spent with the source being activated. The ramp-up procedure must be used at the beginning of construction survey activities or after more than a 30-minute break in survey activities using the specified HRG equipment to provide additional protection to marine mammals in or near the survey area by allowing them to vacate the area prior to operation of survey equipment at full power. Ocean Wind would not initiate ramp-up until the clearance process has been completed (see Clearance and Shutdown Zones section above). Ramp-up activities would be delayed if a marine mammal(s) enters its respective shutdown zone. Ramp-up would only be reinitiated if the animal(s) has been observed exiting its respective shutdown zone or until additional time has elapsed with no further sighting (*i.e.,* 15 minutes for small odontocetes and seals, and 30 minutes for all other species). Based on our evaluation of the applicant's proposed measures, as well as other measures considered by NMFS, NMFS has preliminarily determined that the proposed mitigation measures would provide the means affecting the least practicable impact on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.
8	**Proposed Monitoring and Reporting** In order to promulgate a rulemaking for an activity, section 101(a)(5)(A) of the MMPA states that NMFS must set forth requirements pertaining to the monitoring and reporting of such taking. The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for authorizations must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring. Monitoring and reporting requirements prescribed by NMFS should contribute to improved understanding of one or more of the following: • Occurrence of marine mammal species or stocks in the area in which take is anticipated (*e.g.,* presence, abundance, distribution, density). • Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of: (1) action or environment (*e.g.,* source characterization, propagation, ambient noise); (2) affected species (*e.g.,* life history, dive patterns); (3) co-occurrence of marine mammal species with the action; or (4) biological or behavioral context of exposure (*e.g.,* age, calving or feeding areas). • Individual marine mammal responses (behavioral or physiological) to acoustic stressors (acute, chronic, or cumulative), other stressors, or cumulative impacts from multiple stressors. o How anticipated responses to stressors impact either: (1) long-term fitness and survival of individual marine mammals; or (2) populations, species, or stocks. • Effects on marine mammal habitat (*e.g.,* marine mammal prey species, acoustic habitat, or other important physical components of marine mammal habitat). • Mitigation and monitoring effectiveness. Separately, monitoring is also regularly used to support mitigation implementation, which is referred to as mitigation monitoring, and monitoring plans typically include measures that both support mitigation implementation and increase our understanding of the impacts of the activity on marine mammals. During the construction activities related to Ocean Wind 1, visual monitoring by NMFS-approved PSOs would be conducted before, during, and after impact pile driving; vibratory pile driving; any UXO/MEC detonations, and during HRG surveys, and PAM will be conducted during all impact pile driving and UXO/MEC detonations. Observations by PSOs will support the mitigation measures described above. Also, to increase understanding of the impacts of the activity on marine mammals, observers will record all incidents of marine mammal occurrence at any distance from the piling location, UXO/MEC detonation site, and during active HRG acoustic sources, and monitors will document all behaviors, and behavioral changes, in concert with distance from an acoustic source. The required monitoring is described below, beginning with PSO measures that are applicable to all activities or monitoring, followed by activity-specific monitoring requirements. **Protected Species Observer Requirements** Ocean Wind would be required to collect sighting data and behavioral response data related to construction activities for marine mammal species observed in the region of the activity during the period in which an activity occurs using NMFS-approved visual and acoustic PSOs (see Proposed Mitigation section). All observers must be trained in marine mammal identification and behaviors and are required to have no other construction-related tasks while conducting monitoring. PSOs will monitor all clearance and shutdown zones prior to, during, and following impact pile driving; vibratory pile driving; UXO/MEC detonation; and during HRG surveys using boomers, sparkers, and CHIRPs (with monitoring durations specified further below). PSOs will also monitor the Level B harassment zones and will document any marine mammals observed within these zones, to the extent practicable (noting that some zones are too large to fully observe). Observers would be located at the best practicable vantage points on the pile driving vessel and, where required, dedicated PSO vessels or aerial platforms. Full details regarding all marine mammal monitoring must be included in relevant Plans (*e.g.,* Pile Driving and Marine Mammal Monitoring Plan) that, under this proposed action, Ocean Wind would be required to submit to NMFS for approval at least 90 days in advance of the commencement of any construction activities. The following measures apply to all visual monitoring efforts: 1. Monitoring must be conducted by qualified, trained PSOs who will be placed on the primary vessel relevant to the activity (*e.g.,* pile driving vessel, UXO/MEC vessel, HRG survey vessel) and dedicated PSO vessels (*e.g.,* additional UXO/MEC vessels) and must be in positions that allow for the best vantage point to monitor for marine mammals and implement the relevant shutdown procedures, when determine to be applicable; 2. PSO must be independent, dedicated, and qualified, meaning that they must be employed by a third-party observer provider and must have no other tasks beyond to conduct observational effort, collect data, and communicate with an instruct the relevant vessel crew with regard to the presence of protected species and mitigation requirements; 3. During all activities, PSOs would be located at the best vantage point(s) to provide adequate coverage of the entire visual shutdown and clearance zones, and as much of the Level B harassment zone as possible, while still maintaining a safe work environment; 4. PSOs may not exceed 4 consecutive watch hours, must have a minimum 2-hour break between watches, and may not exceed a combined watch schedule of more than 12 hours in a single 24-hour period; 5. During all observation periods related to pile driving (impact and vibratory), and UXO/MEC detonations, PSOs would be required to use high-magnification (25x), as well as standard handheld (7x), binoculars and the naked eyes to search continuously for marine mammals. During periods of low visibility (*e.g.,* darkness, rain, fog, poor weather conditions, *etc.