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Final Environmental Impact Statement for the Sunrise Wind Project

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COVER SHEET

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ABSTRACT

This Final Environmental Impact Statement (EIS) assesses the reasonably foreseeable impacts on physical, biological, socioeconomic, and cultural resources that could result from the construction and installation, operations and maintenance, and conceptual decommissioning of the Sunrise Wind Project (Project) proposed by Sunrise Wind LLC, in its Construction and Operations Plan (COP). The proposed Project—described in the COP and this Final EIS—would be up to approximately 1,034 megawatts in scale and sited 18.9 statute miles (16.4 nautical miles, 30.4 kilometers) south of Martha's Vineyard, Massachusetts, and approximately 30.5 miles (26.5 nautical miles, 48.1 kilometers) east of Montauk, New York, and 16.7 miles (14.5 nautical miles, 26.8 kilometers) from Block Island, Rhode Island, within the area of Renewable Energy Lease Number OCS-A 0487. The Project would serve the demand for renewable energy in the state of New York. This Final EIS was prepared in accordance with the requirements of the National Environmental Policy Act (42 *United States Code* 4321–4370f) and implementing regulations of the Council on Environmental Quality and the Department of the Interior. This Final EIS will inform the Bureau of Ocean Energy Management (BOEM)'s decision on whether to approve, approve with modifications, or disapprove the Project's COP. Publication of the Draft EIS initiated a 60-day public comment period, after which all comments received were assessed and considered by BOEM in the preparation for this Final EIS. Comments on the Draft EIS can be found in Appendix O.

Additional copies of this Final EIS may be obtained by writing BOEM, Attn: Lisa Landers (address above); by telephone at (703)-787-1520; or by downloading it from the BOEM website at Sunrise Wind Activities | Bureau of Ocean Energy Management (boem.gov).

EXECUTIVE SUMMARY

Introduction

This Final Environmental Impact Statement (EIS) assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from the construction and installation, operations and maintenance (O&M), and conceptual decommissioning of the Sunrise Wind Project, including the Sunrise Wind Farm (SRWF) and Sunrise Wind Export Cable (SRWEC), as proposed by Sunrise Wind LLC (Sunrise Wind, Applicant, or Lessee) in its Construction and Operations Plan (COP). The Bureau of Ocean Energy Management (BOEM) has prepared the Final EIS following the requirements of the National Environmental Policy Act (NEPA) (42 *United States Code* [*USC*] 4321 et seq.) and implementing regulations (40 *Code of Federal Regulations [CFR] Parts* 1500-1508). Additionally, this Final EIS was prepared consistent with the United States Department of the Interior's NEPA regulations (43 *CFR Part* 46), longstanding federal judicial and regulatory interpretations, and United States Administration priorities and policies, including the Secretary of the Interior's Order No. 3399 requiring bureaus and offices not to apply any of the provisions of the 2020 changes to Council on Environmental Quality regulations (the "2020 rule") (Council on Environmental Quality 2020) in a manner that would change the application or level of NEPA that would have been applied to a project action before the 2020 rule went into effect.

Cooperating agencies may rely on this Final EIS to support their decision-making. Sunrise Wind applied to the National Marine Fisheries Service (NMFS) for an incidental take authorization in the form of a Letter of Authorization for Incidental Take Regulations under the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 *USC* 1361 et seq.), for take of marine mammals incidental to specified activities associated with the Project. NMFS needs to render a decision regarding the request for authorization due to NMFS's responsibilities under the MMPA (16 *USC* 1371 (a)(5)(A and D)) and its implementing regulations. NMFS intends to adopt the Final EIS if, after independent review and analysis, NMFS determines the Final EIS to be sufficient to support NMFS's separate Proposed Action and decision to issue the authorization, if appropriate. The United States Army Corps of Engineers (USACE) intends to adopt BOEM's EIS to support its decision on any permits requested under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. Sunrise Wind would require a right-of-way permit (54 *USC* 100902; 36 *CFR* 14) and two special use permits for construction (36 *CFR* 5.7) from the National Park Service (NPS). A right-of-way permit is required for the transmission cable and conduit to reside in lands where the United States holds an easement, i.e., from the mean high-water line to 1,000 feet (304.8 meters) into the Atlantic Ocean. Special use permits for construction are required for construction (1) on those same lands and within the associated water column, and (2) within waters in the Intracoastal Waterway that are subject to the jurisdiction of the United States and within the boundaries of Fire Island National Seashore. The NPS intends to adopt BOEM's Final EIS if the NPS determines that the EIS is sufficient to support permitting decisions. Finally, Sunrise Wind has applied to the United States Environmental Protection Agency (USEPA) for an individual National Pollutants Discharge Elimination System (NPDES) permit to authorize operation of the offshore converter station (OCS-DC) in federal waters. USEPA intends to rely on this Final EIS to support its decision on NPDES permit issuance.

Purpose and Need for the Proposed Action

In Executive Order 14008, Tackling the Climate Crisis at Home and Abroad, issued January 27, 2021, President Biden stated that it is the policy of the United States "to organize and deploy the full capacity of its agencies to combat the climate crisis to implement a government-wide approach that reduces climate pollution in every sector of the economy; increases resilience to the impacts of climate change; protects public health; conserves our lands, waters, and biodiversity; delivers environmental justice; and spurs well-paying union jobs and economic growth, especially through innovation, commercialization, and deployment of clean energy technologies and infrastructure." Through a competitive leasing process under 30 *CFR* 585.211, Sunrise Wind was awarded commercial Renewable Energy Lease OCS-A 0487[1] (Lease Area) covering an area offshore of Massachusetts, Rhode Island, and New York (Figure ES-1). Under the terms of the lease, Sunrise Wind has the exclusive right to submit a COP for activities within the Lease Area and has submitted a COP to BOEM proposing the construction and installation, O&M, and conceptual decommissioning of up to a 1,034-megawatt (MW) offshore wind energy facility in accordance with BOEM's COP regulations under 30 *CFR* 585.626, et seq. Sunrise Wind's goal is to develop a commercial-scale offshore wind energy facility in the Lease Area with wind turbine generators (WTGs); a network of inter-array cables; an OCS-DC; an export cable making landfall in the Town of Brookhaven, New York; and an onshore converter station (OnCS-DC). The Project, as described here, is the Proposed Action considered by BOEM in this Final EIS. The Project is needed to contribute to New York State's (NYS) goal of 2,400 MW of offshore energy generation by 2030. The Project would have the capacity to generate up to 1,034 MW of power to the New York grid and satisfy Sunrise Wind's obligation to the New York State Energy Research and Development Authority for providing up to 924 MW of offshore wind energy for purchase by New York load-serving entities.

Based on BOEM's authority under the Outer Continental Shelf Lands Act (OCSLA) to authorize renewable energy activities on the Outer Continental Shelf and Executive Order 14008, the goal is to deploy 30 gigawatts of offshore wind energy capacity in the United States by 2030 while protecting biodiversity and promoting ocean co-use[2]. In consideration of the goals of the Applicant, the purpose of BOEM's

[1] A portion of the area covered by Renewable Energy Lease OCS-A 0500 and the entirety of the area covered by Renewable Energy Lease OCS-A 0487 were merged and included in a revised Lease OCS-A 0487 issued to Sunrise Wind on March 15, 2021. On July 31, 2013, BOEM conducted a competitive auction and awarded Lease OCS-A 0487, consisting of about 67,250 ac (272.2 km^2), to Deepwater Wind New England LLC. On August 3, 2020, Deepwater Wind New England LLC assigned Lease OCS-A 0487 to Sunrise Wind LLC. Following the January 2015 competitive lease sale for the Wind Energy Area offshore Massachusetts, Lease OCS-A 0500 (187,523 ac [758.9 km^2]) was awarded to RES Developments with an effective date of April 1, 2015. On June 12, 2015, BOEM approved reassignment of OCS-A 0500 to DONG Energy Massachusetts LLC (note: DONG Energy has since renamed its American subsidiary Bay State Wind LLC). On September 3, 2020, Bay State Wind LLC assigned 100 percent of its record title interest in a portion of lease OCS-A 0500, which BOEM designated OCS-A 0530, to Sunrise Wind LLC. On March 15, 2021, BOEM completed the consolidation of lease OCS-A 0530 into Lease OCS-A 0487 through an amendment to Lease OCS-A 0487. The effective date of lease OCS-A 0487 remains October 1, 2013.

[2] Fact Sheet: Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs | The White House, https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/

action is to determine whether to approve, approve with modifications, or disapprove Sunrise Wind's COP. BOEM will make this determination after weighing the factors in subsection 8(p)(4) of the OCSLA that are applicable to plan decisions and in consideration of the above goals. BOEM's action is needed to fulfill its duties under the lease, which require BOEM to submit a decision on the Lessee's plans to construct and operate a commercial-scale offshore wind energy facility within the Lease Area (the Proposed Action).

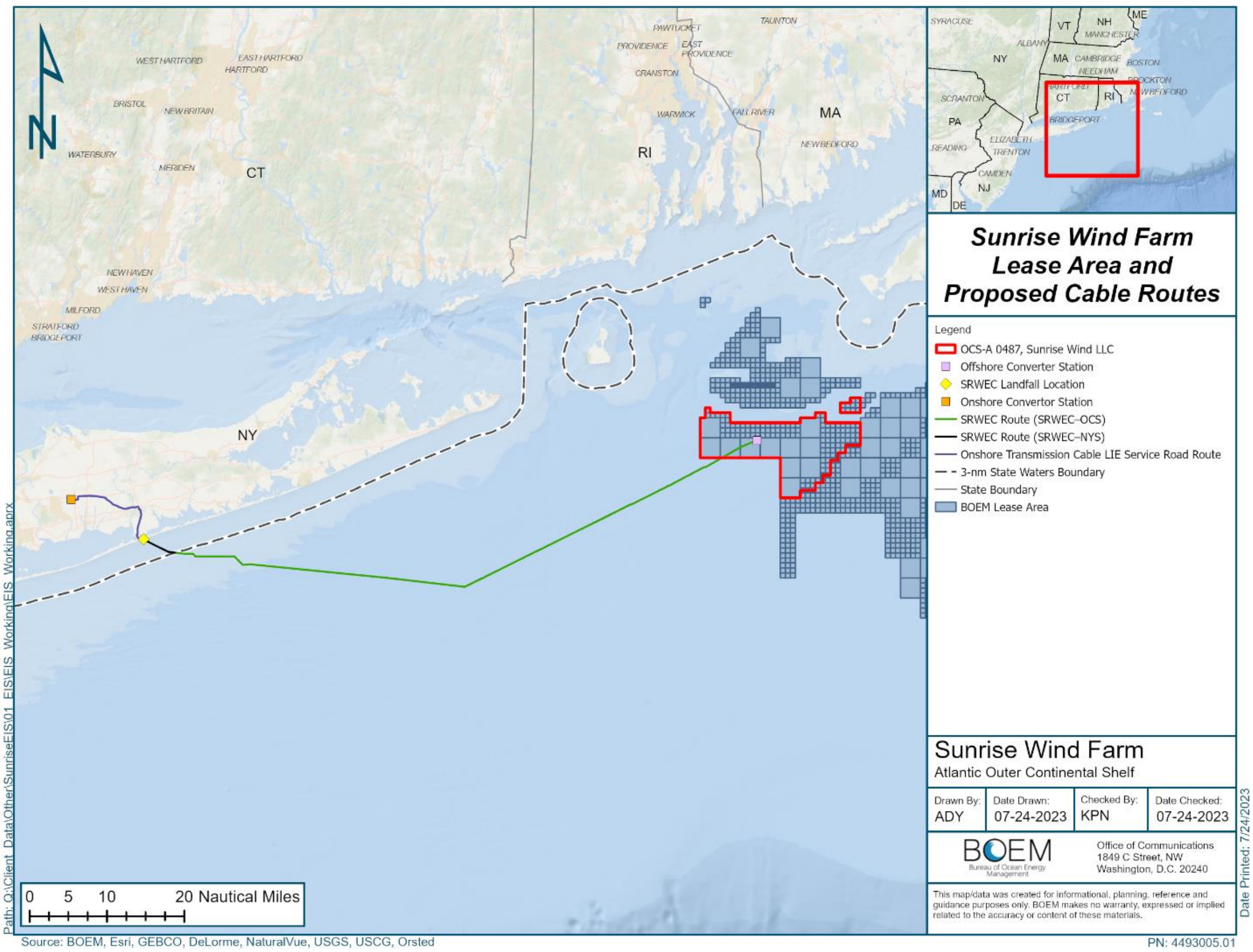

Figure ES-1. Sunrise Wind Farm Lease Area and Proposed Cable Routes

Public Involvement

On August 31, 2021, BOEM issued a Notice of Intent (NOI) to prepare an EIS, initiating a 30-day public scoping period (86 *Federal Register* 48763). A revision to the NOI was published in the *Federal Register* on September 3, 2021, to extend the comment period to October 4, 2021, and to make technical corrections. The NOI solicited public input on the significant resources and issues, impact-producing factors, reasonable alternatives, and potential mitigation measures to analyze in the EIS. BOEM also used the NEPA scoping process to initiate the Section 106 consultation process under the National Historic Preservation Act (54 *USC* 300101 et seq.), as permitted by 36 *CFR* 800.2(d)(3), and sought public comment and input through the NOI regarding the identification of historic properties or potential effects on historic properties from activities associated with approval of the Sunrise Wind COP. BOEM held three virtual public scoping meetings on September 16, 20, and 22, 2021, to present information on the Project and NEPA process, answer questions from meeting attendees, and solicit public comments. Scoping comments were received through Regulations.gov on docket number BOEM-2021-0052, via email to a BOEM representative, and through oral testimony at each of the three public scoping meetings. BOEM received a total of 88 comment submissions from federal and state agencies, local governments, non-governmental organizations, and the general public during the scoping period. The topics most referenced in the scoping comments included climate change, NEPA/public involvement process, mitigation and monitoring, commercial fisheries, for-hire recreational fishing, and general support or opposition. BOEM considered all scoping comments while preparing the Draft EIS. Publication of the Draft EIS initiated a 60-day public comment period open to all, after which BOEM assessed and considered all comments received on the Draft EIS during the preparation of the Final EIS. See Appendix A (*Required Environmental Permits and Consultations)* for additional information on public involvement, and Appendix O (*Public Comments and Responses on the Draft Environmental Impact Statement*) for comments received on the Draft EIS.

Alternatives

BOEM considered a reasonable range of alternatives during the EIS development process that emerged from scoping, interagency coordination, and internal BOEM deliberations. The Final EIS evaluates the No Action Alternative and two action alternatives (one of which has sub-alternatives). The Proposed Action (Alternative B) and Alternatives C-1, C-2, and C-3 are not mutually exclusive; BOEM may select a combination of alternatives that meet the purpose and need of the proposed Project. BOEM considered input from cooperating agencies when selecting the Preferred Alternative. The alternatives are as follows:

- Alternative A - No Action Alternative
- Alternative B - Proposed Action
- Alternative C - Fisheries Habitat Impact Minimization Alternative
    - Alternative C-1 - Reduced Layout from Priority Areas via Exclusion of up to Eight WTG Positions

- Alternative C-2 - Reduced Layout from Priority Areas via Exclusion of up to Eight WTG Positions and Relocation of up to 12 WTG Positions to the eastern side of the Lease Area
- Alternative C-3 – Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands

Alternatives considered but dismissed from detailed analysis and the rationale for their dismissal are described in Section 2.2 herein.

Alternatives C-1 and C-2 were also determined to be infeasible through the EIS process as data was further collected and analyzed. However, BOEM determined that including all variants of Alternative C in Section 2.1 provided important context regarding the development of the Preferred Alternative. Additional information is provided in Section 2.1.3 and Chapter 3 regarding the variants of Alternative C.

Alternative A – No Action Alternative

Under the No Action Alternative, BOEM would not approve the COP. Project construction and installation, O&M, and decommissioning would not occur, and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project as described under the Proposed Action would not occur. However, all other past and ongoing impact-producing activities would continue. Under the No Action Alternative, impacts to marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization under the MMPA to the Applicant. The current resource condition, trends, and impacts from ongoing activities under the No Action Alternative serve as the existing baseline against which the direct and indirect impacts of all action alternatives are evaluated.

Over the life of the proposed Project, other reasonably foreseeable future impact-producing offshore wind and non-offshore wind activities would be implemented, which would cause changes to the existing baseline conditions even in the absence of the Proposed Action. The continuation of all other existing and reasonably foreseeable future activities described in Appendix E (*Planned Activities Scenario*) without the Proposed Action serves as the baseline for evaluating the cumulative impacts of all alternatives.

Alternative B – Proposed Action

The Proposed Action would construct, operate, maintain, and decommission up to an approximately 1,034-MW wind energy facility on the Outer Continental Shelf offshore of Massachusetts, Rhode Island, and New York within the range of design parameters described in the Sunrise Wind COP (Sunrise Wind 2023) and summarized in Table ES-1 and Appendix C (*Project Design Envelope and Maximum-Case Scenario*). Refer to the Sunrise Wind COP (Sunrise Wind 2023) for additional details on Project design.

Table ES-1. Summary of Project Design Envelope Parameters

Sunrise Wind Farm (SRWF)	**Foundations** • Monopile foundations for the WTGs and a piled jacket foundation for the OCS-DC • Up to 95 foundations for the WTGs and OCS-DC within 102 potential positions • Maximum embedment depth of up to 164 ft (50 m) for WTG monopile foundations and 295 ft (90 m) for OCS-DC piled jacket foundation • Maximum area of seafloor footprint per foundation, inclusive of scour protection and cable protection system stabilization: 1.06 ac (4,290 m^2) for WTG monopile foundations and 1.39 ac (5,625 m^2) for the OCS-DC foundation structure
	Wind Turbine Generators (WTGs) • Up to 94 WTGs within 102 potential positions • Nameplate capacity of 11 MW • Rotor diameter of 656 ft (200 m) • Hub height of 459 ft (140 m) above mean sea level (AMSL) • Upper blade tip height of 787 ft (240 m) AMSL
	Inter-array Cables (IAC) • Maximum 161-kV AC cables buried up to a target depth of 4 to 6 ft (1.2 to 18 m) • Maximum total length of up to 180 mi (290 km) • Maximum cable diameter of 8 in (200 mm) • Maximum disturbance corridor width of 98 ft (30 m) per circuit
	Offshore Converter Station (OCS-DC) • One OCS-DC • Up to 295 ft (90 m) total structure height from lowest astronomical tide (LAT) (including lightning protection and ancillary structures)
SRWEC-OCS (Outer Continental Shelf waters) and SRWEC-NYS (New York State waters)	**Sunrise Wind Export Cable (SRWEC)** • One 320-kV DC export cable bundle buried to a target depth of 4 to 6 ft (1.2 to 1.8 m) offshore and buried to a target depth of 6 ft (1.8 m) in NYS waters. • Maximum total corridor length of up to 104.6 mi (168.4 km) • Maximum individual cable diameter of 7.8 in (200 mm) and maximum bundled diameter of 15.6 in (400 mm) • Maximum disturbance corridor width of 98 ft (30 m) • Maximum seafloor disturbance for horizontal directional drilling at exit pit of 61.8 ac (25 ha) • Maximum disturbance for Landfall Work Area (onshore) of up to 6.5 ac (2.6 ha)
Onshore Facilities	**Onshore Transmission Cable and onshore interconnection cable** • Onshore transmission cable, including associated transition joint bay and fiber optic cable, up to 17.5 mi (28.2 km) long, with a temporary disturbance corridor of 30 ft (9.1 m) and maximum duct bank target burial depth of 6 ft (1.8 m) • Maximum cable diameter of 6 in (152 mm) • Onshore interconnection cable to connect to the existing Holbrook Substation
	Onshore Converter Station (OnCS-DC) • One OnCS-DC with an operational footprint of up to 6 ac (2.4 ha)

Source: Sunrise Wind 2023

in = inches, ft = feet, m = meters, ac = acres, m^2 = square meters, ha = hectares, mm = millimeters, mi = miles, km = kilometers, MW = Megawatts, kV = kilovolts, AMSL = above mean sea level, AC = alternating current, DC = direct current
SRWEC = Sunrise Wind Export Cable, SRWEC-OCS = Sunrise Wind Export Cable located in waters on the Outer Continental Shelf, SRWEC-NYS = Sunrise Wind Export Cable located in New York State waters, WTGs = wind turbine generators, OCS-DC = offshore converter station - direct current, OnCS-DC = onshore converter station - direct current

Alternative C – Fisheries Habitat Impact Minimization

Under Alternative C, the construction, O&M, and eventual decommissioning of up to a 1,034-MW wind energy facility on the OCS offshore of Massachusetts, Rhode Island, and New York would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. However, Alternative C is proposed with the intent to minimize impacts to fisheries habitats in the proposed Project Area that are the most vulnerable to long-term impacts. This alternative considered and prioritized contiguous areas of complex bottom habitat to be excluded from development to potentially avoid and minimize impacts to complex fisheries habitats, while still meeting BOEM's purpose and need for the Project.

Areas for prioritization were identified by NMFS on May 2, 2022, based upon the proximity of Atlantic cod spawning activity in the vicinity of the Project Area, assumed hard bottom complex substrate, and the presence of large boulders (Figure 2.1-7). Priority Area 1 was deemed the higher priority by NMFS due to the close proximity to Cox Ledge and documented Atlantic cod spawning activity based on recent acoustic and telemetry data. Priority Area 1 includes 18 wind turbine generator (WTG) positions as well as the OCS-DC. Priority Area 2 includes 18 WTG positions, contains areas of high reflectance (indicative of hard substrates) and large boulders, and is adjacent to detected Atlantic cod spawning activity. Priority Area 3 includes 14 WTG positions and areas of high reflectance but fewer large boulders. Priority Area 4 includes 4 WTG positions and mid-to-high reflectance with large boulders.

Each of the sub-alternatives below may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need.