*), PSOs would be required to use alternative technologies (*i.e.,* infrared or thermal cameras) to monitor the shutdown and clearance zones. At least one PSO located on the foundation pile driving vessel and UXO/MEC monitoring vessel would be equipped with “Big Eye” binoculars (*e.g.,* 25 × 150; 2.7 view angle; individual

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	ocular focus; height control) of appropriate quality. These would be mounted on a pedestal on the deck of the vessel at the most appropriate vantage point that would provide for the optimal sea surface observation, as well as safety of the PSO; 6. PSOs should have the following minimum qualifications: a. Visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water's surface with the ability to estimate the target size and distance. The use of binoculars is permitted and may be necessary to correctly identify the target(s); b. Ability to conduct field observations and collect data according to the assigned protocols; c. Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations; d. Writing skills sufficient to document observations, including but not limited to: the number and species of marine mammals observed, the dates and times of when in-water construction activities were conducted, the dates and time when in-water construction activities were suspended to avoid potential incidental injury of marine mammals from construction noise within a defined shutdown zone, and marine mammal behavior; e. Ability to communicate orally, by radio, or in-person, with project personnel to provide real-time information on marine mammals observed in the area, as necessary. Observer teams employed by Ocean Wind, in satisfaction of the mitigation and monitoring requirements described herein, must meet the following additional requirements: 1. At least one observer must have prior experience working as an observer; 2. Other observers may substitute education (a degree in biological science or a related field) or training for experience; 3. One observer will be designated as lead observer or monitoring coordinator (“Lead PSO”). This Lead PSO would have prior experience working as an observer in an offshore environment; 4. At least two PSOs located on platforms (either vessel-based or aerial) would be required to have a minimum of 90 days of at-sea experience working in those roles in an offshore environment and would be required to have no more than eighteen months elapsed since the conclusion of their last at-sea experience; and, 5.All PSOs must be approved by NMFS. Ocean Wind would be required to submit the curriculum vitae (CV) of the initial set of PSOs necessary to commence the project to NMFS OPR (at *itp.potlock@noaa.gov*) for approval at least 60 days prior to the first day of construction activities. PSO resumes would need to include the dates of training and any prior NMFS approval, as well as the dates and description of their last PSO experience, and must be accompanied by information documenting their successful completion of an acceptable training course. NMFS would allow for 3 weeks to approve PSOs from the time that the necessary information is received by NMFS, after which any PSOs that meet the minimum requirements would automatically be considered approved. Some activities planned to be undertaken by Ocean Wind may require the use of PAM, which would necessitate the employment of at least one acoustic PSO (aka PAM operator on duty at any given time). PAM operators would be required to meet several of the specified requirements described above for PSOs, including: 2, 6b-e, 8, 10, and 11. Furthermore, PAM operators would be required to complete a specialized training for operating the PAM systems and must demonstrate familiarity with the PAM system on which they will be working. PSOs would be able to act as both acoustic and visual observers during the construction of Ocean Wind 1 if the individual(s) demonstrates that they have had the required level and appropriate training and experience to perform each task. However, a single individual would not be allowed to concurrently act in both roles. Ocean Wind would be required to conduct briefings between construction supervisors, construction crews, and the PSO/PAM team prior to the start of all construction activities. When new personnel join the work, briefings must be held to explain all responsibilities, communication procedures, marine mammal monitoring protocols, and operational procedures. An informal guide must be included with the Marine Mammal Monitoring Plan to aid in identifying species if they are observed in the vicinity of the project area. Ocean Wind's personnel and PSOs would also be required to use available sources of information on North Atlantic right whale presence to aid in monitoring efforts. This includes: 1. Monitoring daily of the Right Whale Sightings Advisory System; 2. Consulting of the WhaleAlert app; and, 3. Monitoring of the Coast Guard's VHF Channel 16 throughout the day to receive notifications of any sightings and information associated with any Dynamic Management Areas, to plan construction activities and vessel routes, if practicable, to minimize the potential for co-occurrence with North Atlantic right whales. Additionally, whenever multiple project-associated vessels (of any size; *e.g.,* construction survey, crew transfer) are operating concurrently, any visual observations of ESA-listed marine mammals must be communicated to PSOs and vessel captains associated with other vessels to increase situational awareness. The following are proposed monitoring and reporting measures that NMFS would require specific to each construction activity: **WTG and OSS Foundation Installation** Ocean Wind would be required to implement the following monitoring procedures during all impact pile driving activities of monopiles and/or pin piles related to WTG and OSS installation. Ocean Wind would be required to have a minimum of four PSOs actively observing marine mammals before, during, and after (specific times described below) the installation of foundation piles (monopiles and/or pin piles). At least four PSOs must be actively observing for marine mammals. At least two PSOs must be actively observing on the pile driving vessel while at least two PSOs are actively observing on a secondary, PSO-dedicated vessel. At least one active PSO on each platform must have a minimum of 90 days at-sea experience working in those roles in offshore environments with no more than 18 months elapsed since the conclusion of the at-sea experience. Concurrently, at least one acoustic PSO (*i.e.,* passive acoustic monitoring (PAM) operator) must be actively monitoring for marine mammals before, during and after impact pile driving. All PSOs would need to be located at the best vantage point(s) on the impact pile driving vessel and dedicated PSO vessels in order to ensure 360° visual coverage of the entire clearance and shutdown zones around the vessels, and as much of the Level B harassment zone as possible. During all observation periods associated with impact pile driving, PSOs would use high magnification (25x) binoculars, standard handheld (7x) binoculars, and the naked eye to search continuously for marine mammals. At least one PSO on the foundation pile driving vessel must be equipped with Big Eye binoculars (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality. These must be pedestal mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation and PSO safety. As described in the Proposed Mitigation section, if the minimum visibility zone cannot be visually monitored at all times using this or alternative equipment, pile driving operations may not commence or, if active, must shutdown. To supplement visual observers within the applicable shutdown zones, Ocean Wind would utilize at least one PAM operator before, during, and after pile installation. This PAM operator would assist the PSOs in ensuring full coverage of the clearance and shutdown zones. All on-duty visual PSOs will remain in contact

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	with the PAM operator on-duty, who will monitor the PAM systems for acoustic detections of marine mammals in the area. The use of real-time PAM will require at least one PAM operator to monitor each system by viewing the data/data products that would be streamed in real-time or near real-time to a computer workstation and monitor. In some cases, the PAM operator may be located onshore with the workstation and monitor or they may be located on a vessel. In either situation, PAM operators will maintain constant and clear communications with visual PSOs on duty regarding animal detections that would be approaching or found within the applicable zones related to impact pile driving. Ocean Wind would utilize PAM to acoustically monitor the clearance and shutdown zones, and would record all detections of marine mammals and estimated distance (noting whether they are in the Level A harassment or Level B harassment zones). To effectively utilize PAM, Ocean Wind would implement the following protocols: • PAM operators would be stationed on at least one of the dedicated monitoring vessels in addition to the PSOs; or located remotely/onshore. • PAM operators would have completed specialized training for operating PAM systems prior to the start of monitoring activities. • All on-duty PSOs will be in contact with the PAM operator on-duty, who will monitor the PAM systems for acoustic detections of marine mammals that are vocalizing in the area. • For real-time PAM systems, at least one PAM operator will be designated to monitor each system by viewing data or data products that are streamed in real-time or near real-time to a computer workstation and monitor located on a Project vessel or onshore. • The PAM operator will inform the Lead PSO on duty of animal detections approaching or within applicable ranges of interest to the pile driving activity via the data collection software system (*i.e.,* Mysticetus or similar system) who will be responsible for requesting the designated crewmember to implement the necessary mitigation procedures. • Acoustic monitoring during nighttime and low visibility conditions during the day will complement visual monitoring (*e.g.,* PSOs and thermal cameras) and will cover an area of at least the Level B harassment zone around each foundation. All PSOs and PAM operators would be required to begin monitoring 60 minutes prior to any impact pile driving, during, and after for 30 minutes. As described in the Proposed Mitigation section, in addition to the clearance zones which can be both visually and acoustically cleared, PSOs would need to visually clear an area extending 1.65 km from the pile during summer months and 2.5 km during December prior to any impact pile driving activities occurring. During this period, marine mammals must be able to be visually detected within the entire minimum visibility zone for a full 30 minutes immediately prior to the start of impact pile driving. The impact pile driving of both monopiles and/or pin piles would only be able to commence when the minimum visibility zone is fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and the clearance zones are clear of marine mammals for at least 30 minutes, as determined by the Lead PSO, immediately prior to the initiation of impact pile driving. For North Atlantic right whales, any visual or acoustic detection would trigger a delay to the commencement of pile driving. In the event that a large whale is sighted or acoustically detected that cannot be confirmed as a non-North Atlantic right whale species, it must be treated as if it were a North Atlantic right whale. Following a shutdown, monopile and/or pin