Alternative C-1: Sunrise Wind's proposed layout includes 102 WTG positions; however, only 94 11-MW WTGs would be needed to meet the Project's maximum capacity of up to 1,034 MW[3]. Under Alternative C-1, the construction and installation, O&M, and eventual decommissioning of a wind energy facility and an OCS-DC would occur within the design parameters outlined in the Sunrise Wind Project COP (Sunrise Wind 2023) subject to applicable mitigation measures. However, certain WTG positions would be excluded from the identified Priority Areas to reduce impacts to sensitive benthic habitats and areas where Atlantic cod spawning has been detected. Under this alternative, the Project would maintain a uniform east-west and north-south grid of 1 by 1-nautical mile (nm) spacing between WTGs. Alternative C-1 would result in the exclusion of up to 8 WTG positions from the identified Priority Areas. The specific 8 WTG positions that would be excluded from the identified Priority Areas are informed through the impact analysis described in Chapter 3.

Alternative C-2: Under Alternative C-2, up to 8 WTG positions identified for exclusion from development in Alternative C-1 would remain the same, and up to an additional 12 WTG positions would be removed from the Priority Areas and relocated to the eastern side of the Lease Area. The construction and installation, O&M, and eventual decommissioning of a wind energy facility and an OCS-DC would occur

[3] Sunrise Wind executed a contract with the New York State Energy Research and Development Authority (NYSERDA) for a 25-year Offshore Wind Renewable Energy Certificate (OREC) Agreement in October 2019 that allows NYSERDA to purchase up to 924 MW of offshore wind energy. Sunrise Wind is exploring opportunities to enter into other potential offtake agreements or sell additional electricity (up to 110 MW) on a merchant basis.

within the design parameters outlined in the Sunrise Wind Project COP (Sunrise Wind 2023) subject to applicable mitigation measures. The Project would maintain a uniform east-west and north-south grid of 1 by 1-nm spacing between WTGs. Alternative C-2 assumes that habitat on the eastern side of the Lease Area is suitable for development. The specific WTG positions that would be excluded from the identified Priority Areas are informed through the impact analysis described in Chapter 3.

Alternative C-3: Alternative C-3 was developed following publication of the Draft EIS to address concerns regarding pile refusal due to glauconite sands present within the southeastern and eastern portions of the Lease Area while still minimizing impacts to benthic and fisheries resources. Alternative C-3a, C-3b, and C-3c consider different WTG configurations to avoid sensitive habitats and engineering constraints while still meeting the New York State Energy Research and Development Authority's (NYSERDA) Offshore Wind Renewable Energy Certificate (OREC) Purchase and Sale Agreement. An ancillary habitat impact minimization benefit of this alternative is that 13 WTGs are removed from Priority Areas 2 and 3 because of the presence of glauconite sands. Under Sub-Alternative C-3a, up to 87 WTGs would be installed in the 87 potential positions[4]. Under Sub-Alternative C-3b, up to 84 WTGs would be installed in the 87 potential positions[4]. Under Sub-Alternative C-3c, 80 WTGs would be installed in the 87 potential positions[4]. Under Alternatives C-3b and C-3c, some WTG positions may also be removed from Priority Area 1, as detailed in Chapter 3.

Preferred Alternative

After carefully considering the EIS alternatives, including feedback and information received from the public, cooperating agencies, tribal nations, key stakeholder groups (e.g., commercial fishermen), and the Applicant, BOEM has identified Sub-Alternative C-3b (924 MW Option) as the Preferred Alternative. This alternative also considers the results of BOEM's independent feasibility review and economic feasibility analysis.

The Preferred Alternative would occur within the range of design parameters outlined in the Sunrise Wind COP and is subject to applicable mitigation, which includes measures that SRW has committed to implement to avoid or reduce impacts. The Preferred Alternative would include micrositing of WTG positions and certain segments of inter-array cables to avoid complex benthic habitats, boulders, UXOs, shipwrecks, and other sensitive seafloor resources.

Environmental Impacts

This EIS uses a four-level classification scheme to characterize the potential beneficial and adverse impacts of alternatives as either negligible, minor, moderate, or major. Resource-specific adverse and beneficial impact level definitions are presented in each Chapter 3 resource section.

[4] Based on Appendix G-3 Foundation Feasibility Assessment dated June 30, 2023, only 84 WTGs out of the 87 WTG analyzed are feasible for development. WTG positions No. 77, 107, and 137 were determined to be infeasible due to presence of glauconitic sands (Public Facing Version; Ørsted Offshore North America 2023b).

BOEM analyzes the impacts of past and ongoing activities in the absence of the Project as the No Action Alternative. The No Action Alternative is the baseline against which all action alternatives are evaluated. BOEM also separately analyzes cumulative impacts of the No Action Alternative, which considers all other ongoing and reasonably foreseeable future activities described in Appendix E (*Planned Activities Scenario*). In this analysis, the cumulative impacts of the No Action Alternative serve as the baseline against which the cumulative impacts of all action alternatives are evaluated. Table ES-2 summarizes the impacts and cumulative impacts of each alternative. Under the No Action Alternative, the environmental and socioeconomic impacts and benefits of the action alternatives would not occur.

NEPA implementing regulations (40 *CFR* 1502.16) require that an EIS evaluate the potential unavoidable adverse impacts associated with a Proposed Action. Adverse impacts that can be reduced by mitigation measures but not eliminated are considered unavoidable. The same regulations also require that an EIS review the potential impacts of irreversible or irretrievable commitments of resources resulting from implementation of a Proposed Action. Irreversible commitments occur when the primary or secondary impacts from the use of a resource either destroy the resource or preclude it from other uses. Irretrievable commitments occur when a resource is consumed to the extent that it cannot recover or be replaced.

Chapter 4, *Other Required Impact Analyses*, describes potential unavoidable adverse impacts. Most potential unavoidable adverse impacts associated with the Proposed Action would occur during the construction phase and would be short-term. Chapter 4 also describes the irreversible and irretrievable commitment of resources by resource area. The most notable of such commitments could include effects on habitat or individual members of protected species, as well as potential loss of use of commercial fishing areas.

Table ES-2. Summary and Comparison of Maximum Overall Impacts among Alternatives

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C-1 Fisheries Habitat Impact Minimization (exclude 8 WTG positions)	Alternative C-2 Fisheries Habitat Impact Minimization (exclude up to 8 WTG positions and relocate up to 12 WTG positions)	Alternative C-3 Fisheries Habitat Impact Minimization (reduced layout considering feasibility due to glauconite sands)	Preferred Alternative (Up to 84 WTGs in 87 potential positions: Reduced Layout from Priority Areas by exclusion of 3 WTG positions)
3.4 Air Quality						
Alternative Impacts	**Minor** to **moderate; Minor** to **moderate beneficial**	**Minor** to **moderate; Minor** to **moderate beneficial**	**Minor** to **moderate; Minor** to **moderate beneficial**	**Minor** to **moderate; Minor** to **moderate beneficial**	**Minor** to **moderate; Minor** to **moderate beneficial**	**Minor** to **moderate; Minor** to **moderate beneficial**
Cumulative Impacts	**Minor** to **moderate; Minor** to **moderate beneficial**	**Minor** to **moderate; Minor** to **moderate beneficial**	**Minor** to **moderate; Minor** to **moderate beneficial**	**Minor** to **moderate; Minor** to **moderate beneficial**	**Minor** to **moderate; Minor** to **moderate beneficial**	**Minor** to **moderate; Minor** to **moderate beneficial**
3.5 Water Quality						
Alternative Impacts	**Minor**	**Minor**	**Minor**	**Minor**	**Minor**	**Minor**
Cumulative Impacts	**Minor**	**Minor**	**Minor**	**Minor**	**Minor**	**Minor**
3.6 Bats						
Alternative Impacts	**Minor**	**Minor**	**Minor**	**Minor**	**Minor**	**Minor**
Cumulative Impacts	**Minor**	**Minor**	**Minor**	**Minor**	**Minor**	**Minor**

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C-1 Fisheries Habitat Impact Minimization (exclude 8 WTG positions)	Alternative C-2 Fisheries Habitat Impact Minimization (exclude up to 8 WTG positions and relocate up to 12 WTG positions)	Alternative C-3 Fisheries Habitat Impact Minimization (reduced layout considering feasibility due to glauconite sands)	Preferred Alternative (Up to 84 WTGs in 87 potential positions: Reduced Layout from Priority Areas by exclusion of 3 WTG positions)
3.7 Benthic Resources						
Alternative Impacts	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**
Cumulative Impacts	**Moderate; Moderate beneficial**	**Moderate; Moderate beneficial**	**Moderate; Moderate beneficial**	**Moderate; Moderate beneficial**	**Moderate, Moderate beneficial**	**Moderate, Moderate beneficial**
3.8 Birds						
Alternative Impacts	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**
Cumulative Impacts	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**
3.9 Coastal Habitat and Fauna						
Alternative Impacts	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**
Cumulative Impacts	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**
3.10 Finfish, Invertebrates, and Essential Fish Habitat						
Alternative Impacts	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**
Cumulative Impacts	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C-1 Fisheries Habitat Impact Minimization (exclude 8 WTG positions)	Alternative C-2 Fisheries Habitat Impact Minimization (exclude up to 8 WTG positions and relocate up to 12 WTG positions)	Alternative C-3 Fisheries Habitat Impact Minimization (reduced layout considering feasibility due to glauconite sands)	Preferred Alternative (Up to 84 WTGs in 87 potential positions: Reduced Layout from Priority Areas by exclusion of 3 WTG positions)
3.11 Marine Mammals[5]						
Alternative Impacts (without baseline)	**No impact**	**Moderate** for NARWs; **Minor** to **moderate** for mysticetes (other than NARWs), odontocetes, and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds	**Moderate** for NARWs; **Minor** to **moderate** for other mysticetes, odontocetes and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds	**Moderate** for NARWs; **Minor** to **moderate** for other mysticetes, odontocetes and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds	**Moderate** for NARWs; **Minor** to **moderate** for other mysticetes, odontocetes and pinnipeds**;** **Minor beneficial** for odontocetes and pinnipeds	**Moderate** for NARWs; **Minor** to **moderate** for other mysticetes, odontocetes and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds
Alternative Impacts (with baseline)	**Moderate** for mysticetes (other than NARWs); **Minor** to **moderate** impacts for odontocetes and pinnipeds;	**Minor** to **moderate** for mysticetes (other than NARWs), odontocetes, and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds**;**	**Minor** to **moderate** for mysticetes (other than NARWs), odontocetes, and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds	**Minor** to **moderate** for mysticetes (other than NARWs), odontocetes, and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds	**Minor** to **moderate** for mysticetes (other than NARWs), odontocetes, and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds	**Minor** to **moderate** for mysticetes (other than NARWs), odontocetes, and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds

[5] For marine mammals BOEM has assessed the impacts of the No Action Alternative and action alternatives with and without the environmental baseline (e.g., ongoing activities) to support determinations under the Marine Mammal Protection Act. Impacts including the environmental baseline were assessed as major for the No Action Alternative and action alternatives for the North Atlantic right whale (NARW) because ongoing activities such as entanglement and vessel strikes continue to compromise the viability of the species due to their low population numbers and downward population trends. The complete list of impact-producing factors that determined the impact range is described in Section 3.1 and Appendix E, Table E1-12 of this Final EIS.

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C-1 Fisheries Habitat Impact Minimization (exclude 8 WTG positions)	Alternative C-2 Fisheries Habitat Impact Minimization (exclude up to 8 WTG positions and relocate up to 12 WTG positions)	Alternative C-3 Fisheries Habitat Impact Minimization (reduced layout considering feasibility due to glauconite sands)	Preferred Alternative (Up to 84 WTGs in 87 potential positions: Reduced Layout from Priority Areas by exclusion of 3 WTG positions)
	Minor beneficial for odontocetes and pinnipeds					
	Major for NARW	**Major** for NARW	**Major** for NARW	**Major** for NARW	**Major** for NARW	**Major** for NARW
Cumulative Impacts	**Moderate** for mysticetes (other than NARWs), odontocetes, and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds	**Moderate** for mysticetes (other than NARWs), odontocetes, and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds	**Moderate** for mysticetes (other than NARWs), odontocetes, and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds	**Moderate** for mysticetes (other than NARWs), odontocetes, and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds	**Moderate** for mysticetes (other than NARWs), odontocetes, and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds	**Moderate** for mysticetes (other than NARWs), odontocetes, and pinnipeds; **Minor beneficial** for odontocetes and pinnipeds
	Major for NARW	**Major** for NARW	**Major** for NARW	**Major** for NARW	**Major** for NARW	**Major** for NARW
3.12 Sea Turtles						
Alternative Impacts	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**
Cumulative Impacts	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**
3.13 Wetlands and Other Waters of the United States						
Alternative Impacts	**Minor**	**Minor**	**Minor**	**Minor**	**Minor**	**Minor**
Cumulative Impacts	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C-1 Fisheries Habitat Impact Minimization (exclude 8 WTG positions)	Alternative C-2 Fisheries Habitat Impact Minimization (exclude up to 8 WTG positions and relocate up to 12 WTG positions)	Alternative C-3 Fisheries Habitat Impact Minimization (reduced layout considering feasibility due to glauconite sands)	Preferred Alternative (Up to 84 WTGs in 87 potential positions: Reduced Layout from Priority Areas by exclusion of 3 WTG positions)
3.14 Commercial Fisheries and For-Hire Recreational Fishing						
Alternative Impacts	**Minor** to **major** for commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation; **Minor beneficial**	**Minor** to **major** for commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation; **Minor beneficial**	**Minor** to **major** for commercial fishing; **Minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation; **Minor beneficial**	**Minor** to **major** for commercial fishing; **Minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation; **Minor beneficial**	**Minor** to **major** for commercial fishing; **Minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation; **Minor beneficial**	**Minor** to **major** for commercial fishing; **Minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation; **Minor beneficial**
Cumulative Impacts	**Moderate** to **major** for commercial fisheries and **minor** to **moderate** for for-hire recreational fishing depending on the fishery and fishing operation; **Minor** to **moderate beneficial**	**Major**	**Major**	**Major**	**Major**	**Major**
3.15 Cultural Resources						
Alternative Impacts	**Major**	**Major**	**Major**	**Major**	**Major**	**Major**
Cumulative Impacts	**Major**, **Minor beneficial**	**Major**, **Minor beneficial**	**Major**, **minor beneficial**	**Major**, **Minor beneficial**	**Major**; **Minor beneficial**	**Major**; **Minor beneficial**

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C-1 Fisheries Habitat Impact Minimization (exclude 8 WTG positions)	Alternative C-2 Fisheries Habitat Impact Minimization (exclude up to 8 WTG positions and relocate up to 12 WTG positions)	Alternative C-3 Fisheries Habitat Impact Minimization (reduced layout considering feasibility due to glauconite sands)	Preferred Alternative (Up to 84 WTGs in 87 potential positions: Reduced Layout from Priority Areas by exclusion of 3 WTG positions)
3.16 Demographics, Employment, and Economics						
Alternative Impacts	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**	**Minor; Minor beneficial**
Cumulative Impacts	**Minor; Moderate beneficial**	**Minor; Moderate beneficial**	**Minor; Moderate beneficial**	**Minor; Moderate beneficial**	**Minor; Moderate beneficial**	**Minor; Moderate beneficial**
3.17 Environmental Justice						
Alternative Impacts	**Minor** to **moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**
Cumulative Impacts	**Minor** to **moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**
3.18 Land Use and Coastal Infrastructure						
Alternative Impacts	**Minor, Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**
Cumulative Impacts	**Minor, Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**	**Moderate; Minor beneficial**
3.19 Navigation and Vessel Traffic						
Alternative Impacts	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**
Cumulative Impacts	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**
3.20 Other Uses						

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C-1 Fisheries Habitat Impact Minimization (exclude 8 WTG positions)	Alternative C-2 Fisheries Habitat Impact Minimization (exclude up to 8 WTG positions and relocate up to 12 WTG positions)	Alternative C-3 Fisheries Habitat Impact Minimization (reduced layout considering feasibility due to glauconite sands)	Preferred Alternative (Up to 84 WTGs in 87 potential positions: Reduced Layout from Priority Areas by exclusion of 3 WTG positions)
Alternative Impacts	**Negligible** for marine mineral extraction, marine and national security uses, aviation and air traffic, cables and pipelines, and radar systems; **Major** for scientific research and surveys	**Negligible** for marine mineral extraction, cables, and pipelines; **Minor** for aviation and air traffic, most military and national security uses, and radar systems; **Moderate** for United States Coast Guard (USCG) Search and rescue (SAR) operations; **Major** for scientific research and surveys	**Negligible** for marine mineral extraction, cables, and pipelines; **Minor** for aviation and air traffic, most military and national security uses, and radar systems; **Moderate** for USCG SAR operations; **Major** for scientific research and surveys	**Negligible** for marine mineral extraction, cables, and pipelines; **Minor** for aviation and air traffic, most military and national security uses, and radar systems; **Moderate** for USCG SAR operations; **Major** for scientific research and surveys	**Negligible** for marine mineral extraction, cables, and pipelines; **Minor** for aviation and air traffic, military and national security uses, and radar systems; **Moderate** for USCG SAR operations; **Major** for scientific research and surveys	**Negligible** for marine mineral extraction, cables, and pipelines; **Minor** for aviation and air traffic, military and national security uses, and radar systems; **Moderate** for USCG SAR operations; **Major** for scientific research and surveys
Cumulative Impacts	**Negligible** for marine mineral extraction; **Minor** for aviation and air traffic, and cables and pipelines; **Moderate** for radar	**Negligible** for marine mineral extraction, and cables and pipelines; **Minor** for aviation and	**Negligible** for marine mineral extraction, and cables and pipelines; **Minor** for aviation and air	**Negligible** for marine mineral extraction, and cables and pipelines; **Minor** for aviation and	**Negligible** for marine mineral extraction, and cables and pipelines; **Minor** for aviation and	**Negligible** for marine mineral extraction, and cables and pipelines; **Minor** for aviation and air

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C-1 Fisheries Habitat Impact Minimization (exclude 8 WTG positions)	Alternative C-2 Fisheries Habitat Impact Minimization (exclude up to 8 WTG positions and relocate up to 12 WTG positions)	Alternative C-3 Fisheries Habitat Impact Minimization (reduced layout considering feasibility due to glauconite sands)	Preferred Alternative (Up to 84 WTGs in 87 potential positions: Reduced Layout from Priority Areas by exclusion of 3 WTG positions)
	systems; **Minor** for military and national security; **Moderate** for SAR activities; **Major** for scientific research and surveys	air traffic, and most military and national security uses; **Moderate** for radar systems; **Major** for USCG SAR operations and scientific research and surveys	traffic, and most military and national security uses; **Moderate** for radar systems; **Major** for USCG SAR operations and scientific research and surveys	air traffic, and most military and national security uses; **Moderate** for radar systems; **Major** for USCG SAR operations and scientific research and surveys	air traffic, and most military and national security uses; **Moderate** for radar systems; **Major** for USCG SAR operations and scientific research and surveys	traffic, and most military and national security uses; **Moderate** for radar systems; **Major** for USCG SAR operations and scientific research and surveys
3.21 Recreation and Tourism						
Alternative Impacts	**Moderate**; **Minor beneficial**	**Moderate**; **Minor beneficial**	**Moderate**; **Minor beneficial**	**Moderate**; **Minor beneficial**	**Moderate**; **Minor beneficial**	**Moderate**; **Minor beneficial**
Cumulative Impacts	**Moderate**; **Minor beneficial**	**Moderate**; **Minor beneficial**	**Moderate**; **Minor beneficial**	**Moderate**; **Minor beneficial**	Moderate; **Minor beneficial**	**Moderate**; **Minor beneficial**
3.22 Scenic and Visual Resources						
Alternative Impacts	**Moderate**	**Major**	**Major**	**Major**	**Major**	**Major**
Cumulative Impacts	**Major**	**Major**	**Major**	**Major**	**Major**	**Major**

Impact rating colors are as follows: orange = major; yellow = moderate; green = minor; light green = negligible or beneficial to any degree. All impact levels are assumed to be adverse unless otherwise specified as beneficial. Where impacts are presented as multiple levels, the color representing the most adverse level of impact has been applied.