pile installation may not recommence until the minimum visibility zone is fully visible and clear of marine mammals for 30 minutes. **Cofferdam Installation and Removal** Ocean Wind would be required to implement the following procedures during all vibratory pile driving activities on sheet piles associated with cofferdam installation and removal. Ocean Wind would be required to have a minimum of two PSOs on active duty during any installation and removal of the temporary cofferdams. These PSOs would always be located at the best vantage point(s) on the vibratory pile driving platform or secondary platform in the immediate vicinity of the vibratory pile driving platform, in order to ensure that appropriate visual coverage is available of the entire visual clearance zone and as much of the Level B harassment zone, as possible. NMFS would not require the use of PAM during vibratory pile driving activities related to the installation or removal of the temporary cofferdam. PSOs will monitor the clearance zone for the presence of marine mammals for 30 minutes before, throughout the installation of the sheet piles (and casing pipe, if installed), and for 30 minutes after all vibratory pile driving activities have ceased. Sheet pile or casing pipe installation may only commence when visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to initiation of impact or vibratory pile driving. During all observation periods related to vibratory pile driving, PSOs must use high-magnification (25x), standard handheld (7x) binoculars, and the naked eye to search continuously for marine mammals. During periods of low visibility (*e.g.,* darkness, rain, fog, *etc.*), PSOs must use alternative technology (*i.e.,* IR/Thermal camera) to monitor clearance and shutdown zones. **UXO/MEC Detonations** Ocean Wind would be required to implement the following procedures during all UXO/MEC detonations. Ocean Wind would be required to use a minimum of six PSOs and one PAM operator located on at least two dedicated PSO vessels. All PSOs and PAM operators would be required to begin monitoring 60 minutes prior to the UXO/MEC detonation event, during the event, and after for 30 minutes. As UXO/MEC detonation would only occur during daylight hours, PSOs would only need to monitor during daylight hours (*i.e.,* period between civil twilight rise and set). Ocean Wind would be required to utilize a PAM operator at least 60 minutes prior to detonation events to monitor for marine mammals prior to and after detonation events. The PAM operator would be stationed on one of the dedicated monitoring vessels but may also be located remotely on-shore, but this is subject to approval by NMFS. When real-time PAM is used, at least one PAM operator would be designated to monitor each system by viewing the data or data products that would be streamed in real-time or near real-time to a computer workstation and monitor, which would be located either on an Ocean Wind vessel or onshore. The PAM operator would work in coordination with the visual PSOs to ensure no detections of marine mammals prior to detonation occurring. The PAM operator would inform the Lead PSO on-duty of any animal detections approaching or within the applicable ranges of interest to the detonation activity via the data collection software (*i.e.,* Mysticetus or a similar system), who would then be responsible for requesting the necessary mitigation procedures. The PAM operator would monitor to and past the clearance zone for large whales (10 km), as possible. Ocean Wind would also be required to perform aerial surveys, given the size of the UXO/MEC detonation zones, and at least two PSOs must also be located on the plane during aerial surveys that would occur before, during, and after UXO/detonation events. Aerial PSOs (which would be the same as the vessel-based PSOs) would continue to monitoring for marine mammals before, during, and after the detonation has occurred. PSOs will monitor the clearance zone for the presence of marine mammals for 60 minutes before, throughout the detonation event, and for 30 minutes after. Detonation may only commence when visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 60 minutes immediately prior to detonation occurring. For detonation zones (based on UXO/MEC charge weight) larger than 2 km, a secondary vessel would be used to monitor the detonation zone(s). In the event a secondary vessel is needed, two PSOs would be located at an appropriate vantage point on this vessel and would

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	maintain watch during the same time period as the PSOs on the primary monitoring vessel. Ocean Wind would be required to ensure that the clearance zones are fully (100 percent) monitored prior to, during, and after detonation events. During all observation periods related to UXO/MEC detonation, PSOs must use high-magnification (25x), standard handheld (7x) binoculars, and the naked eye to search continuously for marine mammals. PSOs located on the UXO/MEC monitoring vessel would also be equipped with "Big Eye" binoculars (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control). These would be mounted on a pedestal on the deck of the vessel at the most appropriate vantage point that would provide for the optimal sea surface observation, as well as safety of the PSO. **HRG Surveys** Ocean Wind would be required to implement the following procedures during all HRG surveys. Between four and six PSOs would be present on every 24-hour survey vessel, and two to three PSOs would be present on every 12-hour survey vessel. Ocean Wind would be required to have at least one PSO on active duty during HRG surveys that are conducted during daylight hours (*i.e.,* from 30 minutes prior to sunrise through 30 minutes following sunset) and at least two during HRG surveys that are conducted during nighttime hours. During all observation periods, PSOs must use standard handheld (7x) binoculars and the naked eye to search continuously for marine mammals. During periods of low visibility (*e.g.,* darkness, rain, fog, *etc.*), PSOs must use alternative technology (*i.e.,* IR/Thermal camera) to monitor clearance and shutdown zones, as necessary. NMFS does not require the use of PAM during HRG survey activities. All PSOs would begin monitoring 30 minutes prior to the activation of boomers, sparkers, or CHIRPs; throughout boomer, sparker, or CHIRP use; and for 30 minutes after the use of the acoustic sources has ceased. Given that multiple HRG vessels may be operating concurrently, any observations of marine mammals would be required to be communicated to PSOs on all nearby survey vessels. Ramp-up of boomers, sparkers, and CHIRPs would only commence when visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to initiation of survey activities utilizing the specified acoustic sources. During daylight hours when survey equipment is not operating, Ocean Wind would ensure that visual PSOs conduct, as rotation schedules allow, observations for comparison of sighting rates and behavior with and without use of the specified acoustic sources. Off-effort PSO monitoring must be reflected in the monthly PSO monitoring reports. **Marine Mammal Passive Acoustic Monitoring** Ocean Wind would be required to utilize a PAM system to supplement visual monitoring for all monopile and pin pile installations, as well as during all UXO/MEC detonations. The PAM system must be monitored by a minimum of one PAM operator beginning at least 60 minutes prior to soft start of impact pile driving of monopiles and pin piles and UXO/MEC detonation, at all times during monopile and pin pile installation and UXO/MEC detonation, and 30 minutes post-completion of impact pile installation and UXO/MEC detonation. PAM PSOs must immediately communicate all detections of marine mammals at any distance (*i.e.,* not limited to the Level B harassment zones) to visual PSOs, including any determination regarding species identification, distance, and bearing and the degree of confidence in the determination. PAM operators may be on watch for a maximum of 4 consecutive hours followed by a break of at least 2 hours between watches. PAM operators must be required to demonstrate that they have completed specialized training for operating PAM systems, including identification of species-specific mysticete vocalizations. PSOs can act as PAM operators or visual PSOs (but not simultaneously) as long as they demonstrate that their training and experience are sufficient to perform each task. Some PAM systems may be used for real-time mitigation monitoring. This can utilize a variety of sources, but the most likely options, as proposed in Ocean Wind's PSMMP, will be discussed here. Towed PAM systems may be utilized for the Ocean Wind 1 project. These would consist of cabled hydrophone arrays that would be deployed from a vessel and then typically monitored from a tow vessel. Notably, several challenges exist when using a towed PAM system (*i.e.,* the tow vessel may not be fit for the purpose as it may be towing other equipment, operating sound sources, or working in patterns not conducive to effective PAM). Furthermore, detection and localization capabilities for low-frequency cetacean calls (*i.e.,* mysticete species) can be difficult in a commercial deployment setting. Alternatively, these systems have many positive benefits, as they are often low cost to operate, have high mobility, and are fairly easy and reliable to operate. These types of systems also work well in conjunction with visual monitoring efforts. Another PAM system being considered by Ocean Wind are mobile and hybrid PAM systems that are often autonomous and may utilize Autonomous Surface Vehicle (ASV) and radio-linked autonomous acoustic recorders. Ocean Wind plans to deploy PAM arrays specific for mitigation and monitoring of marine mammals outside of the shutdown zone to optimize the PAM system's capabilities to monitor for the presence of animals potentially entering these zones. The exact configuration and number of PAM systems would depend on the size of the zone(s) being monitored, the amount of noise expected in the area, and the characteristics of the signals being monitored. More closely spaced hydrophones would allow for more directionality, and perhaps, range to the vocalizing marine mammals; although, this approach would add additional costs and greater levels of complexity to the project. As larger baleen cetacean species (*i.e.,* mysticetes), which would produce loud and lower-frequency vocalizations, may be able to be heard with fewer hydrophones spaced at greater distances. However, smaller cetaceans (such as mid-frequency delphinids; odontocetes) may necessitate more hydrophones and to be spaced closer together given the shorter range of the shorter, mid-frequency acoustic signals (*e.g.,* whistles and echolocation clicks). As there are no "perfect fit" single optimal array configurations, these set-ups would need to be considered on a case-by-case basis. A Passive Acoustic Monitoring Plan must be submitted to NMFS and BOEM for review and approval at least 180 days prior to the planned start of monopile and pin pile installations. PAM should follow standardized measurement, processing methods, reporting metrics, and metadata standards for offshore wind (Van Parijs *et al.,* 2021). The plan must describe all proposed PAM equipment, procedures, and protocols. However, NMFS considers PAM usage for every project on a case-by-case basis and would continue discussions with Ocean Wind for choosing the PAM system that is determined to be appropriate for this proposed project. **Acoustic Monitoring for Sound Field and Harassment Isopleth Verification (SFV)** During the installation of the first 3 monopile foundations, the installation of the first full jacket foundation (consisting of 16 total pin piles), and during all UXO/MEC detonations, Ocean Wind must empirically determine source levels, the ranges to the isopleths corresponding to the Level A harassment and Level B harassment thresholds and the transmission loss coefficient(s). Ocean Wind may also estimate ranges to the Level A harassment and Level B harassment isopleths by extrapolating from in situ measurements conducted at several distances from the monopile and pin piles being driven and all UXOs/MECs being detonated. Ocean Wind must measure received levels at a standard distance of 750 m from the monopiles and pin piles and at both the presumed modeled Level A harassment and Level B harassment