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ABBREVIATIONS AND ACRONYMS

°C	degrees Celsius
°F	degrees Fahrenheit
µg/L	micrograms per liter
µPa	micropascals
μPa^2s	1 micropascal squared second
µT	microteslas
A	
AAPA	American Association of Port Authorities
ac	acre(s)
AC	alternating current
ACCOL	Anderson Cabot Center for Ocean Life
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
ADCP	Acoustic Doppler Current Profiler
ADLS	Aircraft Detection Lighting System
AEL	adult equivalent losses
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
AMAPPS	Atlantic Marine Assessment Program for Protected Species
AMSL	above mean sea level
APE	Area of Potential Effect
APM	Applicant Proposed Measure
Applicant	Sunrise Wind LLC
AQRV	air quality related value
ASLF	ancient submerged landforms
ASMFC	Atlantic States Marine Fisheries Commission
ASV	autonomous surface vehicle
ATON	Aids to Navigation
AUV	autonomous underwater vehicles
AWEA	American Wind Energy Association
B	
BACT	Best Available Control Technology
BEA	Bureau of Economic Analysis

BIWF	Block Island Wind Farm
BMP	best management practice
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement

C

CAA	Clean Air Act
Call	Call for Information and Nominations
CCCRRF	Climate Change and Coastal Resiliency Reserve Funds
CDP	Census Designated Place
CEA	Critical Environmental Area
CECP	Clean Energy and Climate Plan
CEJSC	Commission on EJ and Sustainable Communities
CEQ	Council on Environmental Quality
CES	Comprehensive Energy Strategy
CFE	controlled flow excavation
CFR	Code of Federal Regulations
CH_4	methane
CIRCA	Connecticut Institute for Resilience & Climate Adaptation
CLCPA	Climate Leadership and Community Protection Act
CLIEC	Caithness Long Island Energy Center
cm	centimeter
cm/s	centimeters per second
CMECS	Coastal and Marine Ecological Classification Standard
CO	carbon monoxide
CO_2	carbon dioxide
CO_{2e}	carbon dioxide equivalent
COA	corresponding onshore area
COBRA	CO-Benefits Risk Assessment
COP	Construction and Operations Plan
CPA	Connecticut Port Authority
CPS	cable protection system
CREDC	Capital Region Economic Development Council
CRRA	Community Risk and Resiliency Act
CT	Connecticut
CTV	crew transfer vessel

CVA	Certified Verification Agent
CVOW	Coastal Virginia Offshore Wind
CWA	Clean Water Act
CWIS	cooling water intake system
cy	cubic yard(s)

D

dB	decibel
dBA	decibels on the A-weighted scale
dB_{RMS}	decibel root mean square
DC	direct current
DDT	dichlorodiphenyltrichloroethane
DECD	Department of Economic and Community Development
DEEP	Department of Energy and Environmental Protection
DIF	design intake flow
DMA	Dynamic Management Area
DO	dissolved oxygen
DOD	[United States] Department of Defense
DOE	[United States] Department of Energy
DOER	Dredging Operations and Environmental Research Program
DoN	[United States] Department of the Navy
DOT	Department of Transportation
DP	dynamic positioning
DPS	distinct population segments
DSM	digital surface map
DTM	digital terrain model
DVTA	Disaster Village Training Area

E

EA	Environmental Assessment
EEA	Executive Office of Energy and Environmental Affairs
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice
EM&CP	Environmental Management and Construction Plan

EMF	electric and magnetic field
eNGOs	environmental nongovernmental organizations
EPA	[United States] Environmental Protection Agency
EPM	environmental protection measure
EPRI	Electric Power Research Institute
ESA	Endangered Species Act
Eversource	Eversource Investment LLC

F

FAA	Federal Aviation Administration
FBRMP	Fisheries and Benthic Research Monitoring Plan
FDR/FIR	Facility Design Report/Fabrication and Installation Report
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FIMP	Fire Island Inlet to Montauk Point
FLIDAR	floating light detection and ranging
FMP	Fishery Management Plan
FOV	field of view
FR	Federal Register
ft	foot/feet
ft^2	square feet
FTE	full-time equivalent

G

G&G	geophysical and geotechnical
GAA	geographic analysis area
gal	gallon(s)
GARFO	Greater Atlantic Regional Fisheries Office
GDP	gross domestic product
GHG	greenhouse gas
GIS	geographic information system
GW	gigawatt(s)
GWSA	Global Warming Solutions Act

H

ha	hectare(s)
HabCam	Habitat Mapping Camera
HAP	hazardous air pollutant
HAPC	Habitat Areas of Particular Concern
HD	high definition
HDD	horizontal directional drilling
HF	high-frequency
HMS	highly migratory species
HRG	high-resolution geophysical
HRVEA	Historic Resources Visual Effects Analysis
HSE	Health, Safety, and Environment
HVAC	high voltage alternating current
HVDC	high voltage direct current
Hz	hertz

I

IAC	inter-array cables
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICPC	International Cable Protection Committee
ICW	Intracoastal Waterway
IEC	International Electrotechnical Commission
IMO	International Maritime Organization
in	inch(es)
IOOS	Integrated Ocean Observing System
iPaC	Information for Planning and Consultation
IPCC	Intergovernmental Panel on Climate Change
IPF	impact-producing factor
IR	infrared
IRP	Integrated Resource Plan
ISMP	Invasive Species Management Plan
ITA	Incidental Take Authorization
IVM	Integrated Vegetation Management
IWG	Interagency Working Group

J

JASMINE	JASCO Animal Simulation Model Including Noise Exposure
JEDI	Jobs and Economic Development Impact

K

kg	kilogram(s)
kHz	kilohertz
kJ	kilojoules
km	kilometer(s)
km^2	square kilometers
KOP	key observation point
kV	kilovolt(s)
kW	kilowatt(s)

L

L	liter(s)
LAER	lowest achievable emission rate
LAT	lowest astronomical tide
lbs	pounds
LCA	landscape character area
Lease Area	Lease Area OCS-A 0487
Lessee	Sunrise Wind LLC
LIDAR	light detection and ranging
LIE	Long Island Expressway
LIRR	Long Island Railroad
LME	Large Marine Ecosystem
LNG	liquified natural gas
LOA	Letter of Authorization
LOD	limit of disturbance
L_{pk}	peak sound pressure level
LSZ	landscape similarity zone

M

m	meter(s)
m^2	square meters
M&SI	mortality and serious injury

m/s	meters per second
MA	Massachusetts
MAFMC	Mid-Atlantic Fishery Management Council
MARA	marine archaeological resource assessment
MARAD	Maritime Administration
MARCS	Marine Accident Risk Calculation System
MARPOL	International Convention for the Prevention of Pollution from Ships
MassCEC	Massachusetts Clean Energy Center
MassDEP	Massachusetts Department of Environmental Protection
MCDA	multi-criteria decision algorithm
MDE	Maryland Department of the Environment
MEC	munitions and explosives of concern
MEPA	Massachusetts Environmental Policy Act
mG	milligauss
mg	milligram
mgd	million gallons per day
MHHW	mean higher high water
MHWL	mean high water line
mi	statute mile(s)
mi^2	square miles
MLLW	mean lower low water
MLW	mean low water
mm	millimeter(s)
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
mph	miles per hour
MPT	Maintenance and Protection of Traffic
MRASS	mariner radio-activated sound signals
MRIP	Marine Recreational Information Program
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSIR	Marine Site Investigation Report
MSL	mean sea level
mT	metric ton(s)
MTA	Metropolitan Transit Authority
mV/m	millivolts per meter
MVP	Municipal Vulnerability Preparedness Grant Program

MW	megawatt(s)

N

N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NARW	North Atlantic right whales
NAS	noise attenuation systems
NCCR	National Coastal Condition Reports
NDRC	National Disaster Relief Competition
NEAMAP	Northeast Area Monitoring and Assessment Program
NECI	National Centers for Environmental Information
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEMEDS	New England Marine Energy Development System
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NJ DEP	New Jersey Department of Environmental Protection
NLPSC	Northeast Large Pelagic Survey Collaborative
nm	nautical mile(s)
NMFS	National Marine Fisheries Service
NNSR	Nonattainment New Source Review
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NO_X	nitrogen oxides
NPCC	Northeast Power Coordinating Council, Inc.
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NRPB	Northeast Regional Planning Body
NSRA	Navigation Safety Risk Assessment
NSR	noise sensitive receptor
NVD	night vision devices
NVIC	Navigation and Vessel Inspection Circular

NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
NY	New York
NYB	New York Bight
NYCRR	New York Codes, Rules and Regulations
NYISO	New York Independent System Operator
NYMRC	New York Marine Rescue Center
NYNHP	New York Natural Heritage Program
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
NYSDOT	New York State Department of Transportation
NYSDPS	New York State Department of Public Service
NYSERDA	New York State Energy Research and Development Authority
NYSHPO	New York State Historic Preservation Office

O

O&M	operations and maintenance
OBC	Overburdened Community
O_3	ozone
OCA	ocean character area
OCS	Outer Continental Shelf
OCS-DC	offshore converter station
OCSLA	Outer Continental Shelf Lands Act
OER	[Rhode Island] Office of Energy Resources
OMB	[United States] Office of Management and Budget
OnCS-DC	onshore converter station
OPR	[NOAA Fisheries] Office of Protected Resources
OREC	Offshore Wind Renewable Energy Certificate Purchase and Sale Agreement
Ørsted	Ørsted North America, Inc.
OSRP	Oil Spill Response Plan
OSS	offshore substation
OSW	offshore wind

P

PAM	passive acoustic monitoring

PAPE	Preliminary Area of Potential Effect
PATON	Private Aids to Navigation
PCBs	polychlorinated biphenyls
PDE	Project Design Envelope
PECP	Permits and Environmental Compliance Plan
PEJA	Potential Environmental Justice Area
PIT	passive integrated transponder
PK	zero-to-peak sound pressure level
PM	particulate matter
PM_{10}	particulate matter less than 10 micrometers in aerodynamic diameter
$PM_{2.5}$	particulate matter less than 2.5 micrometers in aerodynamic diameter
Project	Sunrise Wind Offshore Wind Project, Sunrise Wind Project, or Sunrise Wind Farm Project
PSD	Prevention of Significant Deterioration
PSMMP	Protected Species Mitigation and Monitoring Plan
PSO	protected species observer
PSS	practical salinity scale
PTM	particle tracking model
PTS	Permanent Threshold Shift

R

RARMS	Risk Assessment with Risk Mitigation Strategy
RCS	radar cross-section
RFI	Request for Interest
RHA	Rivers and Harbors Appropriation Act of 1899
RI	Rhode Island
RICRMC	Rhode Island Coastal Resources Management Council
RIDEM	Rhode Island Department of Environmental Management
RISDS	Rhode Island Sound Disposal Site
RITE	Roosevelt Island Tidal Energy
ROD	record of decision
ROI	region of influence
ROSA	Responsible Offshore Science Alliance
ROV	remotely operated vehicle
ROW	right-of-way
RSZ	rotor-swept zone

RTE	rare, threatened, and endangered
RWSAS	Right Whale Sighting Advisory System

S

SAMP	Special Area Management Plan
SAP	Site Assessment Plan
SAR	search and rescue
SAV	submerged aquatic vegetation
SBMT	South Brooklyn Marine Terminal
SC-GHG	social cost of greenhouse gas
SCA	seascape character area
SCADA	supervisory control and data acquisition
SCDHS	Suffolk County Department of Health Services
SCFWH	Significant Coastal Fish and Wildlife Habitats
SEFSC	Southeast Fisheries Science Center
SD	standard deviation
SEL	sound exposure level
SEL_{cum}	cumulative sound exposure level
SEL_{max}	maximum sound exposure level
SF_6	sulfur hexafluoride
SFW	South Fork Wind
SHPO	State Historic Preservation Office
SLIA	Seascape and Landscape Impact Assessment
SLVIA	Seascape, Landscape, and Visual Impacts methodology
SMA	seasonal management area
SO_2	sulfur dioxide
SOV	service operating vessel
SPCC	spill prevention, control, and countermeasure
SPDES	State Pollutant Discharge Elimination System
SPL	sound pressure level
SPL_{rms}	sound pressure level, root-mean-square
SRW	Sunrise Wind LLC
SRWEC	Sunrise Wind Export Cable
SRWEC-NYS	Sunrise Wind Export Cable located in New York State waters
SRWEC-OCS	Sunrise Wind Export Cable located in waters on the Outer Continental Shelf

SRWF	Sunrise Wind Farm
SSER	South Shore Estuary Reserve
SST	sea surface temperature
STIP	State Transportation Improvement Program
Sunrise Wind	Sunrise Wind LLC
SWPPP	Stormwater Pollution Prevention Plan

T

TCP	Traditional Cultural Properties
TDR	Transfer of Development Rights
TJB	transition joint bay
TNT	trinitrotoluene
TOD	transit-oriented design
TOPSIS	Technique for Order Preference by Similarity of Ideal Solution
TP	transition piece
tpy	tons per year
ts	trout spawning
TSS	total suspended sediment
TTS	Temporary Threshold Shift

U

UME	unusual mortality event
U.S.	United States
USACE	United States Army Corps of Engineers
USC	United States Code
USCB	United States Census Bureau
USCG	United States Coast Guard
USDOI	United States Department of the Interior
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UXO	unexploded ordnance

V

VADEQ	Virginia Department of Environmental Quality

VCEJ	Virginia Council on Environmental Justice
VHF	very high-frequency
VFD	variable frequency drive
VIA	Visual Impact Assessment
VMS	vessel monitoring system
VOC	volatile organic compound
VRA	Visual Resources Assessment
VSA	Visual Study Area
VSR	visually sensitive resource

W

WDA	Wind Development Area
WEA	Wind Energy Area
WIIA	Water Infrastructure Improvement Act
WOTUS	waters of the United States
WQIP	Water Quality Improvement Project
WTC	wind turbine clutter
WTG	wind turbine generator

Z

ZVI	Zone of Visual Influence

Chapter 1

Introduction

1.0 INTRODUCTION

This Final Environmental Impact Statement (EIS) assesses the potential reasonably foreseeable environmental, social, economic, historic, and cultural impacts that could result from the construction, operations and maintenance (O&M), and conceptual decommissioning of the Sunrise Wind Project (Project) proposed by Sunrise Wind LCC (Sunrise Wind, Applicant, or Lessee), in its Construction and Operations Plan (COP) (Sunrise Wind 2023).[6] The proposed Project described in the COP and this Final EIS would have a nameplate capacity of up to 1,034 megawatts (MW) and sited within Lease Area OCS-A 0487 (Lease Area), approximately 18.9 statute miles (mi) (16.4 nautical miles [nm], 30.4 kilometers [km]) south of Martha's Vineyard, Massachusetts, and approximately 30.5 mi (26.5 nm, 48.1 km) east of Montauk, New York, and 16.7 mi (14.5 nm, 26.8 km) from Block Island, Rhode Island. The Project would provide clean, reliable offshore wind energy to the state of New York[7] and could potentially offer additional offtake agreements or sell additional electricity on a merchant basis. This Final EIS will inform the United States Department of Interior (USDOI), Bureau of Ocean Energy Management (BOEM) in deciding whether to approve, approve with modifications, or reject the COP (30 *Code of Federal Regulations* [*CFR*] 585.628). Publication of the Draft EIS initiated a 60-day public comment period. BOEM used the comments received during the public review period to inform preparation of the Final EIS.

This Final EIS was prepared following the requirements of the National Environmental Policy Act (NEPA) (42 *United States Code* [*USC*] 4321 et seq.) and implementing regulations (40 *CFR* 1500-1508). The Council on Environmental Quality's (CEQ) current regulations contain a presumptive time limit of 2 years for completing EISs, and a presumptive page limit of 150 pages or fewer or 300 pages for proposals of unusual scope or complexity. BOEM followed those limits in preparing this Final EIS in accordance with the new regulations. Additionally, this Final EIS was prepared consistent with the USDOI NEPA regulations (43 *CFR* 46); longstanding federal judicial and regulatory interpretations; and Administration priorities and policies, including Secretary's Order No. 3399 entitled *Department-Wide Approach to the Climate Crisis and Restoring Transparency and Integrity to the Decision-Making Process*, dated April 16, 2021, requiring bureaus and offices to not apply any of the provisions of the 2020 changes to CEQ Regulations (85 *Federal Register* 43304-43376) "in a manner that would change the application or level of NEPA that would have been applied to a Proposed Action before the 2020 Rule went into effect."[8]

[6] The Sunrise Wind COP is available on BOEM's website: https://www.boem.gov/renewable-energy/state-activities/sunrise-wind.

[7] Sunrise Wind executed a contract with the New York State Energy Research and Development Authority (NYSERDA) for a 25-year Offshore Wind Renewable Energy Certificate (OREC) Agreement in October 2019. Under the OREC Agreement, NYSERDA would purchase ORECs for 880 MW of offshore wind energy, with the ability to increase by 5 percent without requiring an amendment (totaling up to 924 MW), generated by the operational Project and make them available for purchase by New York load-serving entities. The Project is being developed to fulfill its obligations to New York in accordance with its OREC Agreement.

[8] Secretarial Order 3399 is available on the Department of Interior's website: https://www.doi.gov/sites/doi.gov/files/elips/documents/so-3399-508_0.pdf

1.1 Background

In 2009, the USDOI announced final regulations for the Outer Continental Shelf (OCS) Renewable Energy Program, which was authorized by the Energy Policy Act of 2005. The Energy Policy Act provisions implemented by BOEM provide a framework for issuing renewable energy leases, easements, and rights-of-way for OCS activities (Section 1.3, *Regulatory Overview)*. BOEM's renewable energy program occurs in four distinct phases: (1) planning and analysis, (2) lease issuance, (3) site assessment, and (4) construction and operations. The history of BOEM's planning and leasing activities offshore for the Lease Area is summarized in Table 1.1-1.

Table 1.1-1. History of BOEM Planning and Leasing for Offshore Wind Lease Areas OCS-A 0487 and OCS-A 0500

Year	Milestone	
	OCS-A 0487	**OCS-A 0500**
2010	N/A	On December 29, 2010, BOEM published a Request for Interest (RFI) in the Federal Register to gauge commercial interest in wind energy development offshore Massachusetts. BOEM invited the public to comment and provide information-including information on environmental issues and data—for consideration of the RFI area for commercial wind energy leases.
2011	On August 18, 2011, BOEM published a Call for Information and Nominations (Call) for Commercial Leasing for Wind Power on the OCS Offshore Rhode Island and Massachusetts in the Federal Register. The public comment period for the Call closed on October 3, 2011. In conjunction with the Call, BOEM published a Notice of Intent (NOI) to prepare an environmental assessment on the proposed leasing, site characterization and assessment activities in the offshore area under consideration in the Call. BOEM received eight indications of interest to obtain a commercial lease for a wind energy project and 81 comments on the Call; as well as 24 comments in response to the NOI.	The Massachusetts RFI area was delineated based on deliberation and consultation with the Massachusetts Renewable Energy Task Force. The subsequent selection of a Wind Energy Area (WEA) was based on input received on this RFI area. Responding to requests received from the public and the Commonwealth of Massachusetts, BOEM reopened the comment period for the RFI on March 17, 2011. The comment period ended on April 18, 2011.
2012	On February 24, 2012, BOEM announced the Rhode Island/Massachusetts WEA was comprised of approximately 164,750 acres (666.7 km^2) within an Area of Mutual Interest identified by Rhode Island and Massachusetts in a Memorandum of Understanding between the two states in 2010. BOEM published a Proposed Sale Notice in the Federal Register on December 3, 2012, for a 60-day public comment period.	After careful consideration of the public comments, as well as input from BOEM's intergovernmental Massachusetts Renewable Energy Task Force, BOEM modified the planning area offshore Massachusetts and proceeded to publish a Call in the Federal Register on February 6, 2012 to identify locations within the offshore Call Area in which there was industry interest to seek commercial leases for

Year	Milestone	
		developing wind projects. BOEM published a NOI to prepare an Environmental Assessment (EA) of the Call Area. The comment period for the Call closed March 22, 2012. On February 6, 2012, under Docket ID: BOEM-2011-0116 BOEM published a “Notice of Intent to Prepare an EA for Commercial Wind Leasing and site assessment activities on the Atlantic OCS Offshore Massachusetts”. On November 2, 2012, BOEM announced the availability of the EA for public review and comment.
2013	June 4, 2013, BOEM made available a revised EA for the WEA offshore Rhode Island and Massachusetts. As a result of the analysis in the revised EA, BOEM issued a Finding of No Significant Impact, which concluded that reasonably foreseeable environmental effects associated with the commercial wind lease issuance and related activities would not significantly impact the environment. On June 5, 2013, BOEM published the Final Sale Notice to auction two leases offshore Rhode Island and Massachusetts for commercial wind energy development. On July 31, 2013, BOEM auctioned the two lease areas announcing Deepwater Wind New England LLC as the winner of both. The competitive auction received \$3,838,288 in high bids and consisted of 11 rounds of bidding between three participants. BOEM issued Renewable Energy Lease Area OCS-A 0487 (Lease Area) to the Applicant on October 1, 2013.	The Department of Energy’s National Renewable Energy Laboratory (NREL), under an interagency agreement with BOEM, provided technical assistance to identify and delineate leasing areas for offshore wind energy development within WEAs on the Atlantic coast. In December 2013, NREL submitted a report to BOEM that focuses on the Massachusetts WEA.
2014	N/A	On June 17, 2014, Secretary of the Interior, Sally Jewell and BOEM Acting Director, Walter Cruickshank joined Massachusetts Governor Deval Patrick to announce that more than 742,000 acres (3,002.8 km^2) offshore Massachusetts would be available for commercial wind energy leasing. The proposed area is the largest in federal waters and would nearly double the federal offshore acreage available for commercial-scale wind energy projects. The Massachusetts Proposed Sale Notice was made available for a 60-day public comment period, which closed on August 18, 2014.

Year	Milestone	
2015	N/A	On Jan. 29, 2015, BOEM held a competitive lease sale (i.e., auction) for the WEA offshore Massachusetts. The auction lasted two rounds. RES America Developments, Inc. was the winner of Lease Area OCS-A 0500 (187,523 acres [758.9 km^2]) and Offshore MW LLC was the winner of Lease Area OCS-A 0501 (166,886 acres [675.3 km^2]). The commercial wind energy leases were signed by BOEM on March 23, 2015, and went into effect on April 1, 2015.
2017	N/A	On June 29, 2017, BOEM approved the Site Assessment Plan (SAP) for Lease OCS-A 0500 (Bay State Wind). The SAP approval allows for the installation of two floating light and detection ranging (FLIDAR) buoys and one metocean/current buoy.
2018	On September 18, 2018, Deepwater Wind New England LLC requested an extension of the site assessment term for commercial Lease OCS-A 0487 pursuant to 30 *CFR* 585.235(b). On October 24, 2018, BOEM approved a 3.5-year extension of the site assessment term, from July 1, 2019, to January 1, 2023.	N/A
OCS-A 0487 Milestone		
2020	Sunrise Wind submitted its initial Construction and Operations Plan (COP) to BOEM on September 1, 2020. On September 3, 2020, Bay State Wind LLC assigned 100 percent of its record title interest in a portion of Lease OCS-A 0500, which BOEM designated OCS-A 0530, to Sunrise Wind LLC. The effective date of Lease OCS-A 0487 remains as October 1, 2013. On December 18, 2020, Sunrise Wind submitted an updated COP to BOEM.	
2021	BOEM completed the consolidation of Lease OCS-A 0530 into Lease OCS-A 0487.	
2021	On June 7, 2021, Sunrise Wind submitted an updated COP to BOEM.	
2021	Sunrise Wind submitted their updated COP dated August 23, 2021. On August 31, 2021, BOEM published in the Federal Register a NOI to Prepare an Environmental Impact Statement for Sunrise Wind's Proposed Wind Energy Facility Offshore New York. A revision to the NOI was published in the Federal Register on September 3, 2021, to extend the comment period to October 4, 2021, and to make technical corrections. The resulting OCS-A 0487 Lease Area is 109,952 acres (445.0 km^2; shown in mint green on Figure 1.1-1 **S***unrise Wind Lease Area Assigned from OCS-A 0500 to OCS-A 0487*). Sunrise Wind proposes to develop the entire Lease Area EXCEPT for the isolated aliquot cluster in OCS block 3959 (Figure 1.1-1).	
2021	On August 31, 2021, BOEM published a Notice of Intent (NOI; BOEM 2021) to Prepare an Environmental Impact Statement (EIS) for the Sunrise Wind project offshore New York. The NOI was corrected September 3, 2021, to extend the comment period to October 4, 2021, and to make technical corrections.	

Year	Milestone
2021	On October 29, 2021, Sunrise Wind submitted an updated COP to BOEM.
2022	On April 8, 2022, Sunrise Wind submitted an updated COP to BOEM.
2022	On August 19, 2022, Sunrise Wind submitted an updated COP to BOEM.
2022	On December 12, 2022, BOEM announced the availability of the Draft Environmental Impact Statement (Draft EIS) for the proposed Sunrise Wind project offshore New York. The Notice of Availability for the Sunrise Wind Draft EIS published in the Federal Register on December 16, 2022, opening a 60-day public comment period, which ended on February 14, 2023. The input received via this process will inform preparation of the Final Environmental Impact Statement (Final EIS).
2023	On September 27, 2023, Sunrise Wind submitted an updated COP to BOEM.
2023	On December 15, 2023, BOEM published a Notice of Availability for the Sunrise Wind Final EIS (Docket Number BOEM-0023-056) initiating a minimum 30-day mandatory waiting period, during which BOEM is required to pause before issuing a ROD.

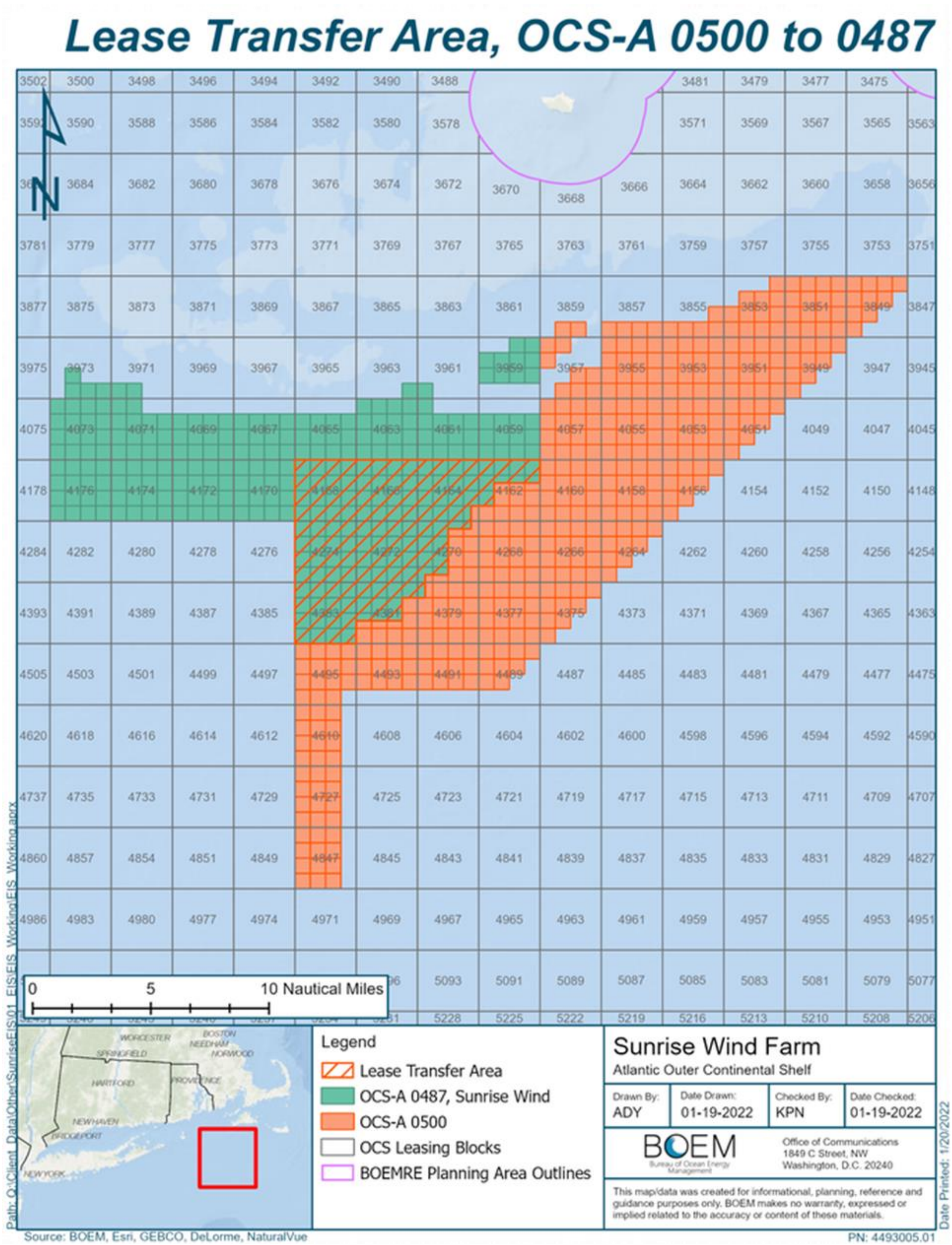

Figure 1.1-1. Sunrise Wind Lease Area Assigned from OCS-A 0500 to OCS-A 0487

1.2 Purpose and Need for the Proposed Action

In Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad,* issued January 27, 2021, President Biden stated that it is the policy of the United States "to organize and deploy the full capacity of its agencies to combat the climate crisis to implement a government-wide approach that reduces climate pollution in every sector of the economy; increases resilience to the impacts of climate change; protects public health; conserves our lands, waters, and biodiversity; delivers environmental justice; and spurs well-paying union jobs and economic growth, especially through innovation, commercialization, and deployment of clean energy technologies and infrastructure."

Through a competitive leasing process under 30 *CFR* 585.211, Sunrise Wind was awarded commercial Renewable Energy Lease OCS-A 0487[9] (Lease Area) covering an area offshore of Massachusetts, Rhode Island, and New York. Under the terms of the lease, Sunrise Wind has the exclusive right to submit a COP for activities within the Lease Area, and it has submitted a COP to BOEM proposing the construction and installation, O&M, and conceptual decommissioning of up to a 1,034-megawatt (MW) offshore wind energy facility in accordance with BOEM's COP regulations under 30 *CFR* 585.626, et seq. (Figure 2.1-1).

Sunrise Wind's goal is to develop a commercial-scale, offshore wind energy facility in the Lease Area, with up to 94 wind turbine generators (WTGs) in 102 potential positions, an offshore converter station (OCS-DC), inter-array cables, an onshore converter station (OnCS-DC), an offshore transmission cable making landfall on Long Island, New York, and an onshore interconnection cable to the Long Island Power Authority Holbrook Substation. The Project would generate up to approximately 1,034 MW of renewable energy.

This Project would help the state of New York achieve the aggressive clean energy goals set forth in the Clean Energy Standards Order and the Climate Leadership and Community Protection Act through an Offshore Wind Renewable Energy Certificate Purchase and Sale Agreement (OREC) with the New York State Energy Research and Development Authority (NYSERDA) to deliver 880 MW of offshore wind energy. Sunrise Wind has the ability under the OREC to deliver a maximum capacity of 924 MW of offshore wind energy (NYSERDA 2019).

Based on BOEM's authority under the Outer Continental Shelf Lands Act (OCSLA) to authorize renewable energy activities on the OCS, and Executive Order 14008; the shared goals of the federal agencies to deploy 30 gigawatts (GW) of offshore wind energy capacity in the United States by 2030, while

[9] A portion of the area covered by Renewable Energy Lease OCS-A 0500 and the entirety of the area covered by Renewable Energy Lease OCS-A 0487 were merged and included in a revised Lease OCS-A 0487 issued to Sunrise Wind on March 15, 2021. On July 31, 2013, BOEM conducted a competitive auction and awarded Lease OCS-A 0487, consisting of about 67,250 ac (272.2 km^2), to Deepwater Wind New England LLC. On August 3, 2020, Deepwater Wind New England LLC assigned Lease OCS-A 0487 to Sunrise Wind LLC. Following the January 2015 competitive lease sale for the Wind Energy Area offshore Massachusetts, Lease OCS-A 0500 (187,523 ac [758.9 km^2]) was awarded to RES Developments with an effective date of April 1, 2015. On June 12, 2015, BOEM approved reassignment of OCS-A 0500 to DONG Energy Massachusetts LLC (note: DONG Energy has since renamed its American subsidiary to Bay State Wind LLC). On September 3, 2020, Bay State Wind LLC assigned 100 percent of its record title interest in a portion of lease OCS-A 0500, which BOEM designated OCS-A 0530, to Sunrise Wind LLC. On March 15, 2021, BOEM completed the consolidation of lease OCS-A 0530 into Lease OCS-A 0487 through an amendment to Lease OCS-A 0487. The effective date of lease OCS-A 0487 remains October 1, 2013.

protecting biodiversity and promoting ocean co-use[10]; and in consideration of the goals of the Applicant, the purpose of BOEM's action is to determine whether to approve, approve with modifications, or reject Sunrise Wind's COP. BOEM will make this determination after weighing the factors in subsection 8(p)(4) of the OCSLA that are applicable to plan decisions and in consideration of the above goals. BOEM's action is needed to fulfill its duties under the lease, which require BOEM to make a decision on the Lessee's plans to construct and operate a commercial-scale offshore wind energy facility within the Lease Area (the Proposed Action).

In addition, the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) received a request for authorization to take marine mammals incidental to construction activities related to the Project, which NMFS may authorize under the Marine Mammal Protection Act (MMPA). NMFS's issuance of an MMPA incidental take authorization is a major federal action and, in relation to BOEM's action, is considered a connected action (40 *CFR* 1501.I)(1)). The purpose of the NMFS action—which is a direct outcome of Sunrise Wind's request for authorization to take marine mammals incidental to specified activities associated with the Project (e.g., pile driving)—is to evaluate Sunrise Wind's request under requirements of the MMPA (16 *USC* 1371(a)(5)(A) and its implementing regulations administered by NMFS and to decide whether to issue the authorization. If NMFS makes the findings necessary to issue the requested authorization, NMFS intends to adopt, after independent review, BOEM's Final EIS to support that decision and to fulfill its NEPA requirements.

The United States Army Corps of Engineers (USACE) New York District anticipates a permit action to be undertaken through authority delegated to the District Engineer by 33 *CFR* 325.8, under Section 10 of the Rivers and Harbors Act of 1899 (RHA) (33 *USC* 403) and Section 404 of the Clean Water Act (CWA) (33 *USC* 1344). It is anticipated that Section 408 permission would be required pursuant to Section 14 of the RHA of 1899 (33 *USC* 408) for any proposed alterations that have the potential to alter, occupy or use any USACE federally authorized Civil Works projects. The USACE considers issuance of a permit under these three delegated authorities a major federal action connected to BOEM's action (40 *CFR* 1501.9(e)(1)). Sunrise Wind's stated purpose and need for the Project, as indicated above, is to provide a commercially viable offshore wind energy project within the Lease Area to help New York achieve its renewable energy goals. The basic Project purpose, as determined by USACE for Section 404(b)(1) guidelines evaluation, is offshore wind energy generation. The overall Project purpose for Section 404(b)(1) guidelines evaluation, as determined by USACE, is the construction and operation of a commercial-scale offshore wind energy project for renewable energy generation and distribution to the New York energy grids.

The purpose of USACE Section 408 action as determined by Engineer Circular 1165-2-220 is to evaluate the Applicant's request and determine whether the proposed alterations are injurious to the public interest or impair the usefulness of the USACE project. USACE Section 408 permission is needed to ensure that congressionally authorized projects continue to provide their intended benefits to the

[10] Fact Sheet: Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs | The White House: https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/.

public. USACE intends to adopt BOEM's EIS to support its decision on any permits and permissions requested under Section 10 of the RHA, Section 404 of the CWA, and Section 14 of the RHA. The USACE would adopt the EIS per 40 *CFR* 1506.3 if, after its independent review of the document, it concludes that the EIS satisfies the USACE's comments and recommendations. Based on its participation as a cooperating agency and its consideration of the Final EIS, the USACE would issue a Record of Decision to formally document its decision on the Proposed Action.

The National Park Service (NPS) received an application from Sunrise Wind for a right-of-way (54 *USC* 100902; 36 *CFR* 14) and two special use permits for construction (36 *CFR* 5.7) at Fire Island National Seashore. A right-of-way permit is required for the transmission cable and conduit to reside in lands where the United States holds an easement, i.e., from the mean high water line to 1,000 feet [ft; 305 meters (m)] into the Atlantic Ocean. Special use permits for construction are required for construction (1) on those same lands and within the associated water column, and (2) within waters in the Intracoastal Waterway (ICW) that are subject to the jurisdiction of the United States and within the boundaries of Fire Island National Seashore.

The United States Environmental Protection Agency (USEPA) regulates point sources that discharge pollutants to waters of the United States (WOTUS) pursuant to the CWA (Section 316(b), 40 *CFR* 122, 125, 33 *USC* 1251). New York State (NYS) has partially delegated authority within state jurisdiction (discussed in Section 1.4) and the USEPA retains authority over point sources on the OCS. The OCS–DC would be located in federal waters and therefore would not fall within any specific state's jurisdiction. Sunrise Wind submitted an individual National Pollutant Discharge Elimination System (NPDES) permit application for operation of the OCS–DC to USEPA Region 1 in December 2021 and that application has been deemed complete. Consistent with the description provided in 40 *CFR* 125.81, the OCS–DC is a new facility that is considered a point source, has a cooling water intake system (CWIS) that uses at least 25 percent of the water withdrawn for cooling, has a design intake flow (DIF) and discharge volume of approximately 8.1 million gallons per day (mgd), and is thus subject to the Track I requirements for new facilities defined at 40 *CFR* 125.84(b) as it pertains to Section 316(b) of the CWA.

1.3 Regulatory Overview

The Energy Policy Act of 2005, Public Law 109-58, amended the OCSLA (43 *USC* 1331 et seq.)[11] by adding a new subsection 8(p) that authorizes the Secretary of the Interior to issue leases, easements, and rights-of-way in the OCS for activities that "produce or support production, transportation, or transmission of energy from sources other than oil and gas," which include wind energy projects.

The Secretary of the Interior delegated this authority to the former Minerals Management Service, and later to BOEM. Final regulations implementing the authority for renewable energy leasing under the OCSLA (30 *CFR* 585) were promulgated on April 22, 2009[12]. These regulations prescribe BOEM's responsibility for determining whether to approve, approve with modifications, or reject Sunrise Wind's COP (30 *CFR* 585.628).

Subsection 8(p)(4) of the OCSLA states: "[t]he Secretary shall ensure that any activity under [subsection 8(p)] is conducted in a manner that provides for –

(A) safety;

(B) protection of the environment;

(C) prevention of waste;

(D) conservation of the natural resources of the outer Continental Shelf;

(E) coordination with relevant federal agencies;

(F) protection of national security interests of the United States;

(G) protection of correlative rights in the outer Continental Shelf;

(H) a fair return to the United States for any lease, easement, or right-of-way under this subsection;

(I) prevention of interference with reasonable uses (as determined by the Secretary) of the Exclusive Economic Zone (EEZ), the high seas, and the territorial seas;

(J) consideration of—

   i) the location of, and any schedule relating to, a lease, easement, or right-of-way for an area of the outer Continental Shelf; and

   ii) any other use of the sea or seabed, including use for a fishery, a sealane, a potential site of a deepwater port, or navigation;

(K) public notice and comment on any proposal submitted for a lease, easement, or right-of-way under this subsection; and

(L) oversight, inspection, research, monitoring, and enforcement relating to a lease, easement, or right-of-way under this subsection."

[11] Public Law No. 109-58, § 119 Stat. 594 (2005).

[12] Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf, 74 *Federal Register* 19638–19871 April 29, 2009 (MMS 2009).

As stated in M-Opinion 37067, ". . . subsection 8(p)(4) of OCSLA imposes a general duty on the Secretary to act in a manner providing for the subsection's enumerated goals. The subsection does not require the Secretary to ensure that the goals are achieved to a particular degree, and she retains wide discretion to determine the appropriate balance between two or more goals that conflict or are otherwise in tension."[13]

Section 2 of commercial Renewable Energy Lease OCS-A 0487 provides the Lessee with an exclusive right to submit a COP to BOEM for approval. Section 3 provides that BOEM will decide whether to approve a COP in accordance with applicable regulations in 30 *CFR* 585, noting that BOEM retains the right to reject a COP based on its determination that the proposed activities would have unacceptable environmental consequences, would conflict with one or more of the requirements set forth in 43 *USC* 1337(p)(4), or for other reasons provided by BOEM under 30 *CFR* 585.613(e)(2) or 585.628(f); BOEM reserves the right to approve a COP with modifications; and BOEM reserves the right to authorize other uses within the leased area that would not unreasonably interfere with activities described in Addendum A, Description of Leased Area and Lease Activities.

BOEM's evaluation and decision on the COP are also governed by other applicable federal statutes and implementing regulations such as NEPA and the Endangered Species Act (ESA) (16 *USC* 1531–1544). The analyses in this Final EIS will inform BOEM's decision under 30 *CFR* 585.628 for the COP that was initially submitted in September 2020 and later updated with current information on December 18, 2020, June 7, 2021, August 23, 2001, October 29, 2021, April 8, 2022, August 19, 2022, and September 27, 2023. BOEM is required to coordinate with federal agencies and state and local governments and ensure that renewable energy development occurs in a safe and environmentally responsible manner. In addition, BOEM's authority to approve activities under the OCSLA only extends to approval of activities on the OCS, although onshore elements of the Proposed Action are included in BOEM's analysis in the EIS to support analysis of a complete project. Appendix A (*Required Environmental Permits and Consultations)* outlines the federal, state, regional, and local permits and authorizations that are required for the Project and the status of each permit and authorization. Appendix A provides a description of BOEM's consultation efforts during development of the Final EIS.

[13] M-Opinion 37067 at page 5, http://doi.gov/sites/doi.gov/files/m-37067.pdf.

1.4 Relevant Existing NEPA and Consulting Documents

Consistent with the CEQ directive "Incorporation by reference" (40 *CFR* 1501.12), BOEM used the following NEPA, non-NEPA, and consulting documents to inform the Final EIS.

- 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 2007 (OCS EIS/EA MMS 2007-046): https://www.boem.gov/renewable-energy/guide-ocs-alternative-energy-final-programmatic-environmental-impact-statement-eis
- The Energy Policy Act of 2005 (EPAct) amended Section 8 of the Outer Continental Shelf Lands Act (OCSLA) (43 *USC* 1337) to authorize the Secretary of the Interior to issue a lease, easement, or right-of-way on the OCS for activities that are not otherwise authorized by the OCSLA, or other applicable law, if those activities:
    1. Produce or support production, transportation, or transmission of energy from sources other than oil and gas; or
    2. Use, for energy-related purposes or other authorized marine-related purposes, facilities currently or previously used for activities authorized under the OCSLA, except that any oil and gas energy-related uses shall not be authorized in areas in which oil and gas preleasing, leasing, and related activities are prohibited by a moratorium.
- *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York, 2016* (BOEM 2016): https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/NY/NY-Public-EA-June-2016.pdf
- BOEM has prepared this Environmental Assessment (EA), *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York*, to determine whether the issuance of a lease and approval of a Site Assessment Plan (SAP) within the Wind Energy Area (WEA) offshore New York would lead to reasonably foreseeable significant impacts on the environment and, thus, whether an EIS should be prepared before a lease is issued. BOEM identified the WEA for the purposes of conducting this environmental analysis and considering the area for leasing.
- *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts 2014* (BOEM 2014): https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/MA/Revised-MA-EA-2014.pdf
- BOEM prepared an EA to determine whether issuance of leases and approval of SAPs within an area identified offshore Rhode Island and Massachusetts would have a significant effect on the environment and whether an EIS must be prepared. BOEM conducted its analysis to comply with NEPA, 42 *USC* 4321-4370(f), the CEQ regulations at 40 *CFR* 1501.3(b) and 1508.9, USDOI regulations implementing NEPA at 43 *CFR* 46, and USDOI Manual (DM) Chapter 15 (516 DM 15).
- BOEM conducted its environmental analysis after identifying an area potentially suitable for commercial wind development or a WEA. BOEM identified the WEA through input from the BOEM-led Massachusetts Intergovernmental Task Force (Task Force), comments on the Notice

of Intent to Prepare an Environmental Assessment (77 *Federal Register [FR]* 5830), comments on the Commercial Leasing for Wind Power on the OCS Offshore Massachusetts - Call for Information and Nominations (77 *FR* 5820), comments on the Commercial Leasing for Wind Power on the OCS Offshore Massachusetts – Request for Interest (RFI) (75 *FR* 82055), and input received during public outreach efforts. The environmental analysis was limited to the effects of lease issuance: site characterization activities (i.e., surveys of the Lease Area and potential cable routes) and site assessment activities (i.e., construction and operation of meteorological towers and/or buoys on the leases to be issued) within the WEA offshore of Rhode Island and Massachusetts (referred to herein as the Rhode Island and Massachusetts WEA).

- On November 2, 2012, BOEM published a Notice of Availability for the Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts Environmental Assessment (2012 EA) (77 *FR* 66185) for a 30-day comment period. Public information meetings were held in Massachusetts on November 13, 14, and 15, 2012, to provide stakeholders an additional opportunity to offer comments on the 2012 EA. To address comments received during the public comment period, public information meetings, stakeholder outreach, required consultations, and Task Force meetings, BOEM revised the 2012 EA. The revised EA includes a summary of the comments and questions received. This finding is accompanied by and cites the revised EA.
- Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts, Revised Environmental Assessment, June 2014 (BOEM 2014): https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/MA/Revised-MA-EA-2014.pdf https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Renewable_Energy_Program/State_Activities/BOEM RI_MA_Revised EA_22May2013.pdf
- BOEM has elected to incorporate by reference the Sunrise Wind COP prepared by Stantec Consulting Services, Inc. for Sunrise Wind dated September 27, 2023. The COP and its supporting documentation provide a description of the proposed Project activity, Project siting and design development, resources required, site characterization and assessment of potential impacts, and references. The Sunrise Wind COP is located on the BOEM webpage for the Sunrise Wind Project at this link: https://www.boem.gov/renewable-energy/state-activities/sunrise-wind-construction-and-operation-plan.
- Additional environmental studies conducted to support planning for offshore wind energy development are cited throughout the EIS where applicable, and are available on BOEM's website at: https://www.boem.gov/renewable-energy-research-completed-studies.