threshold ranges, or an alternative distance as agreed to in the SFV Plan. If acoustic field measurements collected during installation of the first or subsequent monopile, pin pile, and UXOs/MEC being detonated indicate ranges to the isopleths corresponding to Level A harassment and Level B harassment thresholds are greater than the ranges predicted by modeling (assuming 10-dB attenuation), Ocean Wind must implement additional noise mitigation measures prior to installing the next monopile or pin pile, or detonating any additional UXOs/MECs. Initial additional measures may include improving the efficacy of the implemented noise mitigation technology (*e.g.,* BBC, DBBC) and/or modifying the piling schedule to reduce the sound source. Each sequential modification would be evaluated empirically by acoustic field measurements. In the event that field measurements indicate ranges to isopleths corresponding to Level A harassment and Level B harassment thresholds are

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	greater than the ranges predicted by modeling (assuming 10 dB attenuation), NMFS may expand the relevant harassment, clearance, and shutdown zones and associated monitoring protocols. If harassment zones are expanded beyond an additional 1,500 m, additional PSOs would be deployed on additional platforms, with each observer responsible for maintaining watch in no more than 180° and of an area with a radius no greater than 1,500 m. If acoustic measurements indicate that ranges to isopleths corresponding to the Level A harassment and Level B harassment thresholds are less than the ranges predicted by modeling (assuming 10 dB attenuation), Ocean Wind may request a modification of the clearance and shutdown zones for impact pile driving of monopiles and pin piles and for detonation of all UXOs/MECs. For a modification request to be considered by NMFS, Ocean Wind would have had to conduct SFV on 3 or more monopiles and 1 entire jacket foundation (16 pin piles) and on all UXOs/MECs to verify that zone sizes are consistently smaller than predicted by modeling (assuming 10 dB attenuation). In addition, if a subsequent monopile and pin pile installation and location is selected that was not represented by previous three locations (*i.e.,* substrate composition, water depth), SFV would be conducted. Furthermore, if a subsequent UXO/MEC charge weight is encountered and/or detonation location is selected that was not representative of the previous locations (*i.e.,* substrate composition, water depth), SFV would also be required to be conducted. Upon receipt of an interim SFV report, NMFS may adjust zones (*i.e.,* Level A harassment, Level B harassment, clearance, and/or shutdown) to reflect SFV measurements. The shutdown and clearance zones for pile driving would be equivalent to the measured range to the Level A harassment isopleths plus 10 percent (shutdown zone) and 20 percent (clearance zone), rounded up to the nearest 100 m for PSO clarity. However, the minimum visibility zone would not be decreased to a radius smaller than 1.65 km in the summer (and 2.5 km in the winter) from the pile. The shutdown zone for sei, fin, blue, and sperm whales (*i.e.,* large whales) would not be reduced to a size less than 1.8 km in the summer and 2.5 km in the winter. The visual and PAM clearance and shutdown zones for North Atlantic right whales would not be decreased, regardless of acoustic field measurements. The Level B harassment zone would be equal to the largest measured range to the Level B harassment isopleth. Ocean Wind would be required to submit a SFV Plan at least 180 days prior to the planned start of impact pile driving or any detonation activities. The plan would describe how Ocean Wind would ensure that the first three monopile and pin pile installation sites and each UXO/MEC detonation site selected for SFV are representative of the rest of the monopile and pin pile installation and UXO/MEC sites. In the case that these sites are not determined to be representative of all other monopile and pin pile installation sites and UXO/MEC detonation locations, Ocean Wind would include information on how additional sites would be selected for SFV. The plan would also include methodology for collecting, analyzing, and preparing SFV data for submission to NMFS. The plan would describe how the effectiveness of the sound attenuation methodology would be evaluated based on the results. Ocean Wind must also provide, as soon as they are available but no later than 48 hours after each installation, the initial results of the SFV measurements to NMFS in an interim report after each monopile for the first 3 piles and pin pile installation for the first full jacket foundation (16 pin piles). **Reporting** Prior to any construction activities occurring, Ocean Wind would provide a report to NMFS (at *itp.potlock@noaa.gov* and *pr.itp.monitoringreports@noaa.gov*) that demonstrates that all required training for Ocean Wind personnel, which includes the vessel crews, vessel captains, PSOs, and PAM operators have completed all required trainings. NMFS would require standardized and frequent reporting from Ocean Wind during the life of the proposed regulations and LOA. All data collected relating to the Ocean Wind 1 project would be recorded using industry-standard software (*e.g.,* Mysticetus or a similar software) installed on field laptops and/or tablets. Ocean Wind would be required to submit weekly, monthly and annual reports as described below. During activities requiring PSOs, the following information would be collected and reported related to the activity being conducted: • Date and time that monitored activity begins or ends; • Construction activities occurring during each observation period; • Watch status (*i.e.,* sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform); • PSO who sighted the animal; • Time of sighting; • Weather parameters (*e.g.,* wind speed, percent cloud cover, visibility); • Water conditions (*e.g.,* sea state, tide state, water depth); • All marine mammal sightings, regardless of distance from the construction activity; • Species (or lowest possible taxonomic level possible); • Pace of the animal(s); • Estimated number of animals (minimum/maximum/high/low/best); • Estimated number of animals by cohort (*e.g.,* adults, yearlings, juveniles, calves, group composition, *etc.