1.5 Methodology for Assessing the Project Design Envelope

The Project is being developed based on a Project Design Envelope (PDE) concept, consistent with BOEM's *Draft Guidance Regarding the Use of a Project Design Envelope in a Construction and Operations Plan* (BOEM 2018). This concept allows Sunrise Wind to define and bracket proposed Project characteristics for environmental review and permitting while maintaining a reasonable degree of flexibility for selecting and purchasing Project components, such as WTGs, foundations, submarine cables, and the OCS-DC.

This Final EIS assesses the impacts of the PDE described in the Sunrise Wind COP and presented in Appendix C (*Project Design Envelope and Maximum-Case Scenario*) by using the "maximum-case scenario" process. The maximum-case scenario analyzes the aspects of each design parameter or combination of design parameters that would result in the most significant impact for each physical, biological, and socioeconomic resource. This Final EIS evaluates potential impacts of the Proposed Action and each alternative using the maximum-case scenario to assess the design parameters or combination of parameters for each environmental resource and considers the interrelationship between aspects of the PDE rather than simply viewing each design parameter independently. Certain resources may have multiple maximum-case scenarios, and the most impactful design parameters may not be the same for all resources. Appendix E explains the PDE approach in more detail and presents a detailed table outlining the design parameters with the highest potential for impacts by resource area.

1.6 Methodology for Assessing Impacts

1.6.1 Past and Ongoing Activities and Trends (Existing Baseline)

This EIS also assesses past, present (ongoing), and reasonably foreseeable future (planned) actions that could occur during the life of the Project. Ongoing and planned actions occurring within the geographic analysis area (GAA) include (1) other offshore wind energy development activities; (2) undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); (3) tidal energy projects; (4) marine minerals use and ocean-dredged material disposal; (5) military use; (6) marine transportation (commercial, recreational, and research-related); (7) fisheries use, management, and monitoring surveys; (8) global climate change; (9) oil and gas activities; and (10) onshore development activities. Specifically within the vicinity of the Fire Island National Seashore landfall area, ongoing and planned actions and trends include (1) recreational use including swimming, fishing, and boating; (2) ongoing presence of undersea submarine cables; (3) construction of the new William Floyd Parkway bridge and demolition of the current bridge; (4) onshore development activities associated with the new William Floyd Parkway Bridge; (5) fisheries and wildlife use, management, and monitoring surveys; and (6) global climate change.

Each resource-specific *Environmental Consequences* section in Chapter 3 of this Final EIS includes a description of the baseline conditions of the affected environment. The existing baseline considers past and present activities in the GAA, including those related to offshore wind projects with an approved COP (e.g., Vineyard Wind 1 and South Fork) and approved past and ongoing site assessment surveys, as well as other non-wind activities (e.g., Navy military training, existing vessel traffic, climate change). The existing condition of resources, as influenced by past and ongoing activities and trends, comprises the existing baseline condition for impact analysis. Other factors currently impacting the resource, including climate change, are also acknowledged for that resource and are included in the impact level conclusion.

1.6.2 Planned Activities

It is reasonable to predict that future activities may occur over time, and that cumulatively, those activities would impact the existing baseline conditions discussed in Section 1.6.1. Cumulative impacts are analyzed and concluded separately in each resource-specific *Environmental Consequences* section in Chapter 3 of this Final EIS. Cumulative impacts include analyzing the impacts of all offshore wind farms currently proposed within the GAA of for each resource as well as the existing baseline conditions. The existing baseline condition as influenced by future planned activities evaluated in Appendix E (*Planned Activities Scenario*) comprises the baseline condition for cumulative impact analysis. The impacts of future planned offshore wind projects are predicted using information from and assumptions based on COPs submitted to BOEM that are currently undergoing independent review.

Chapter 2

Alternatives

2.0 ALTERNATIVES

2.1 Alternatives Analyzed in Detail

BOEM considered a reasonable range of alternatives during the EIS development process that emerged from scoping, interagency coordination, and internal BOEM deliberations. Alternatives were reviewed using BOEM's screening criteria ("screening criteria") (BOEM 2022). Alternatives that did not meet the screening criteria (i.e., were initially found to be infeasible or did not meet the purpose and need for BOEM's action) were dismissed from detailed analysis in this Final EIS. Alternatives considered but dismissed from detailed analysis and the rationale for their dismissal are described in Table 2.1-1. Alternatives C-1 and C-2 were also determined to be infeasible through the EIS process as data was further collected and analyzed. However, BOEM determined that including all variants of Alternative C in Section 2.1 provided important context regarding the development of the Preferred Alternative C-3(b). Additional information is provided in Section 2.1.3 and Chapter 3 regarding the variants of Alternative C. The action alternatives listed in Table 2.1-1 are not mutually exclusive. BOEM may "mix and match" multiple listed Final EIS alternatives to result in a Preferred Alternative identified in Section 2.1.4 of this Final EIS provided that (1) the design parameters are compatible; and (2) the Preferred Alternative still meets the purpose and need.

Although BOEM's authority under the OCSLA only extends to the activities on the OCS, alternatives related to addressing nearshore and onshore elements as well as offshore elements of the Proposed Action are analyzed in the EIS. BOEM's regulations (30 *CFR* 585.620) require that the COP describes all planned facilities that the Lessee would construct, operate, and decommission for the Project, including onshore and support facilities and all anticipated Project easements. As a result, those federal, state, and local agencies with jurisdiction over nearshore, onshore, and offshore impacts are able to adopt, at their discretion, those portions of BOEM's EIS that support their own permitting decisions.

NMFS and USACE are serving as cooperating agencies. NMFS intends to adopt the Final EIS if, after independent review and analysis, NMFS determines the Final EIS to be sufficient to support its separate Proposed Action and decision to issue the authorization, if appropriate. USACE similarly intends to adopt the EIS if it is determined to be sufficient after independent review to meet its responsibilities under Section 404 of the CWA and Section 10 of the RHA. Under the Proposed Action and other action alternatives, NMFS's action alternative is to issue the requested Letter of Authorization to the Applicant to authorize incidental take for the activities specified in its application and that are being analyzed by BOEM in the reasonable range of alternatives described here. USACE is required to analyze alternatives to the proposed Project that are reasonable and practicable pursuant to NEPA and the CWA 404(b)(1) Guidelines. The range of alternatives analyzed in the Final EIS, including cable route options within the PDE and alternatives considered but dismissed, represents a reasonable range of alternatives for this analysis.

NPS is serving as a cooperating agency and intends to adopt the Final EIS if it is determined to be sufficient after independent review and analysis to meet their NEPA compliance requirements.

Construction permits and right-of-way for the transmission cable are required if Sunrise Wind intends to locate the transmission cable under the seafloor within Fire Island National Seashore. Under the Proposed Action and other action alternatives, Sunrise Wind would require a right-of-way permit (54 *USC* 100902; 36 *CFR* 14) and two special use permits for construction (36 *CFR* 5.7) from the NPS. A right-of-way permit is required for the transmission cable and conduit to reside in lands where the United States holds an easement, i.e., from the mean high water line to 1,000 ft into the Atlantic Ocean. Special use permits for construction are required for construction (1) on those same lands and within the associated water column, and (2) within waters in the ICW that are subject to the jurisdiction of the United States and within the boundaries of Fire Island National Seashore.

USEPA is also serving as a cooperating agency and will rely on the Final EIS to support its decision for issuing an individual NPDES permit to authorize operation of the OCS-DC in federal waters. Sunrise Wind submitted an individual NPDES permit for operation of the OCS-DC to USEPA Region 1 in December 2021 and that application has been deemed complete. Consistent with the description provided in 40 *CFR* 125.81, the OCS–DC is a new facility that is considered a point source, has a CWIS that uses at least 25 percent of the water withdrawn for cooling, has a DIF and discharge volume of approximately 8.1 mgd, and is thus subject to the Track I requirements for new facilities defined at 40 *CFR* 125.84(b) as it pertains to Section 316(b) of the CWA.

BOEM decided to use the NEPA substitution process for National Historic Preservation Act (NHPA) Section 106 purposes, pursuant to 36 *CFR* 800.8(c), during its review of the Project. Section 106 of the NHPA regulations, “Protection of Historic Properties” (36 *CFR* 800), provides for use of the NEPA substitution process to fulfill a federal agency’s NHPA Section 106 review obligations in lieu of the procedures set forth in 36 *CFR* 800.3 through 800.6. Draft avoidance, minimization, and mitigation measures to resolve adverse effects on historic properties are presented in Appendix H (*Mitigation and Monitoring*). Ongoing consultation with consulting parties and government-to-government consultation with tribal nations may result in additional measures or changes to these measures.

Table 2.1-1. Alternatives Considered for Analysis

Alternative	Description
Alternative A: No Action Alternative	Under the No Action Alternative, BOEM would not approve the COP; the Project construction and installation, O&M, and conceptual decommissioning would not occur; and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project as described under the Proposed Action would not occur. However, all other past and ongoing impact-producing activities would continue. The current resource condition, trends, and impacts from ongoing activities under the No Action Alternative serve as the existing baseline against which the direct and indirect impacts of all action alternatives are evaluated. Over the life of the proposed Project, other reasonably foreseeable future impact-producing offshore wind and non-offshore wind activities would be implemented, which would cause changes to the existing baseline conditions even in the absence of the Proposed Action. The continuation of all other existing and reasonably foreseeable future activities described in

Alternative	Description
	Appendix E (*Planned Activities Scenario*) without the Proposed Action serves as the baseline for the evaluation of cumulative impacts.
Alternative B: Proposed Action	Under Alternative B, the construction, O&M, and conceptual decommissioning of up to a 1,034-MW wind energy facility consisting of up to 94 WTGs within 102 potential positions, one OCS-DC, and inter-array cables linking the individual WTGs to the OCS-DC would be developed in the Lease Area. The Lease Area is approximately 16.4 nm (18.9 mi, 30.4 km) south of Martha's Vineyard, Massachusetts; approximately 26.5 nm (30.5 mi, 48.1 km) east of Montauk, New York; and approximately 14.5 nm (16.7 mi, 26.8 km) from Block Island, Rhode Island. One export cable would connect to the onshore export cable systems which would connect to the onshore converter station (OnCS-DC) in the Town of Brookhaven, Long Island, New York at the Union Avenue site. Development of the wind energy facility would occur within the range of design parameters outlined in the COP (Sunrise Wind 2023), subject to applicable mitigation measures.
Alternative C: Fisheries Habitat Impact Minimization	Under Alternative C, the construction, O&M, and eventual decommissioning of up to a 1,034-MW wind energy facility consisting of up to 94 WTGs within 102 potential positions, one OCS-DC, and inter-array cables linking the individual WTGs to the OCS-DC would be developed in the Lease Area. The Wind Energy Area would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. However, this alternative considered and prioritized contiguous areas of complex bottom habitat to be excluded from development to potentially avoid and/or minimize impacts to complex fisheries habitats, while still meeting BOEM's purpose and need for the project. Each of the sub-alternatives outlines below may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need. **Alternative C-1:** A total of 94 WTGs would be developed under this alternative that prioritizes relocating WTGs out of the Priority Areas identified by NMFS. This alternative would result in the exclusion of up to 8 WTG positions from development within the identified Priority Areas. The specific 8 WTG positions that would be excluded from the identified Priority Areas are informed through the impact analysis described in Chapter 3. Alternative C-1 was determined to be infeasible through the EIS process as data was further collected and analyzed. However, BOEM determined that including all variants of Alternative C in Section 2.1 provided important context regarding the development of the Preferred Alternative C-3(b). Additional information is provided in Section 2.1.3 and Chapter 3 regarding the variants of Alternative C. **Alternative C-2:** Up to a total of 94 WTGs would be developed under this alternative that prioritizes relocating WTGs out of the Priority Areas identified by NMFS. This alternative would exclude up to 8 WTG positions identified in Alternative C-1 from development, and up to an additional 12 WTG positions would be removed from the Priority Areas and relocated to the eastern side of the Lease Area. The specific WTG positions that would be excluded from the identified Priority Areas are informed through the impact analysis described in Chapter 3. Alternative C-2 was determined to be infeasible through the EIS process as data was further collected and analyzed. However, BOEM determined that including all variants of Alternative C in Section 2.1 provided important context regarding the development of the Preferred Alternative C-3(b). Additional information is provided in Section 2.1.3 and Chapter 3 regarding the variants of Alternative C. **Alternative C-3:** Up to a total of 87 WTGs would be developed under this alternative that prioritizes relocating WTGs out of the Priority Areas identified by NMFS, while considering feasibility due to pile refusal risk from the presence of glauconite sands in the southeastern

Alternative	Description
	portion of the Lease Area. Sub-Alternatives C-3a, C-3b (Preferred Alternative), and C-3c consider different WTG configurations to avoid sensitive habitats and engineering constraints while still meeting the minimum capacity required by the NYSERDA OREC of 880 MW. Section 2.1.3.3 and Section 3.7.8 provide additional details on the number of WTG positions and layouts considered for each of the sub-alternatives for Alternative C-3.

2.1.1 Alternative A – No Action Alternative

Under the No Action Alternative, BOEM would not approve the COP. Project construction and installation, O&M, and decommissioning would not occur, and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project as described under the Proposed Action would not occur. However, all other past and ongoing impact-producing activities would continue. Under the No Action Alternative impacts to marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization under the MMPA to the Applicant. The current resource condition, trends, and impacts from ongoing activities under the No Action Alternative serve as the existing baseline against which the direct and indirect impacts of all action alternatives are evaluated.

Over the life of the proposed Project, other reasonably foreseeable future impact-producing offshore wind and non-offshore wind activities would be implemented, which would cause changes to the existing baseline conditions even in the absence of the Proposed Action. The continuation of all other existing and reasonably foreseeable future activities described in Appendix E (*Planned Activities Scenario*) without the Proposed Action serves as the baseline for the evaluation of cumulative impacts. Table 2.4-1 includes an impact assessment of the No Action Alternative for each resource, including an assessment for cumulative effects.

2.1.2 Alternative B – Proposed Action

The Sunrise Wind Farm (SRWF) and Sunrise Wind Export Cable (SRWEC) are the two primary components of the Project (Figure 2.1-1). The Project uses a project design envelope (PDE) approach, consistent with BOEM's *Draft Guidance Regarding the Use of a Project Design Envelope in a Construction and Operations Plan* (BOEM 2018). This approach results in a range of characteristics and locations for some components of the Proposed Action. Chapter 1, Section 1.6 and Appendix C (*Project Design Envelope and Maximum-Case Scenario*) provide additional information on the PDE approach.

The SRWF would be located within federal waters (Atlantic Ocean) on the OCS, specifically in the Lease Area, approximately 16.4 nm (18.9 mi, 30.4 km) south of Martha's Vineyard, Massachusetts; approximately 26.5 nm (30.5 mi, 48.1 km) east of Montauk, New York; and approximately 14.5 nm (16.7 mi, 26.8 km) from Block Island, Rhode Island (Figure 2.1-1).

Table 2.1-2 summarizes the SRWF components. The sections that follow, Section 3.1 of the COP, and Appendix C provide additional details. A detailed map showing the locations of all proposed Project components, including WTG positions, inter-array cables (IAC), the OCS-DC, transmission cables, and onshore facilities is provided in Figure 2.1-1, Figure 2.1-2, and Figure 2.1-3. For the purposes of this Final EIS, the Project Area refers to the potential maximum footprint of the proposed facilities including the SRWF, SRWEC, and the onshore facilities (OnCS-DC, onshore transmission cable, and onshore interconnection cable).

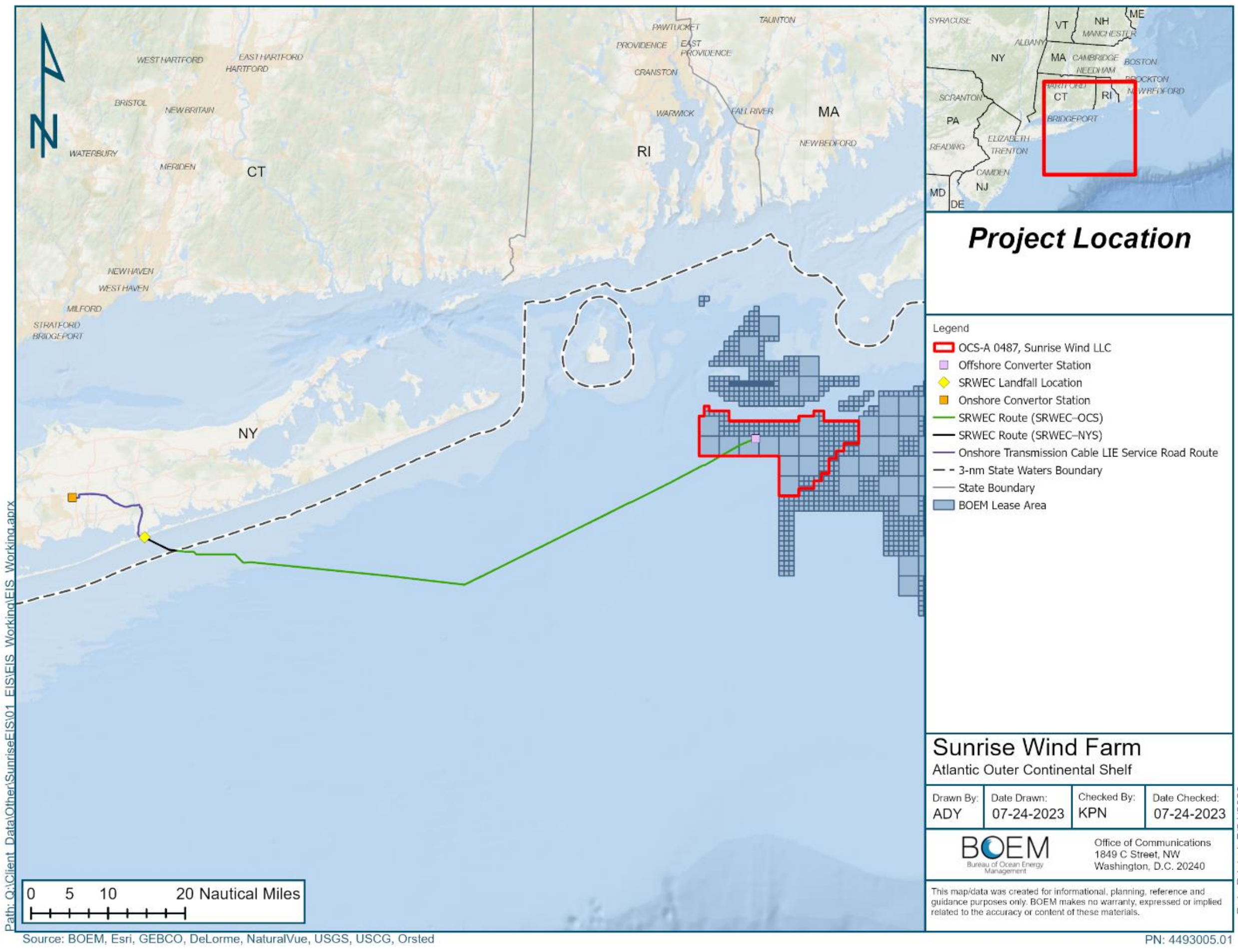

Figure 2.1-1. Overview of Project Components and Locations

Table 2.1-2. Summary of Sunrise Wind Project Components

Sunrise Wind Farm (SRWF)	**Foundations**	• Monopile foundations for the WTGs and a piled jacket foundation for the OCS-DC • Up to 95 foundations for the WTGs and OCS-DC within 103 potential positions • Maximum embedment depth of up to 164 ft (50 m) for WTG monopile foundations, and 295 ft (90 m) for OCS-DC piled jacket foundation • Maximum area of seafloor footprint per foundation, inclusive of scour protection and cable protection system stabilization: 1.06 ac (4,290 m^2) for WTG monopile foundations and 1.39 ac (5,625 m^2) for the OCS-DC foundation structure
	Wind Turbine Generators (WTGs)	• Up to 94 WTGs within 102 potential positions • Nameplate capacity of 11 MW • Rotor diameter of 656 ft (200 m) • Hub height of 459 ft (140 m) above mean sea level (AMSL) • Upper blade tip height of 787 ft (240 m) AMSL
	Inter-array Cables (IAC)	• Maximum 161-kV AC cables buried up to a target depth of 4 to 6 ft (1.2 to 1.8 m) • Maximum total length of up to 180 mi (290 km) • Maximum cable diameter of 8 in (200 mm) • Maximum disturbance corridor width of 98 ft (30 m) per circuit
	Offshore Converter Station – Direct Current (OCS-DC)	• One OCS-DC • Up to 295 ft (90 m) total structure height from lowest astronomical tide (including lightning protection and ancillary structures)
SRWEC-OCS (Outer Continental Shelf waters) and SRWEC-NYS (New York State waters)	**Sunrise Wind Export Cable (SRWEC)**	• One 320-kV DC export cable bundle buried to a target depth of 4 to 6 ft (1.2 to 1.8 m) • Maximum total corridor length of up to 104.6 mi (168.4 km) • Maximum individual cable diameter of 7.8 in (200 mm) and maximum bundled diameter of 15.6 in (400 mm) • Maximum bundled cable diameter of 15.8 in (400 mm) • Maximum disturbance corridor width of 98 ft (30 m) • Maximum seafloor disturbance for horizontal directional drilling exit pit of 61.8 ac (25 ha) • Maximum disturbance for Landfall Work Area (onshore) of up to 6.5 ac (2.6 ha)
Onshore Facilities	**Onshore Transmission Cable and onshore interconnection cable**	• Onshore transmission cable, including associated transition joint bay and fiber optic cable, up to 17.5 mi (28.2 km) long, with a temporary disturbance corridor of 30 ft (9.1 m) and maximum duct bank target burial depth of 6 ft (1.8 m) • Maximum cable diameter of 6 in (152 mm) • Onshore interconnection cable to connect to Holbrook Substation
	Onshore Converter Station – Direct Current (OnCS-DC)	• One OnCS-DC with operational footprint of up to 6 ac (2.4 ha)

Source: Sunrise Wind 2023

in = inches, ft = feet, m = meters, ac = acres, m^2 = square meters, ha = hectares, mm = millimeters, mi = miles, km = kilometers, MW = megawatts, kV = kilovolts, AMSL = above mean sea level, AC = alternating current, DC = direct current
SRWEC = Sunrise Wind Export Cable, SRWEC-OCS = Sunrise Wind Export Cable located in waters on the Outer Continental Shelf, SRWEC-NYS = Sunrise Wind Export Cable located in New York State waters, WTGs = wind turbine generators, OCS-DC = offshore converter station - direct current, OnCS-DC = onshore converter station - direct current

2.1.2.1 Construction and Installation

Construction and installation of the proposed SRWF and SRWEC would occur over several years within applicable seasonal work windows and within a uniform east-west and north-south grid with 1-nm by 1-nm (1.15-mi by 1.15-mi) spacing between WTGs. Construction and installation would include transportation and installation of foundations, installation of cable systems, installation of WTGs, and installation of the OCS-DC. Table 2.1-3 provides the anticipated construction schedule for all Project components.

Table 2.1-3. Indicative Project Construction Schedule

Project Component	Schedule
Onshore Facilities (OnCS-DC, onshore transmission cable, onshore interconnection cable, Laydown Yards)	Q3 of 2023 through Q4 of 2025
ICW HDD	Q1 2024 through Q2 2024
Temporary Landing Structure	Q1 2024 (installation); Q1-Q2 2024 and Q3 2024-Q2 2025, outside of Memorial Day-Labor Day (use); Q2 2025, prior to Memorial Day (removal)
Sunrise Wind Export Cable	Q3 through Q4 of 2024 and Q1 through Q2 of 2025
Offshore Foundations	Q3 through Q4 of 2024 and Q2 through Q3 of 2025 (excluding January – April)
Inter-array Cables	Q2 through Q3 of 2024; Q2 through Q4 of 2025
WTGs	Q2 through Q4 of 2025
OCS-DC	Q3 of 2024 through Q3 of 2025

Source: Sunrise Wind 2023

Following approval by the NYSPSC of EM&CP 1[14] in July 2023, Sunrise Wind planned to initiate work on certain sections of the onshore transmission cable in Q4 2023. Ground disturbance would occur along certain NYSDOT controlled ROW (4 mi [6.4 km] of the Long Island Expressway South Service Road from Waverly Avenue to Horseblock Road) and would include the installation of splice vaults and duct banks (approximately 15 ft (4.6 m) deep for splice vaults and approximately 5 to 8 ft (1.5 to 2.4 m) for duct banks). Target burial depth would vary based on site-specific conditions. Following approval by NYSPSC of EM&CP 2 (anticipated in Q4 2023), Sunrise Wind planned to initiate work on remaining sections of the onshore transmission cable, as well as the onshore interconnection cable. Ground disturbance would include installation of splice vaults and duct banks (approximately 15 ft (4.6 m) deep for splice vaults and approximately 5 to 8 ft (1.5 to 2.4 m) for duct banks). Target burial depth would vary based on site-specific conditions and may be deeper in areas of HDD or trenchless crossings.

[14] Documents associated with the Environmental Management and Construction Plan (EM&CP) Phase 1 and Phase 2 are available at: https://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?Mattercaseno=20-T-0617

Site preparation activities are necessary during construction. Site preparation includes activities such as high-resolution geophysical (HRG) surveys, unexploded ordnance (UXO)/munitions and explosives of concern (MEC) risk mitigation, debris and boulder clearance, pre-lay grapnel run, sand wave leveling, and pre-trenching. HRG surveys are anticipated to support the construction of WTG and OCS-DC foundations and installation of export, inter-array, and OCS-DC interconnector cables.

Avoidance is the preferred approach to UXO/MEC mitigation; however, for instances where avoidance is not possible, confirmed MEC or UXO may be disposed in place via low-noise methods, such as controlled deflagration or by opening the MEC or UXO and removing the explosive components, or it may be relocated. Relocation, if used, would be to another safe location on the seafloor or to a designated disposal area. The choice of removal method and suitable safety measures would be made with the assistance of an MEC/UXO specialist and the appropriate agencies (Sunrise Wind 2023).

2.1.2.1.1 Onshore Activities and Facilities

2.1.2.1.1.1 Onshore Converter Station

Power from the Project would be delivered to the electric grid via an OnCS-DC, which would be constructed in the Town of Brookhaven, Long Island, New York near Union Avenue at the intersection of the Long Island Expressway ([LIE] I.e., Interstate 495) and Route 97 (Union Avenue site). The OnCS-DC would support the Project’s interconnection to the existing electrical grid by transforming the Project voltage to 138 kV AC. Interconnection to the electric grid would occur at the existing Holbrook Substation also located in the Town of Brookhaven, New York.

The Union Avenue site, an approximately 7-acre (ac; 2.8-hectare [ha]) area (Figure 2.1-2), is located on two parcels to be improved jointly as a common development. The entire station footprint area would be graveled and surrounded by a 7-ft (2.1-m) high fence topped with a 1-ft (0.3-m) tall, barbed wire extension for a total height of 8 ft (2.4 m). Access would be provided through a minimum of one drive-through gate and one walk-through gate. Vegetative screening of the site would be provided as needed in consultation with the Town of Brookhaven and landowners. Once operational, general yard lighting would be provided within the site for assessment of equipment. In general, yard lighting would be minimal at night and subject to state and local requirements unless there is work in progress on site or lights are required for safety and security purposes.

Equipment and structures for the OnCS-DC would be supported on foundations expected to be of concrete and would be of a design suitable for existing soil conditions. The majority of the site equipment would require shallow foundations, 4 to 5 ft (1.2 to 1.5 m) in depth based on the expected equipment size. Larger structures may require drilled shaft equipment foundations of 12 to 30 ft (4 to 9 m) in depth.

Onshore facilities would be designed in accordance with the National Electric Safety Code, American National Standards Institute / Institute of Electrical and Electronics Engineers Standards and New York Independent System Operator (NYISO) requirements. Grading at the OnCS-DC would ensure adequate drainage and that the site is graded appropriately to reduce impacts from water accumulation. The design would consider the potential effects of erosion, high winds, and ice. The OnCS-DC would be located in the Town of Brookhaven and would be well inland of the 100-year and 500-year floodplain; the minimum equipment elevations at the OnCS-DC site exceed both the present day and future worst-case Design Flood Elevation, as recommended in American Society of Civil Engineers 24-14 (ASCE 2014).

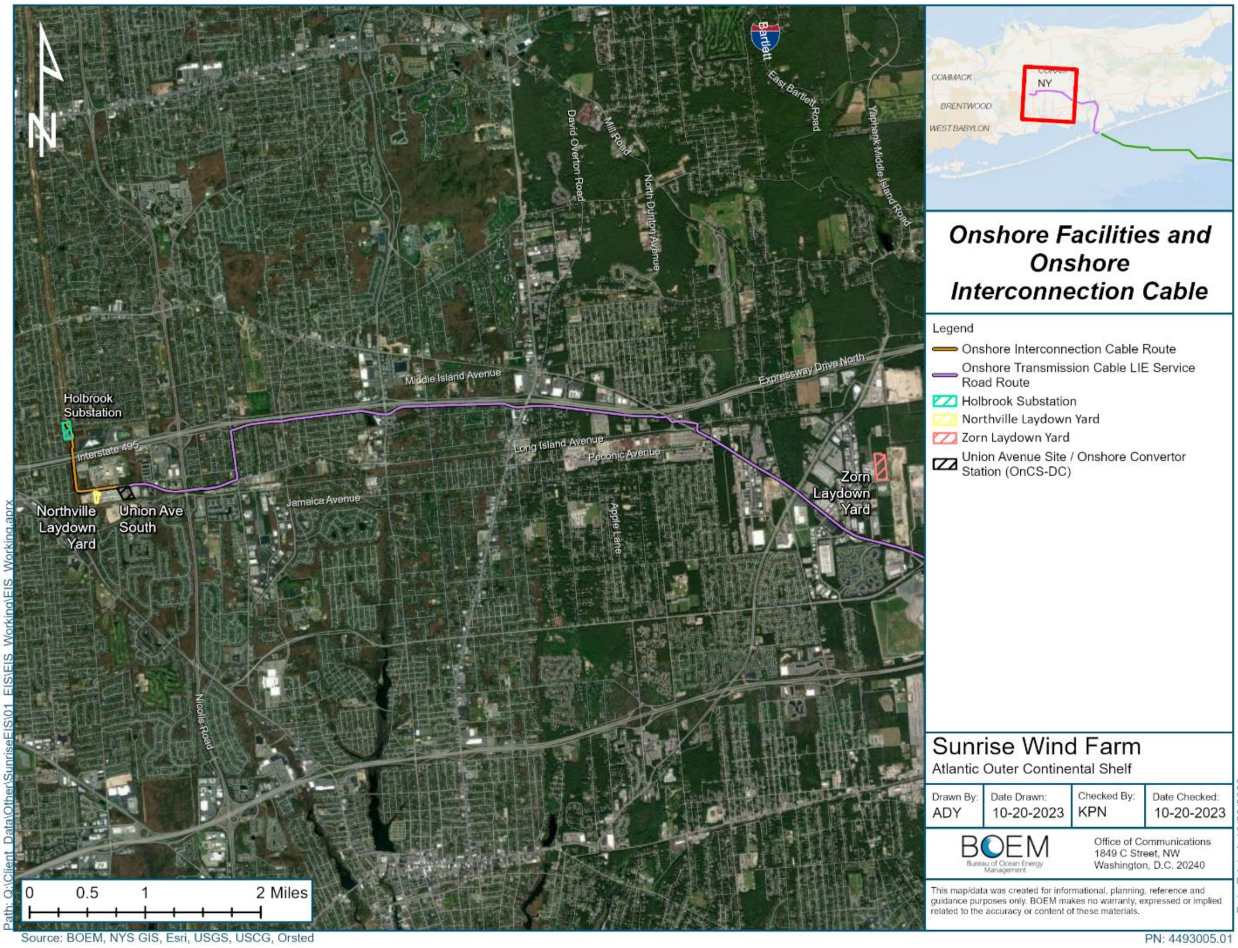

Figure 2.1-2. Overview of Onshore Components and Locations

2.1.2.1.1.1.1 Construction

Construction of the proposed OnCS-DC would involve surveys and protection of sensitive areas, clearing and grading, foundation and equipment installation, site restoration, and commissioning, as described in Table 3.3.1-3 of the COP (Sunrise Wind 2023). Following approval by NYSPSC of EM&CP 1, Sunrise Wind initiated civil work for OnCS-DC in July 2023. Ground disturbance has included excavation for installation of stormwater basins/dry wells (1 ac [0.4 ha], 20 ft [6.1 m] deep); excavation for siting of foundations for control house and storage foundation (0.75 ac [0.3 ha], 5 in [12.7 cm] deep); site grading at eastern edge (1.5 ac [0.6 ha], 6 to 10 in [15.2 to 25.4 cm] deep]; and asphalt milling for removal of an existing asphalt driveway (2 ac [0.8 ha], 2 to 3 in [5.1 to 7.6 cm] deep).

Following approval of EM&CP 1, Sunrise Wind initiated use of two temporary laydown yards to support the staging necessary equipment and materials for development of the OnCS-DC and other Project construction. The two yards approved for use are the Northville and Zorn Yards, and Sunrise Wind plans to only utilize the previously cleared and developed portions of each parcel.

- The Northville laydown yard is approximately 0.16 mi (0.26 km) west from the OnCS-DC on Union Avenue. Approximately 2 ac (0.8 ha) of the parcel is used as a laydown yard. This location is an industrial site that was previously cleared and graded to support various activities at the existing fuel terminal. The laydown yard required minimal grading and gravel/hardening to prepare it for use. Due to the lack of established topsoil, 4 to 6 in (10 to 15 cm) of existing grade was stripped and staged prior to the addition of modified millings. The Northville laydown yard would primarily support construction of the OnCS-DC.
- The Zorn laydown yard is located on a previously disturbed parcel within the Caithness Long Island Energy Center (CLIEC) complex on Zorn Boulevard. Approximately 12.5 ac (5.0 ha) of this 20-ac (8.1 ha) site is utilized as a laydown yard. The site was previously cleared and graded to support the stockpiling of materials, parking, and equipment storage during construction of the CLIEC facility. The laydown yard required minimal grading and gravel/hardening to prepare it for use. Existing topsoil was approximately 6 in (15 cm) and was stripped and staged prior to the addition of modified millings. The Northville laydown yard would primarily support cable installation but would also be used to support other activities.

Sunrise Wind would use mechanical clearing methods for the construction of the Project and does not intend to use any pesticides/herbicides during construction and installation. Following the completion of the proposed Project, locations used for temporary laydown yards would be restored to pre-existing conditions in accordance with landowner requests and permit requirements.

Following approval of EM&CP 2 (anticipated in Q4 2023), Sunrise Wind would initiate installation of additional foundations and equipment. Ground disturbance would include excavation of foundations for electrical equipment (up to approximately 30 ft [9 m] deep).

The maximum areas of land disturbance associated with the construction of the OnCS-DC are provided in Table 3.3.1-4 of the COP (Sunrise Wind 2023).

2.1.2.1.1.2 Onshore Transmission Facilities

Electrical transmission facilities for the Project would be comprised of both onshore and offshore cable systems. Specifically, power from the SRWF would be delivered to the electric grid via distinct transmission cable segments: the SRWEC would carry the power from the SRWF to the transition joint bay (TJB), the onshore transmission cable would carry the power from the TJB to the new OnCS-DC location, and the onshore interconnection cable would carry the power from the new OnCS-DC location to the existing grid at the Holbrook Substation. The SRWEC and onshore transmission cable would be spliced together at co-located TJB and link boxes located at Smith Point County Park on Fire Island in the Town of Brookhaven, New York. The SRWEC and onshore transmission cable have different design and construction parameters; therefore, these transmission components are described separately below.

The proposed onshore transmission cable route has been sited within existing disturbed ROW to the extent practicable. The onshore transmission cable would originate at the TJB on the eastern portion of Smith Point County Park, as described below. The onshore transmission cable would then follow the Long Island Expressway (LIE) Service Road route to the OnCS-DC at the Union Avenue site.

The LIE Service Road Route (hereinafter the onshore transmission cable route) would travel up to 17.5 mi (28.2 km) in length to the OnCS-DC as described below and depicted in Figure 2.1-3. From the Landfall Work Area, the onshore transmission cable would run parallel to Fire Island Beach Road within the paved Smith Point County Park parking lot, crossing under the William Floyd Parkway to a recreational area located to the west of William Floyd Parkway. The onshore transmission cable would be routed across the ICW via the ICW horizontal directional drilling (HDD) to a paved parking lot within the Smith Point Marina along East Concourse Drive. From the ICW Work Area, the onshore transmission cable would turn north along East Concourse and north along William Floyd Parkway to the intersection with Surrey Circle. The onshore transmission cable would be routed along Surrey Circle and would continue north along Church Road then turn west along Mastic Boulevard, north along Francine Place, to the intersection with Montauk Highway. It would cross Montauk Highway to Revilo Avenue and would continue north along Revilo Avenue to the work area for the Sunrise Highway crossing. The onshore transmission cable would then cross Sunrise Highway via trenchless methods to Revilo Avenue, continuing north to the intersection with Victory Avenue and then continue west on Victory Avenue to Horseblock Road, crossing the Carmans River via HDD. The onshore transmission cable would continue northwest along Horseblock Road and cross the Long Island Railroad (LIRR) to Long Island Avenue via trenchless methods. The onshore transmission cable would then turn west along the LIE Service Road, then turn south on Waverly Avenue to Long Island Avenue. The onshore transmission cable would then turn west on Long Island Avenue to Union Avenue and reach the Union Avenue site.

The onshore interconnection cable would begin at a set of termination structures located at the OnCS-DC and would be routed entirely underground along Union Avenue to an existing utility-owned or controlled property for connection to the Holbrook Substation (Figure 2.1-3).

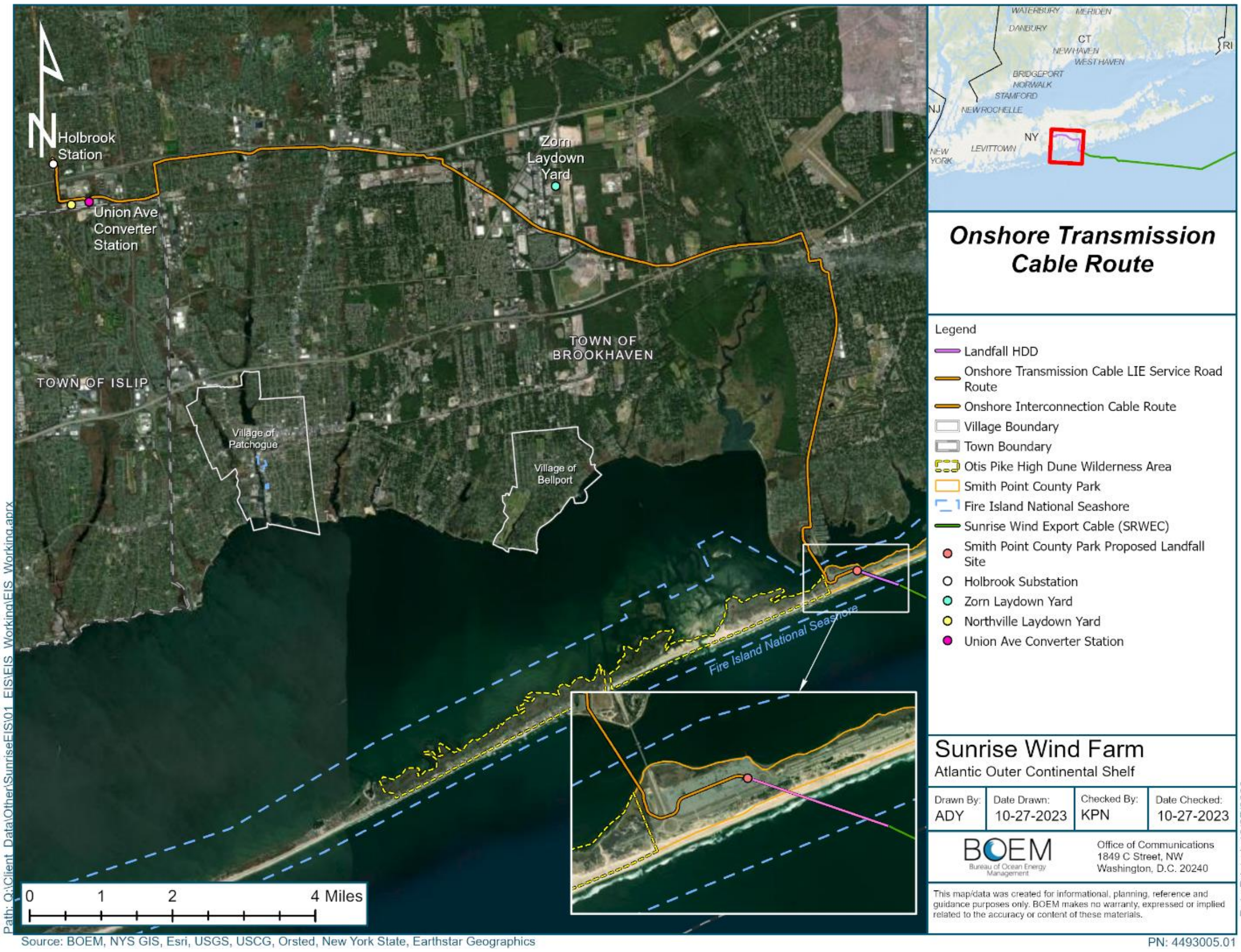

Figure 2.1-3. Proposed onshore transmission cable Route for the Sunrise Wind Project

The design of the Onshore Transmission Facilities considered geologic and local climatic conditions. The underground design avoids overhead weather-related disturbances such as from wind, ice, and lightning. The HDD would also provide some amount of protection from storm surges, flooding, sea level rise, wave runup, and overland wave propagation. Additionally, the proposed route is almost entirely within existing roadways that are designed for adequate drainage to handle such events, and there would be no change to grading or drainage of those facilities as a result of the Project construction. At the landfall location at Smith Point County Park, storm surge levels are up to 13.9 ft (4.2 m), which is inclusive of both the Stillwater elevation and wave setup, an increase in water levels caused by wave breaking, along the Atlantic-facing coast (Sunrise Wind 2023). Within Bellport Bay, storm surge decreases due to the protection of offshore barrier islands.

2.1.2.1.1.3 Onshore Interconnection Cable

The onshore interconnection cable would convey AC power from the OnCS-DC to the existing Holbrook Substation. A cross-section of a typical onshore AC transmission cable is provided in Figure 3.3.2-2 of the COP (Sunrise Wind 2023). The maximum design scenario for the AC onshore interconnection cable is provided in Table 3.3.2-1 of the COP (Sunrise Wind 2023). The onshore interconnection cable from the OnCS–DC would begin at a set of termination structures located along the northerly portion of the site and would be routed entirely underground along Union Avenue to existing utility-owned or controlled property for connection to the Holbrook Substation. The termination structures would be made of galvanized steel on concrete foundations. The onshore interconnection cable would consist of two circuits comprised of six cables per circuit. Each cable within the circuit would consist of a copper conductor core surrounded by cross-linked polyethylene insulation, a metallic shield consisting of plain annealed copper wires, a water-blocking layer over the metallic shield consisting of semi-conducting swellable tapes and laminated copper foil, with the outermost layer consisting of a polyethylene jacket. Fiber optic cables would be co-located with the two main cables as depicted on drawings in Appendix LL of the Environmental Management and Construction Plan Phase 2 (EM&CP 2).

Construction of the onshore interconnection cable would require a temporary disturbance width of up to 100 ft (30.5 m), excluding disturbance areas for trenchless crossing locations. Once installed, the typical operational corridor for each of the 138-kV circuits would be approximately 30 ft (9.1 m) and within easements to be obtained by Sunrise Wind. The onshore interconnection cable is depicted on the onshore interconnection cable Drawings in Appendix LL of the EM&CP 2. The crossing of the LIE (I-495) by the onshore interconnection cable would be installed using a trenchless construction technique (i.e., pipe-jacking).