*); • Description (*i.e.,* as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics); • Description of any marine mammal behavioral observations (*e.g.,* observed behaviors such as feeding or traveling) and observed changes in behavior, including an assessment of behavioral responses thought to have resulted from the specific activity; • Animal's closest distance and bearing from the pile being driven, UXO/MEC, or specified HRG equipment and estimated time entered or spent within the Level A harassment and/or Level B harassment zones; • Construction activity at time of sighting (*e.g.,* vibratory installation/removal, impact pile driving, UXO/MEC detonation, construction survey), use of any noise attenuation device(s), and specific phase of activity (*e.g.,* ramp-up of HRG equipment, HRG acoustic source on/off, soft start for pile driving, active pile driving, post-UXO/MEC detonation, *etc.*); • Description of any mitigation-related action implemented, or mitigation-related actions called for but not implemented, in response to the sighting (*e.g.,* delay, shutdown, *etc.*) and time and location of the action; • Other human activity in the area. For all real-time acoustic detections of marine mammals, the following must be recorded and included in weekly, monthly, annual, and final reports: a. Location of hydrophone (latitude & longitude; in Decimal Degrees) and site name;

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	b. Bottom depth and depth of recording unit (in meters); c. Recorder (model & manufacturer) and platform type (*i.e.,* bottom-mounted, electric glider, *etc.*), and instrument ID of the hydrophone and recording platform (if applicable); d. Time zone for sound files and recorded date/times in data and metadata (in relation to UTC. *i.e.* EST time zone is UTC-5); e. Duration of recordings (start/end dates and times; in ISO 8601 format, yyyy-mm-ddTHH:MM:SS.sssZ); f. Deployment/retrieval dates and times (in ISO 8601 format); g. Recording schedule (must be continuous); h. Hydrophone and recorder sensitivity (in dB *re. 1 μPa*); i. Calibration curve for each recorder; j. Bandwidth/sampling rate (in Hz); k. Sample bit-rate of recordings; and, l. Detection range of equipment for relevant frequency bands (in meters). For each detection the following information must be noted: a. Species identification (if possible); b. Call type and number of calls (if known); c. Temporal aspects of vocalization (date, time, duration, *etc.,* date times in ISO 8601 format); d. Confidence of detection (detected, or possibly detected); e. Comparison with any concurrent visual sightings; f. Location and/or directionality of call (if determined) relative to acoustic recorder or construction activities; g. Location of recorder and construction activities at time of call; h. Name and version of detection or sound analysis software used, with protocol reference; i. Minimum and maximum frequencies viewed/monitored/used in detection (in Hz); and, j. Name of PAM operator(s) on duty. If a North Atlantic right whale is observed at any time by PSOs or personnel on or in the vicinity of any impact or vibratory pile-driving vessel, dedicated PSO vessel, construction survey vessel, or during vessel transit, Ocean Wind must immediately report sighting information to the NMFS North Atlantic Right Whale Sighting Advisory System (866) 755-6622, to the U.S. Coast Guard via channel 16, and through the WhaleAlert app (*http://www.whalealert/org/*) as soon as feasible but no longer than 24 hours after the sighting. Information reported must include, at a minimum: time of sighting, location, and number of North Atlantic right whales observed. If a North Atlantic right whale is detected via Ocean Wind PAM, the date, time, location (*i.e.,* latitude and longitude of recorder) of the detection as well as the recording platform that had the detection must be reported to *nmfs.pacmdata@noaa.gov* as soon as feasible, but no longer than 24 hours after the detection. Full detection data and metadata must be submitted monthly on the 15th of every month for the previous month via the webform on the NMFS North Atlantic right whale Passive Acoustic Reporting System website (*https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates*). Prior to initiation of project activities, Ocean Wind must demonstrate in a report submitted to NMFS (at *itp.potlock@noaa.gov* and *pr.itp.monitoringreports@noaa.gov*) that all required training for Ocean Wind personnel (including vessel crew and captains, and PSOs) has been completed. *Weekly Report* —Ocean Wind would be required to compile and submit weekly PSO and PAM reports to NMFS (at *itp.potlock@noaa.gov* and *PR.ITP.monitoringreports@noaa.gov*) that document the daily start and stop of all pile driving, HRG survey, or UXO/MEC detonation activities, the start and stop of associated observation periods by PSOs, details on the deployment of PSOs, a record of all detections of marine mammals, any mitigation actions (or if mitigation actions could not be taken, provide reasons why), and details on the noise attenuation system(s) used and its performance. Weekly reports would be due on Wednesday for the previous week (Sunday-Saturday). *Monthly Report* —Ocean Wind would be required to compile and submit monthly reports that include a summary of all information in the weekly reports, including project activities carried out in the previous month, vessel transits (number, type of vessel, and route), number of piles installed, and all observations of marine mammals. Monthly reports would be due on the 15th of the month for the previous month. The report should note the location and date of any turbines that become operational. *Annual Report* —Ocean Wind would be required to submit an annual summary report to NMFS no later than 90 days following the end of a given calendar year describing, in detail, the following: • Total number of marine mammals of each species/stock detected and how many were within designated Level A harassment and Level B harassment zones with comparison to authorized take of marine mammals for the associated activity type; • Marine mammal detections and behavioral observations before, during, and after each activity; • What mitigation measures were implemented (*i.e.,* number of shutdowns or clearance zone delays, *etc.*) or, if no mitigative action was taken, why not; • Operational details (*i.e.,* days of impact and vibratory pile driving, days/amount of HRG survey effort, total number and charge weights related to UXO/MEC detonations, *etc.*); • SFV/SSV results; • PAM systems used; • The results, effectiveness, and which noise abatement systems were used during relevant activities (*i.e.,* impact pile driving, UXO/MEC detonation);