To allow for the transportation of equipment and materials from Long Island to the construction site on Fire Island, a temporary pile-supported trestle (or landing structure) would be constructed on the inshore side of Fire Island, in Moriches Bay. The temporary landing structure would extend approximately 242 ft (73.8 m) offshore and be approximately 16 ft (4.9 m) wide. The temporary landing structure would include temporary disturbance of the seafloor of up to 150 square feet (ft^2; 46 square meters [m^2]) for placement of steel piles that would support the structure. The landing structure would be secured to the seabed by approximately 21 steel piles, each measuring 16 inches (in; 40.6 centimeters [cm]) in diameter. All Project infrastructure within the Fire Island National Seashore boundary would occur below the seabed, with the exception of a temporary landing structure.

2.1.2.1.1.4 Onshore Transmission Cable

The onshore transmission cable would convey the energy produced by the SRWF to the OnCS-DC. The SRWEC would connect to the onshore transmission cable within the TJB and link boxes within the Landfall Work Area. The two monopole DC cables would be spliced from this location into two DC onshore transmission cables (each comprising a single-phase cable) and two fiber optic cables. A typical onshore DC transmission cable cross-section is provided in Figure 3.3.2-3 of the COP and the maximum design scenario for the onshore transmission cable is provided in Table 3.3.2-2 of the COP (Sunrise Wind 2023).

Within an existing roadway ROW, the onshore transmission cable portion of the Project Corridor consists of the full extent of the ROW (tax property line to tax property line) and, during construction, would typically require a temporary disturbance width of up to 30 ft (9 m), excluding disturbance areas for trenchless crossing locations and splice vaults. Once installed, 30-ft-wide easements for an operational corridor would be obtained by Sunrise Wind (Table 3.3.3-1 in Sunrise Wind 2023).

The onshore transmission cable would be installed in an underground duct bank consisting of concrete-encased conduits, utilizing cable splice vaults for installation and maintenance access. Each splice vault would be accessible by up to two utility hole covers visible from the surface and spaced approximately 0.5 mi (563 km), except at the trenchless crossings. Outside of sensitive areas, excavators would be used for excavation of trenches and splice vault installation. Land disturbance associated with this excavation would be considered temporary, as these areas would be backfilled and surface conditions restored to pre-existing conditions in coordination with local entities after construction is completed.

Sunrise Wind would use trenchless crossing installation methods to avoid sensitive environmental resources or other physical obstructions (e.g., major highways, railroads) at certain crossing locations. The trenchless installation(s) would either consist of excavating a pair of pits on either side of a crossing or jacking pipe under a crossing (e.g., railroad), which would require additional temporary disturbance areas to support the setup of equipment necessary to perform each crossing. The Project's HDDs are described in detail in the HDD Work Plan provided as Appendix NN of the EM&CP 2. The remaining trenchless crossings are shown on the onshore transmission cable Drawings provided as Appendix KK of the EM&CP 2.

2.1.2.1.1.4.1 Construction

Construction of the onshore transmission cable and onshore interconnection cable would involve site preparation, trench excavation, duct bank and vault installation, cable installation, cable jointing, and final testing, and restoration with additional steps associated with HDD and other trenchless crossing methods. The typical underground transmission cable construction sequence is provided in Table 3.3.2-3 of the COP (Sunrise Wind 2023).

Following approval by NYSPSC of EM&CP 1 in July 2023, Sunrise Wind would initiate work on certain sections of the onshore transmission cable in Q4 2023. Ground disturbance would occur along certain NYSDOT controlled ROW (4 mi [6.4 km] of the Long Island Expressway South Service Road from Waverly Avenue to Horseblock Road) and would include installation of splice vaults and duct banks (approximately 15 ft [4.6 m] deep for splice vaults and approximately 5 to 8 ft [1.5 to 2.4m] for duct banks). Target burial depth would vary based on site-specific conditions. Following approval by NYSPSC of EM&CP 2 (anticipated in Q4 2023), Sunrise Wind would initiate work on remaining sections of the onshore transmission cable, as well as the onshore interconnection cable. Ground disturbance would include installation of splice vaults and duct banks (approximately 15 ft [4.6 m] deep for splice vaults and approximately 5 to 8 ft [1.5 to 2.4 m] for duct banks). Target burial depth would vary based on site-specific conditions and may be deeper in areas of HDD or trenchless crossings.

Temporary laydown yards are required to support the staging of necessary equipment and materials for the installation of the onshore transmission cable and onshore interconnection cable. One laydown yard, Zorn, was identified to support cable installation as well as other Project activities. Following the completion of the proposed Project, locations used for temporary laydown yards would be restored to pre-existing conditions in accordance with landowner requests and permit requirements.

Installation of the onshore transmission cable would generally require excavation of a trench within a temporary disturbance corridor. The onshore transmission cable would be installed within a concrete or thermal equivalent duct bank buried to a depth consistent with local utility standards. From the OnCS-DC, the onshore interconnection cable would be installed underground within a duct bank to the Holbrook Substation. A typical configuration of an underground onshore transmission circuit is shown in Figure 3.3.2-4 of the COP (Sunrise Wind 2023). A typical configuration of the installation of an underground onshore transmission circuit within a road ROW is shown in Figure 3.3.2-5 of the COP (Sunrise Wind 2023). A typical configuration of an underground onshore interconnection circuit is shown in Figure 3.3.2-6 of the COP (Sunrise Wind 2023).

Due to the length of the proposed onshore transmission cable, sections of cable would need to be spliced together with joints for each circuit. Splicing would occur along the entirety of the route approximately every 1,800 to 2,200 ft (549 to 671 m). At each splice location, a splice vault/pit would be required. Once a detailed below-grade utility survey is completed, more refined distances between splice vaults/pits would be determined based upon site specifics. In these locations, the temporary disturbance area required would be larger than for the duct bank installation. The splice vaults would be buried to a depth consistent with local utility standards. The entire temporary disturbance corridor would be restored to pre-construction conditions following installation of the proposed onshore transmission cable. The maximum design scenario for the construction of the Onshore Transmission and onshore interconnection cable is provided in Table 3.3.2-4 of the COP (Sunrise Wind 2023).

Installation of the proposed onshore transmission cable would result in the crossing of multiple waterways, major roadways, and railroads, which would require additional temporary disturbance areas to support the setup of equipment necessary to perform each crossing. The maximum design scenario, identifying the associated crossing method, overall crossing distance, approximate area of short-term and/or permanent impact, along with a description of the workspace locations that would be impacted to facilitate the various major crossings are provided in Table 3.3.2-5 of the COP (Sunrise Wind 2023).

2.1.2.1.1.5 Sunrise Wind Export Cable – Onshore Portion

The onshore termination of the SRWEC would be spliced together with the onshore transmission cable at the co-located TJB and link boxes located at the landfall location at Smith Point County Park, in the Town of Brookhaven, New York. The onshore portion of the SRWEC (up to 1,152 ft [351 m]) would be buried underground (i.e., above the mean high water line [MHWL]) up to the TJB and the remaining, offshore portion would traverse both federal and NYS waters (Figure 2.1-2).

2.1.2.1.1.6 TJB and Link Box Design

The proposed TJB would be comprised of a pit dug in the soil and lined with concrete. The purpose of the TJB is to provide a clean, dry environment for the jointing of the SRWEC and onshore transmission cable as well as protecting the joint once the jointing is completed and allowing for inspections if necessary. In the TJB, each SRWEC would be spliced into one single-phase conductor onshore cable. The sheaths from the SRWEC and the onshore transmission cable would be terminated into the link box via the cable joints. The fiber optic cable from the SRWEC and onshore transmission cable would be joined inside the fiber optic joint box. There would be one TJB, two link boxes, and two fiber optic cable joint boxes.

A conceptual schematic of the TJB is provided in Figure 3.3.3-1 of the COP and Section 3.3.3.1 in the COP (Sunrise Wind 2023) provides a detailed description of the TJB and link box design.

2.1.2.1.1.7 SRWEC Design and Landfall Construction

The SRWEC would be comprised of one distinct cable bundle and would transfer the electricity from the OCS-DC to the TJB located within the Landfall Work Area at Smith Point County Park. The SRWEC would be joined with the onshore transmission cable at the TJB.

The SRWEC cable bundle would be comprised of two cables. Each cable within the single bundle would consist of one copper or aluminum conductor core surrounded by layers of cross-linked polyethylene insulation and various protective armoring and sheathing to protect the cable from external damage and keep it watertight. A fiber optic cable would be bundled together with the two main conductors. The maximum design scenario for the proposed SRWEC is provided in Table 3.3.3-1 of the COP, and Section 3.3.3.2 in the COP (Sunrise Wind 2023) provides a detailed description of SRWEC design.

The SRWEC-NYS would enter NYS territorial waters at a point 3 nm (5.6 km) offshore and would be located up to 5.2 mi (8.4 km) in NYS territorial waters and 1,152 ft (351 m) located onshore. The SRWEC-NYS would span 4.8 mi (7.7 km) until a point approximately 2,225 ft (678 m) offshore from the MHWL, where it would connect utilizing HDD methodology. Two segments of the SRWEC-NYS would be installed via the Landfall HDD, including a segment that would be installed offshore (approximately 2,225 ft [678 m] seaward from the MHWL) and a segment that would be installed onshore (approximately 1,054 ft [321 m] landward from the MHWL). In addition, approximately 98 ft (30 m) would be installed underground from the Landfall HDD entry point to the TJB in Smith Point County Park. The Landfall HDD operations are described in the COP in Section 3.3.3.3.

The proposed Landfall Work Area is located in the eastern area of the Smith Point County Park beach parking lot and accessed from Fire Island Beach Road. The Landfall Work would be fenced for security and safety purposes; however, vehicle and pedestrian traffic within the parking lot would be maintained. The Burma Road Pipe Stringing Area is located onshore south of the Smith Point County Park camping area, within which the conduit pipe would be placed temporarily prior to maneuvering offshore.

The entry location for the Landfall HDD would be in a parking lot 755 ft (230 m) landward from the Fire Island Inlet to Montauk Point (FIMP) Project. The exit location for the Landfall HDD would be 2,525 ft (770 m) seaward from the FIMP Project. The cable would be installed at a depth of approximately 60 ft (18 m; North American Vertical Datum of 1988 [NAVD88]) below the 0’ datum where the FIMP Project is located. Appendix F (*Conceptual Project Engineering Design Drawings / Additional Project Information*) of the Sunrise Wind COP further depicts the horizontal and vertical installation. Sunrise Wind would minimize the sediment removed from the offshore HDD exist to the maximum extent practicable. Upon completion of the excavation of the offshore exit pit, it is anticipated that a temporary trench box would be installed to prevent natural backfill of the excavated pit. Once drilling has been completed, the trench box would be removed for subsequent cable pull-in and final backfill of the excavation. The exit pit would then natural backfill to pre-existing elevations utilizing the horizontally displaced material excavated from the pit. To accommodate future drilling activities and the HDD pipe string pull-in work, divers would use diver jetting and airlift tools to excavate the exit pit. The discharged end would be placed approximately 10 to 20 ft (3 to 6 m) away from the excavation, and materials from the pit would be selectively relocated away from the pit. As the material displaced on the sea floor, the divers would remove the discharge end to minimize build-up in one location. The divers would be deployed and recovered to the lift boat deck by a launch and recovery system. Prior to the onshore cable pull-in, the area around the installed HDD conduit may need to be cleared of sediment to make the HDD conduit ready for the cable pull-in and to access the winch wire that would be used to pull the cable onto the landfall. The clearing would be performed by jetting or airlift tool or a similar tool. The cable is anticipated to be installed at a depth of approximately 60 ft (18 m) at the 0’ datum for the Fire Island to Montauk Point.

Use of construction vehicles would be confined to the Project’s limit of disturbance (LOD). Construction vehicles would include heavy equipment, such as excavators, cranes, dump trucks, and paving equipment. No site disturbances would occur outside the Project’s LOD, which excludes the Otis Pike Wilderness Area and all surface lands of the Fire Island National Seashore. Any equipment that exceeds 15 tons in weight (current weight restriction for the Smith Point Bridge) is expected to utilize barge transport during construction of the Project. Vehicles less than 15 tons would continue to use the bridge.

Continual pedestrian and vehicular use of and access to park amenities within Smith Point County Park on Fire Island and the Smith Point Marina on the mainland and all other existing public access areas pedestrian and public access to the parking lot and park facilities would be maintained. Public access to Smith Point County Park would be maintained throughout construction, and no construction activities would occur in Suffolk County Parks between Memorial Day and Labor Day. Similarly, Sunrise Wind’s use of the Temporary Equipment efforts would not prevent the public from accessing the fishing pier on Smith County Park unless temporarily necessary for safety purposes (e.g., movement of equipment near access point to the fishing pier). Sunrise Wind has committed to maintaining access to all roads and the Smith Point County Park parking lot during construction, therefore no road closures would be required. An occasional and short-term interruption of a few minutes is possible during certain points of the construction to maintain safe operations.

The work area/LOD located in the fenced area west of the Smith Point Bridge, where the new ICW HDD would exit, is the only area that would be closed during construction activities. Closures would be limited to the offseason and would overlap with locations that would be permanently impacted by the new Smith Point Bridge. The public would still have access to the Fire Island Wilderness Visitors Center and other trails and areas west of the bridge during construction. Sunrise Wind has also committed to avoiding all work within Suffolk County Parks during the summer tourist season (Memorial Day to Labor Day).

Sunrise Wind has been closely coordinating with Suffolk County authorities with design review meetings since 2019 to ensure the siting, workspace limits, design specifications, and installation timelines for the Project do not conflict with the Smith Point Bridge replacement project. Sunrise Wind would continue to hold check-in meetings to share project updates and discuss construction timelines to ensure conflicts are avoided or minimized to the extent practicable. Currently, Sunrise Wind anticipates completing construction activities that would overlap with the bridge replacement project areas (the ICW HDD and onshore transmission cable installation) prior to the start of the County's project and would continue to coordinate schedules as the start of construction nears. Waterborne passage along the ICW through the bridge areas would remain possible throughout the bridge construction.

The closest Project disturbance to the Otis Pike Wilderness Area would occur approximately 65 ft (20 m) east of the wilderness boundary, approximately 225 ft (69 m) north of the Fire Island Wilderness Center. Per requirements from NYS, all site disturbances would be confined to the Project's LOD, which would be staked and/or flagged prior to construction and inspected and maintained until restoration activities are completed. Furthermore, areas west of the LOD are also contained by an existing split rail and chain link fence, approximately 65 ft (20 m) from the wilderness boundary, which is expected to provide additional protection to off- LOD areas during the proposed installation of the Project facilities.

The Landfall HDD entry location would be located in the parking lot and no trenching would occur on the beach. Utility holes or vaults within Smith Point County Park would be limited to the TJB near the Landfall HDD and one vault in the recreational fields, west of the existing Smith Point Bridge. The standard vaults would typically come in pre-cast sections to facilitate transportation and installation. While the final design has yet to be completed, each section of the standard vaults is expected to be 20-25 tons. The TJB would be larger than the remaining vaults used throughout the Project to facilitate the splice from land-based cables to sub-sea cables. This may dictate more pre-cast sections or larger sections, than the standard vaults. Depending on final weight, these sections are expected to use the barge for transport, and construction of the vaults is expected to be pre-cast. All construction activities would occur within previously disturbed areas, would be temporary in nature, and limited to approved construction durations (Labor Day to Memorial Day) and species' time-of-year restrictions imposed by agencies. Sunrise Wind would adhere to all plans and requirements within the EM&CP specific to noise, lighting, and dust control to minimize impacts during construction to the adjacent Otis Pike Fire Island Wilderness Area. Utilities would be marked out in accordance with NY Code 753. All marked utilities would be test-pitted by hand or vacuum excavation truck to verify location/depth prior to excavation.

Conduit welding is discussed in COP Section 3.3.3.3. The duct would be assembled on Burma Road within Smith Point County Park. Pipe rollers would be placed along Burma Road to support the conduit strings. The conduit would be maneuvered into the water using rollers and floated to the site by tugs for installation. Once the bore has been sufficiently enlarged and cleansed, the duct would be connected to the drill string either on the barge or with the assistance of divers and the marine support spread and pulled into the prepared hole by the onshore HDD rig from offshore towards the drilling rig located at the Landfall Work Area. Assembly of the duct sections would require welding and short-term placement (i.e., 2–3 weeks per duct) of assembled HDD conduit sections. Approximately 3,500 ft (1,067 m) of duct sections would be laid out at the assembly site. Truck access would be restricted to the paved area and Burma Road for delivery of the conduit. A fabrication area would be enclosed with temporary construction orange safety fencing and set up to allow the conduit-fusing equipment to be stationary during the fabrication process. As the fabrication process occurs, tracked excavators would assist in pulling the conduit strings until each conduit string is fully fabricated. No improvements are planned for Burma Road as it meets the requirements for ingress and egress of the planned construction equipment and personnel. Burma Road activities would take place for approximately 30 days from start of fabrication to removal, cleanup, and restoration of impacted areas. HDD conduit stringing may occur on Burma Road within Smith Point County Park, in an area located onshore south of the Smith Point County Park camping area, and is anticipated to occur between November and December, in accordance with conditions of the Article VII Certificate. The final schedule would depend on the receipt of final permits, but the overall expected schedule is outlined in Table 2.1-4.

Table 2.1-4. Onshore Proposed Construction Schedule

Milestone	Expected Duration [a]	Expected Timeframe [b]
Laydown Yards		
Establish Laydown Yards	1 Month	2023
OnCS–DC		
Civil Works	6 Months	2023-2024
Electrical and System Integration Tests	24-26 Months	2023-2025
Holbrook Substation Expansion		
Expansion Activities	18-20 Months	2023-2025
Onshore Transmission Cable		
Smith Point County Marina		
ICW HDD	3-4 Months	2024
Install Vaults and Duck Banks	3-4 Months	2024
Cable Pulling/Splicing	2-3 Months	2024-2025
Smith Point County Park		
Temporary Equipment [c]	12-14 Months	2024
Install Vaults and Duct Banks	3-4 Months	2024
Cable Pulling/Splicing (Onshore Landfall HDD)	2-3 Months	2024-2025
Landfall HDD	3-4 Months	2024-2025

Milestone	Expected Duration [a]	Expected Timeframe [b]
Burma Road Pipe Stringing	1-2 Months	2024
Cable Pulling/Splicing (Offshore Landfall HDD)	2-3 Months	2025
Onshore Transmission Cable– New York State Department of Transportation ROW		
Install Vaults and Duct Banks	4-5 Months	2023-2024
Cable Pulling/Splicing	2-3 Months	2024
Onshore Transmission Cable-All Other ROW		
Install Vaults and Duct Banks, Cable Pulling and Splicing	14-16 Months	2024-2025
Onshore interconnection cable		
Install Vaults and Duct Banks	6-8 Months	2023-2024
Cable Pulling/Splicing	4-6 Months	2024-2025
SRWEC–NYS		
Offshore Cable Installation	2-3 Months	2025

Source: EM&CP 2023

Notes:

a Note that work may not take place during the entire allowed work duration window.

b Expected timeframes assume work on Phase 1 activities would commence following approval of EM&CP 1 and the permits required by Certificate Condition 17, 17a. Post-Phase 1 activities would commence following approval of EM&CP 2 and all permits.

c Sunrise Wind anticipates the Temporary Equipment is expected to be installed in three to four weeks (March 2024). The Temporary Equipment would be used during each season of construction activity and remain in place for the duration of construction of the Project.

There would be two operational barges used during construction, supplied by Sunrise Wind's contractor. The barges, called Flexi Float Barges, would be operated between the Smith Point Marina and the Smith Point County Park parking lot, as shown in Figure 2.1-4. Loads in excess of 15 tons would be transported via barge, with trailers driven directly onto the barge, transported, and driven directly off again. The barges would be maneuvered using a 700 HP push boat and run continuously from 7 a.m. to 7 p.m., making an estimated six to eight daily trips. It is anticipated that barging would occur between March and May 2024, in September 2024, and January 2025. The largest anticipated load capacity for the barge would be the drill rig at approximately 120,000 pounds (lbs; 54,431 kilograms [kg]). Hazardous materials would not be transported via barge with the exception of the fluids contained in the vehicles or equipment (diesel fuel, motor oil, hydraulic oil, antifreeze, etc.). Assistance from the drawbridge operator would be required to allow the barge to pass under the Smith Point Bridge. These are sectional barges and would be assembled at the marina, with a size of 40 by 90 ft (12 by 27 m) once constructed. Suitable sea fastening would be employed for all loads on the barges. All barges would be certified fit for use and well maintained.

The proposed temporary pier location was selected based on field surveys to minimize impacts to sensitive habitats. Surveys were conducted for submerged aquatic vegetation (SAV), commonly referred to as eelgrass beds, and none were documented near the proposed location of the temporary landing structure. No mudflats are documented within proximity to the temporary landing structure. Impact to tidal wetlands would include up to approximately 150 ft^2 (46 m^2) of temporary impact for placement of the steel piles that would support the structure. Sunrise Wind LLC (SRW) does not expect the installation, use, and removal of the temporary landing structure to impact SAV, and thus SRW does not plan on submitting a SAV Mitigation Plan. Avoidance and minimization measures are included in the previously submitted SAV survey results, Temporary Equipment Analysis (Appendix F to EM&CP 1), and Anchoring Plan (Appendix N of EM&CP 1). Sunrise Wind has committed to avoid anchoring and spudding in the delineated SAV area and the 2018 NYSDOS Seagrass area and would provide the Project Corridor, 2018 NYSDOS Seagrass area, and identified SAV locations to contractors so that they can avoid anchoring/spudding in those locations. The structure has been designed to be most suitable for the site and the minimum size necessary to safely accommodate construction of the Project.