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	• Summarized information related to Situational Reporting; and, • Any other important information relevant to the Ocean Wind 1 project, including additional information that may be identified through the adaptive management process. A final annual report would be prepared and submitted within 30 calendar days following receipt of any NMFS comments on the draft report. If no comments were received from NMFS within 60 calendar days of NMFS' receipt of the draft report, the report would be considered final. *Five-year Report* —By 90 days after the expiration of the rule, Ocean Wind would submit a final report that summarizes all of the data contained within the annual reports. A final five-year report would be prepared and submitted within 60 calendar days following receipt of any NMFS comments on the draft report. If no comments were received from NMFS within 60 calendar days of NMFS' receipt of the draft report, the report would be considered final. **Situational Reporting** Specific situations encountered during the development of Ocean Wind 1 would require immediate reporting to be undertaken. These situations and the relevant procedures include: • If a marine mammal observation occurs during vessel transit, the following information must be recorded: a. Time, date, and location; b. The vessel's activity, heading, and speed; c. Sea state, water depth, and visibility; d. Marine mammal identification to the best of the observer's ability (*e.g.,* North Atlantic right whale, whale, dolphin, seal); e. Initial distance and bearing to marine mammal from vessel and closest point of approach; and, f. Any avoidance measures taken in response to the marine mammal sighting. • If a sighting of a stranded, entangled, injured, or dead marine mammal occurs. In this situation, the sighting would be reported to OPR, the NMFS RWSAS hotline, and the NMFS Greater Atlantic Regional Fisheries Office (GARFO) Marine Mammal and Sea Turtle Stranding & Entanglement Hotline (866-755-6622), and the U.S. Coast Guard within 24 hours. The report must include the following information: a. Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable); b. Species identification (if known) or description of the animal(s) involved; Condition of the animal(s) (including carcass condition if the animal is dead); c. Observed behaviors of the animal(s), if alive; d. If available, photographs or video footage of the animal(s); and e. General circumstances under which the animal was discovered. • If a marine mammal is injured or killed as a result of Ocean Wind 1 project-related activities or vessels. In this case, the vessel captain or PSO on board shall immediately report the strike incident to the NMFS Office of Protected Resources and the GARFO within and no later than 24 hours. If activities related to the Ocean Wind 1 project caused the injury or death of the animal, Ocean Wind would supply a vessel to assist with any salvage efforts, if requested by NMFS. The notification of the strike would include: a. Time, date, and location (latitude/longitude) of the incident; b. Species identification (if known) or description of the animal(s) involved; c. Vessel's speed during and leading up to the incident; d. Vessel's course/heading and what operations were being conducted (if applicable); e. Status of all sound sources in use; f. Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike; g. Environmental conditions (*e.g.,* wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike; h. Estimated size and length of animal that was struck; i. Description of the behavior of the marine mammal immediately preceding and following the strike; j. If available, description of the presence and behavior of any other marine mammals immediately preceding the strike; k. Estimated fate of the animal (*e.g.,* dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and l. To the extent practicable, photographs or video footage of the animal(s). **Sound Monitoring Reporting** Ocean Wind will be required to provide the initial results of SFV (including measurements) to NMFS in interim reports after each monopile installation and pin pile installation or the first three piles as soon as they are available, but no later than 48 hours after each installation. Ocean Wind would also have to provide interim reports after every UXO/MEC detonation as soon as they are available, but no later than 48 hours after each detonation. If SFV is required for subsequent monopile and pin pile installations, the same reporting timeline and data requirements apply. In addition to in situ measured ranges to the Level A harassment and Level B harassment isopleths, the acoustic monitoring report must include: SPL_{peak}, SPL_{rms} that contains 90 percent of the acoustic energy, single strike sound exposure level, integration time for SPL_{rms}, SEL_{ss}, and 24-hour cumulative SEL extrapolated from measurements. All these levels must be reported in the form of median, mean, max, and minimum. The SEL and SPL power spectral density and one-third octave band levels (usually calculated as decidecade band levels) at the receiver locations should be

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	reported. The acoustic monitoring report must also include a description of the hydrophones used, hydrophone and water depth, distance to the pile driven, and sediment type at the recording location. Final results of SFV must be submitted as soon as possible, but no later than within 90 days following completion of impact pile driving of monopiles and pin piles and detonations of up to 10 UXOs/MECs.

This page intentionally left blank.