Sunrise Wind has submitted Appendix E1, *Emergency Response Plan/ Oil Spill Response Plan* (Sunrise Wind 2020) and Appendix E2, *Safety Management System* (Sunrise Wind 2022) as appendices to the COP to BOEM. Sunrise Wind has also filed plans through the EM&CP process, including an Onshore Spill Prevention, Control, and Countermeasure (Onshore SPCC) Plan in EM&CP 1, as well as Appendix NN (*HDD Work Plan*) of EM&CP 2, which includes Safety Data Sheets and an Inadvertent Return Plan, as well as Appendix O (*Materials Management Plan*) of EM&CP 1. The Onshore SPCC Plan described below is applicable to the storage, handling, transportation, and disposal of petroleum, fuels, oil, chemicals, hazardous substances, and other potentially harmful substances which may be used or stored during, or in connection with, onshore construction, operation, or maintenance. The Onshore SPCC Plan addresses measures that would be taken to avoid spills and improper storage or application in the vicinity of ecologically sensitive sites along the ROW and access roads. The Onshore SPCC Plan details the procedures for responding to and remediating the effects of petroleum, fuel, oil, chemical, hazardous substances, and other potentially harmful substance spills per the applicable state and federal laws, regulations, and guidance.

In the event of a discharge or spill that relates to Project operations, the spill would be reported per the protocols outlined in the below sections. The overall environmental risk from unintended discharges or spills is expected to be low due to the nature and quantity of chemicals used and procedures in place for storage, handling, and disposal. Additionally, offshore construction vessels contracted to conduct any work associated with phases of the Project would have an Oil Spill Response Plan (OSRP) onboard that complies with the regulations of USEPA, United States Coast Guard (USCG), and BOEM/Bureau of Safety and Environmental Enforcement (BSEE). The OSRP is necessary in case of any accidental releases of petroleum, fuels, oil, chemicals, hazardous substances into the marine and coastal environment.

Figure 2.1-4. Drawing of the Temporary Landing Structure at the Smith Point Country Park and Marina

2.1.2.1.1.8 Ports for Construction

The Proposed Action would use existing port facilities located in Albany and/or Coeymans, New York; Davisville-Quonset Point, Rhode Island; and New London, Connecticut, for offshore construction, staging and fabrication, crew transfer, and logistics support. Other ports in Massachusetts, Maryland, New Jersey, and Virginia may be used as back-up or support facilities. These back-up options include the Port of New York-New Jersey, New York; the New Bedford Marine Commerce Terminal, Massachusetts; Sparrow's Point, Maryland; Paulsboro Marine Terminal, New Jersey; Port of Providence, Rhode Island; and Port of Norfolk, Virginia. Upgrades at these facilities are not required for the purposes of the Project and are not included as part of the Proposed Action.

2.1.2.1.2 Offshore Activities and Facilities

2.1.2.1.2.1 SRWEC – Offshore Portion

Offshore, the SRWEC would be installed within a survey corridor ranging in width from 1,312 to 2,625 ft (400 to 800 m), depending on water depth. The total width of the disturbance corridor for installation of the SRWEC would be up to 98 ft (30 m), inclusive of any required sand wave leveling and boulder clearance. Dynamic positioning vessels would generally be used for cable burial activities. If anchoring (or a pull ahead anchor) is necessary during cable installation, it would occur within the survey corridor (see Section 3.3.10 of the COP for additional information on vessel anchoring).

Burial of the proposed SRWEC would typically target a depth of 4 to 6 ft (1.2 to 1.8 m) in federal waters, with reasonable efforts to maximize burial depth within this range depending on site-specific conditions, operating parameters of the installation equipment, and to protect against location-specific hazards. The SRWEC-NYS would be buried to a minimum depth of 6 ft (1.8 m) below the seabed in NYS waters. . The target burial depth for the SRWEC would be determined based on an assessment of seafloor conditions, seafloor mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment. The Cable Burial Risk Assessment would be prepared for the Facility Design Report/Fabrication and Installation Report (FDR/FIR) to be reviewed by the Certified Verification Agent (CVA) and submitted to BOEM and BSEE prior to construction. The Cable Burial Feasibility Assessment (COP Appendix G4-*Cable Burial Feasibility Assessment*, Confidential; Ørsted Offshore North America 2023a) provides an assessment of cable burial based on review of site-specific survey data. Where burial cannot occur, sufficient burial depth cannot be achieved, or protection is required due to cables crossing other existing cables, additional cable protection methods may be used (cable protection is discussed further below). The location of the SRWEC and associated cable protection would be provided to NOAA's Office of Coast Survey after installation is completed so that they may be marked on nautical charts. Burial depths at specific locations would be formalized in the FDR/FIR.

Installation of the proposed SRWEC consists of a sequence of events, including pre-lay cable surveys, seafloor preparation, offshore cable installation, beginning with cable pull into the landfall, joint construction, cable installation surveys, cable protection, and connection to the OCS-DC, as summarized in Table 3.3.3-4 of the COP (Sunrise Wind 2023). Additional details for seafloor preparation, cable installation methodologies, and cable protection strategies are described in the COP, including information on Munitions and Explosives of Concern (MEC)/Unexploded Ordinance (UXO) risk mitigation, boulder removal, sand wave leveling, and pre-lay grapnel run.

Based on the identified range of installation methods and requirements, Sunrise Wind has established a design envelope for installation of the proposed SRWEC that reflects the maximum seafloor disturbance associated with construction (see Table 3.3.3-5 of the COP; Sunrise Wind 2023). Short-term seafloor disturbance during installation includes the construction disturbance corridor where seafloor preparation would occur prior to cable installation, as well as the installation of the cable. Vessel anchoring occurring within the surveyed corridor during cable installation would also result in short-term seafloor disturbance. Permanent seafloor disturbance includes areas where additional cable protection may be required post-installation.

2.1.2.1.2.1.1 Offshore Cable Installation Methodology

Selection of cable installation methodologies would be dependent on sediment conditions. As sediment conditions range along the SRWEC and within the SRWF, several different cable installation methodologies may be required during installation. Sunrise Wind has completed geophysical and geotechnical (G&G) surveys of the SRWEC to inform preliminary cable routing and selection of the most appropriate tools for installation of the SRWEC to the target burial depths. The cable bundle would be laid on the seafloor and then trenched post-lay. Alternatively, a trench may be pre-cut prior to cable installation. Based on current understanding of site-specific conditions between landfall at Smith Point, Long Island, and the SRWF, Sunrise Wind is considering jet trenching, mechanical plowing, jet plowing, and mechanical cutting, as described in Section 3.3.3 of the COP (Sunrise Wind 2023).

During cable installation, there may be scenarios where installation to the target burial depth is not achievable using the primary installation methodologies due to mechanical problems with the trencher, adverse weather conditions, and/or unforeseen soil conditions. Therefore, alternative installation methodologies would be utilized, including controlled flow excavation (CFE), pre-cut mechanical plowing, and pre-cut dredging, as described in Section 3.3.3 in the COP (Sunrise Wind 2023). As discussed in Appendix G4 of the COP, the site/ground conditions along the SRWEC and IAC routes are overall, generally favorable for burial operations. The jet trencher is considered to be the most favorable installation tool, though conditions are also regarded as generally favorable for several other burial tools. Prior to installation, a more detailed cable burial feasibility assessment, namely a Burial Assessment Study would be undertaken by each of the cable installation contractors for both the SRWEC and IAC in support of the FIR and would be reviewed by Sunrise Wind. The Burial Assessment Study would provide an assessment of the seabed and geologic conditions along the routes and would demonstrate that an appropriate burial tool has been selected and configured for the Project, and that risks to burial have been suitably mitigated.

Secondary cable protection may be applied where burial cannot occur, sufficient burial depth cannot be achieved due to seafloor conditions, or to avoid risk of interaction with external hazards. The need for secondary cable protection in specific locations would be based on factors such as the as-built burial depths, cable burial risk, and suitability to perform remedial works. The area of impact for secondary cable protection is accounted for in Table 3.3.3-5 of the COP, and cable protection solutions can be found in Section 3.3.3 of the COP (Sunrise Wind 2023).

2.1.2.1.2.1.2 Cable Crossing

The Project's network of submarine cable (inclusive of the SRWEC and IAC) would cross existing submarine assets. There are up to eight known telecommunications cables that would be crossed by the SRWEC, two of which may also be crossed by the IAC (Table 3.3.3-6 and Figure 3.3.3-9 of the COP; Sunrise Wind 2023).

Cable protection at these crossings would be applied for both in-service and out-of-service assets that cannot be safely removed and pose a risk to the SRWEC or IAC. Where appropriate, inactive cable systems would be cut and cleared from the burial route for a short distance on each side. Any cut and cleared cables would typically have the exposed ends weighted with clump weights or short-section chain so that the cable cannot be snagged by other seafloor users, such as fishermen. At all IAC crossings of out-of-service cables, Sunrise Wind would use a de-trenching grapnel to recover a section of the cable to the ship's deck. A sufficiently long section would be cut out, and the remaining cable ends lowered back to the seabed on either side of the IAC. Where feasible and to the extent practicable, Sunrise Wind would bury the cut cable ends to their pre-existing depth and not use any secondary cable protection measures.

Rock berm or concrete mattress separation layers would be installed prior to cable installation, while the rock berm or concrete mattress cover layers would be installed after cable installation. Any rock berm separation and cover layers would be installed using suitably approved rock material. The rock berm separation and cover layers are defined by minimum geometry and vertical and horizontal tolerances. The amount of cable protection would be as required for suitable coverage and technical agreements with respective asset owners. It is assumed up to 1.48 ac (0.6 ha) of cable protection would be required per crossing. The cable protection required for cable crossings is in addition to the secondary cable protection requirements previously described.

2.1.2.1.2.1.3 Foundations

Up to 94 WTG monopile foundations (located at 102 potential positions) with a maximum diameter tapering from 23 ft (7 m) above the waterline to 39 ft (12 m) below the waterline (7/12 m monopile) would be installed in the SRWF. Monopiles would be installed using an impact pile driver with a maximum hammer energy of 4,000 kilojoules (kJ) to a maximum penetration depth of 164 ft (50 m). A monopile foundation typically consists of a single steel tubular section, with several sections of rolled steel plate welded together. For a WTG monopile foundation, a transition piece (TP) may be fitted over the top of the monopile and secured via a bolted connection. Secondary structures on each WTG monopile foundation would include a boat landing or alternative means of safe access (e.g., Get Up Safe – a motion-compensated hoist system allowing vessel-to-foundation personnel transfers without a boat landing), ladders, a crane, and other ancillary components. The TP may either be installed separately following the monopile installation, or the monopile and TP may be fabricated and installed as an integrated single component. If the monopile and TP are fabricated and installed as an integrated component, the secondary structures would be installed on the TP subsequently and in separate smaller operations. The TP portion would be painted yellow and marked according to USCG requirements. A monopile foundation would only be used for the WTGs. Scour protection would have a radial extension of approximately five times the monopile radius and a height of approximately 6.5 ft (2 m) from the original seabed level around selected monopile foundations. Additional cable protection system (CPS) stabilization may be used where the IAC would be pulled into the foundation, requiring additional rock cover on top of the scour protection. This additional rock cover would have a height of approximately 6.5 ft (2 m), for a total of up to 13.1 ft (4 m) from the original seabed level, including the scour protection and CPS stabilization.

An up to four-legged piled jacket foundation would be used for the proposed OCS-DC. The piled jacket foundation would have four legs with two pin piles per leg. The platform height would be up to 88 ft (26.8 m) with a leg diameter of up to 15 ft (4.6 m) and a pile diameter of up to 13 ft (4 m). OCS-DC jacket foundation pin piles (two per leg, eight total) would be installed using an impact pile driver with a maximum hammer energy of 4,000 kJ to a maximum penetration depth of 295 ft (90 m). A piled jacket foundation would be formed of a steel lattice construction (comprising tubular steel members and welded joints) secured to the seafloor using hollow steel pin piles attached to the jacket. Unlike monopiles, there is no separate TP; the TP and ancillary components are fabricated as an integrated part of the jacket. Rock may be used to provide a level seafloor around the base of the structure. Scour protection, if required, would cover the entire jacket footprint, extending an additional 33 to 66 ft (10 to 20 m) beyond the base of the structure and reaching a height of approximately 6.5 ft (2 m) from original seabed level. Additional CPS stabilization may be used where the IAC and SRWEC would be pulled into the foundation, which would require additional rock cover on top of the scour protection. This additional rock cover would have a height of approximately 6.5 ft (2 m), for a total of up to 13.1 ft (4 m) height from the original seabed level, inclusive of the scour protection and CPS stabilization.

Offshore platform piled jacket substructures such as those that would be used for the OCS-DC are typically designed with mudmats to ensure on-bottom stability of the jacket during installation. The permanent anchoring of the jacket is provided by the piles once installation is complete. Mudmats are typically made up of horizontal plates with vertical stiffeners. Mudmats are designed to distribute the load from the piled jacket into the seafloor, from initial set down of the foundation by the installation vessel, through pile installation and grouting, until the piled jacket is sufficiently supported by piles. The design accounts for environmental loads and the static weight of the piled jacket, as well as bearing capacity of the upper soil layers.

The final foundation design specifications would be determined by the final engineering design process, informed by factors including soil conditions, wave and tidal conditions, Project economics, and procurement approach. Detailed information on the foundations would be included in the FDR/FIR, to be reviewed by the CVA and submitted to BSEE and BOEM prior to construction.

To promote safety while the foundations are awaiting installation of the TPs (if used) and WTGs, each foundation would be marked and lit in accordance with USCG requirements. In addition, without the TPs or ancillary structures with the equivalent features, there would be no means for unauthorized access to the foundation.

2.1.2.1.2.2 Offshore Converter Station

2.1.2.1.2.2.1 Design

An OCS-DC would be required to support the proposed Project's maximum design capacity. The water depth at the OCS-DC location would be approximately 164 ft (50 m) MSL based on NOAA Coastal Relief Model data (166 ft [51 m] mean lower low water [MLLW] based on site-specific geophysical surveys). The OCS-DC would convert the medium-voltage AC generated by WTGs to DC and transport it—via the IAC—to the onshore electrical infrastructure for transmission. This would reduce energy losses incurred while transmitting energy over a long distance. Onshore, the OnCS-DC would convert the DC power back to AC for interconnection to the electrical grid.

The OCS would house DC equipment. The DC equipment on the OCS-DC is expected to be rated up to ±320 kV DC. The OCS-DC would house equipment for high-voltage transmission and conversion of electric power from AC to DC. The main equipment would include medium-voltage AC (66-kV) gas-insulated switchgear, one or more converter transformers, and converter reactors. The OCS-DC would also include AC and DC gas- or air-insulated switchgears at voltages to be defined during detailed design, converter valves based on state-of-art voltage-source converter technology, DC smoothing reactors, and supervisory control and data acquisition (SCADA) and protection systems.

In addition to the power transmission system above, the OCS-DC would be equipped with the necessary low-voltage and utility systems. These systems include emergency power generation and uninterrupted power supply seawater cooling, offshore crane, fire and safety, small power and lighting, and communications, sanitary facilities, and lifesaving and rescue. A helideck may also be located on the OCS-DC.

The AC to DC conversion process at the OCS-DC requires a CWIS. Raw seawater for the OCS-DC would be withdrawn through three individual vertical pipes attached to a leg of the steel foundation jacket. The openings of each of the three intake pipes would be located at a height 30 ft (10 m) above the seafloor. A seawater lift pump equipped with a variable frequency drive would be dedicated to each of the three vertical intake pipes. The three seawater lift pumps would pump water into a single manifold that leads into a coarse filtering element designed to remove suspended particles larger than 500 microns. The filtered cooling water would then be exposed to heat exchange equipment and ultimately discharged to the receiving water through a dump caisson. The dump caisson is a single vertical pipe whose terminus is located 40 ft (12 m) below MSL. Additional design details are included in the NPDES permit application, which was submitted to USEPA in December 2021, and EPA issued a draft permit in May 2023. The maximum topside design scenario for the OCS-DC is provided in Table 3.3.6-1 of the COP (Sunrise Wind 2023).

2.1.2.1.2.2.2 Construction

The typical sequence for the proposed OCS-DC installation is summarized in Table 3.3.6-3 of the COP (Sunrise Wind 2023). The proposed schedule for installation and commissioning of the OCS-DC is provided in Section 3.2 of the COP (Sunrise Wind 2023), not including cable pull-in. Seafloor disturbance associated with installation of the proposed OCS-DC is accounted for in Table 3.3.5-2 of the COP (Sunrise Wind 2023), which summarizes the maximum disturbances associated with foundations.

2.1.2.1.2.3 Inter-array Cables

The IAC would carry the electrical current produced by the WTGs to the OCS-DC. The length of the entire network of IAC would be up to 180 mi (290 km). Figure 3.3.4-1 of the COP (Sunrise Wind 2023) presents the indicative IAC layout for the Project. The following subsections describe the design and construction of the proposed IAC.

2.1.2.1.2.3.1 Design

The network of AC IAC would be comprised of a series of cable “strings” that interconnect a small grouping of WTGs to the OCS-DC. The IAC would be installed within surveyed corridors ranging approximately 328 to 1,608 ft (100 to 490 m) in width. The IAC would consist of three bundled copper or aluminum conductor cores surrounded by layers of cross-linked polyethylene or ethylene propylene rubber insulation and various protective armoring and sheathing to protect the cable from external damage and keep it watertight. A fiber optic cable would also be included in the interstitial space between the three conductors and would be used to transmit data from each of the WTGs to the SCADA system. Table 3.3.7-1 of the COP (Sunrise Wind 2023) provides a summary of the proposed IAC maximum design scenario.

2.1.2.1.2.3.2 Construction

The IAC would be installed within a 90-ft (30-m)-wide corridor. Burial of the IAC would typically target a depth of 4 to 6 ft (1.2 to 1.8 m), with reasonable efforts to maximize burial depth within this range, depending on site-specific conditions, operating parameters of the installation equipment, and to protect against location specific hazards. The target burial depth for the IAC would be determined based on an assessment of seafloor conditions, seafloor mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment. Installation of the IAC would follow a similar sequence as described for the SRWEC in Table 3.3.3-4 of the COP (Sunrise Wind 2023), with two exceptions:

- After pre-lay cable surveys and seafloor preparation activities are completed, a cable-laying vessel would be pre-loaded with the IAC. Prior to the first end-pull, the cable would be fitted with a CPS and the cable would be pulled into the WTG or OCS-DC. The vessel would then move towards the second WTG (or the OCS-DC). Cable may be laid on the seafloor and then trenched post-lay or, alternatively, cable laying and burial may occur simultaneously using a lay and bury tool. Alternatively, a trench may be pre-cut prior to cable installation. The pull and lay operation, inclusive of fitting the cable with a CPS, is then repeated for the remaining IAC lengths, connecting the WTGs and the OCS-DC together.
- The IAC would typically not require infield joints; thus, "Joint Construction," as described for the SRWEC, would generally not be required. However, joints may be required in case of a cable repair.

Installation methods for the IAC would be similar to those described for the SRWEC (see Section 3.3.3.4 of the COP; Sunrise Wind 2023). As described for the installation of the SRWEC, seafloor preparation (specifically boulder clearance and sand wave leveling) could be required; boulder clearance trials, as previously described for the SRWEC, may also be implemented prior to wide-scale seafloor preparation activities. Based on a review of the geophysical and geotechnical data, potential cable installation tools, and cable burial requirements, sand leveling is no longer anticipated along the IAC. Although sand wave leveling is no longer anticipated for the IAC, it remains in the PDE until further engineering is completed. Sunrise Wind assumes up to 10 percent of the total IAC network would require boulder clearance and up to 5 percent of the total IAC network would require sand wave leveling prior to installation of the cables. As with the SRWEC, boulder clearance would involve the use of a boulder grab or towed plow to relocate boulders along the IAC routes. As sand wave leveling is no longer anticipated along the IAC route, specific locations and volumes of sediment along the IAC route were not identified. The installation and commissioning of the IAC system is presented in the anticipated construction schedule provided in Section 3.2.2 of the COP (Sunrise Wind 2023).

Cable protection strategies would be required for the IAC. Sunrise Wind assumes up to 15 percent of the entire IAC network may require secondary cable protection in areas where burial cannot occur, sufficient burial depth cannot be achieved due to seafloor conditions, or to avoid risk of interaction with external hazards. As previously described, additional CPS stabilization may be used where the IACs would be pulled into the foundations. The SRWEC and IAC would also need to cross existing cables, which would require cable protection. The anticipated locations where IAC would cross existing cables is provided in Table 3.3.3-6 of the COP (Sunrise Wind 2023). Rock berm or concrete mattress separation layers would be installed over the previously installed cable prior to installing a crossing cable, while the rock berm or concrete mattress cover layers would be installed after cable installation. The location of the IAC and associated cable protection would be provided to NOAA's Office of Coast Survey after installation is completed so that they may be marked on nautical charts.

The installation methods and burial depths would be determined by the engineering design process, informed by detailed geotechnical data, discussion with the chosen installation contractor, and coordination with regulatory agencies and stakeholders. Detailed information on the technique(s) selected, burial requirements, the Cable Burial Risk Assessment, and Burial Assessment Study would be included in the FDR/FIR, to be reviewed by the CVA and submitted to BOEM and BSEE prior to construction. The Cable Burial Feasibility Assessment (Appendix G4, Confidential; Ørsted Offshore North America 2023a), based on review of site-specific survey data, is provided with the MSIR (Appendix G4; Ørsted Offshore North America 2023a) of the COP. As discussed in Appendix G4 of the COP, the site/ground conditions along the inter-array cable routes are overall, generally favorable for burial operations. The jet trencher is considered to be the most favorable installation tool, though conditions are also regarded as generally favorable for several other burial tools Maximum seafloor disturbance associated with construction and operation of the IAC is summarized in Table 3.3.7-2 of the COP (Sunrise Wind 2023).

2.1.2.1.2.4 Wind Turbine Generators

The proposed Project would consist of up to 94 WTGs (within 102 potential positions), sited in a uniform east-west/north-south grid with 1.15 by 1.15 mi (1 by 1 nm; 1.85 by 1.85 km) spacing (Figure 2.1-5). The water depths where the WTGs would be located range from 135 to 184 ft (41 to 56 m) MSL, based on NOAA Coastal Relief Model data (127 to 181 ft [39 to 55 m] MLLW based on site-specific geophysical surveys). As previously noted, a final layout of the Project would be provided as part of the FDR/FIR, to be reviewed by the CVA and submitted to BOEM and BSEE prior to construction.

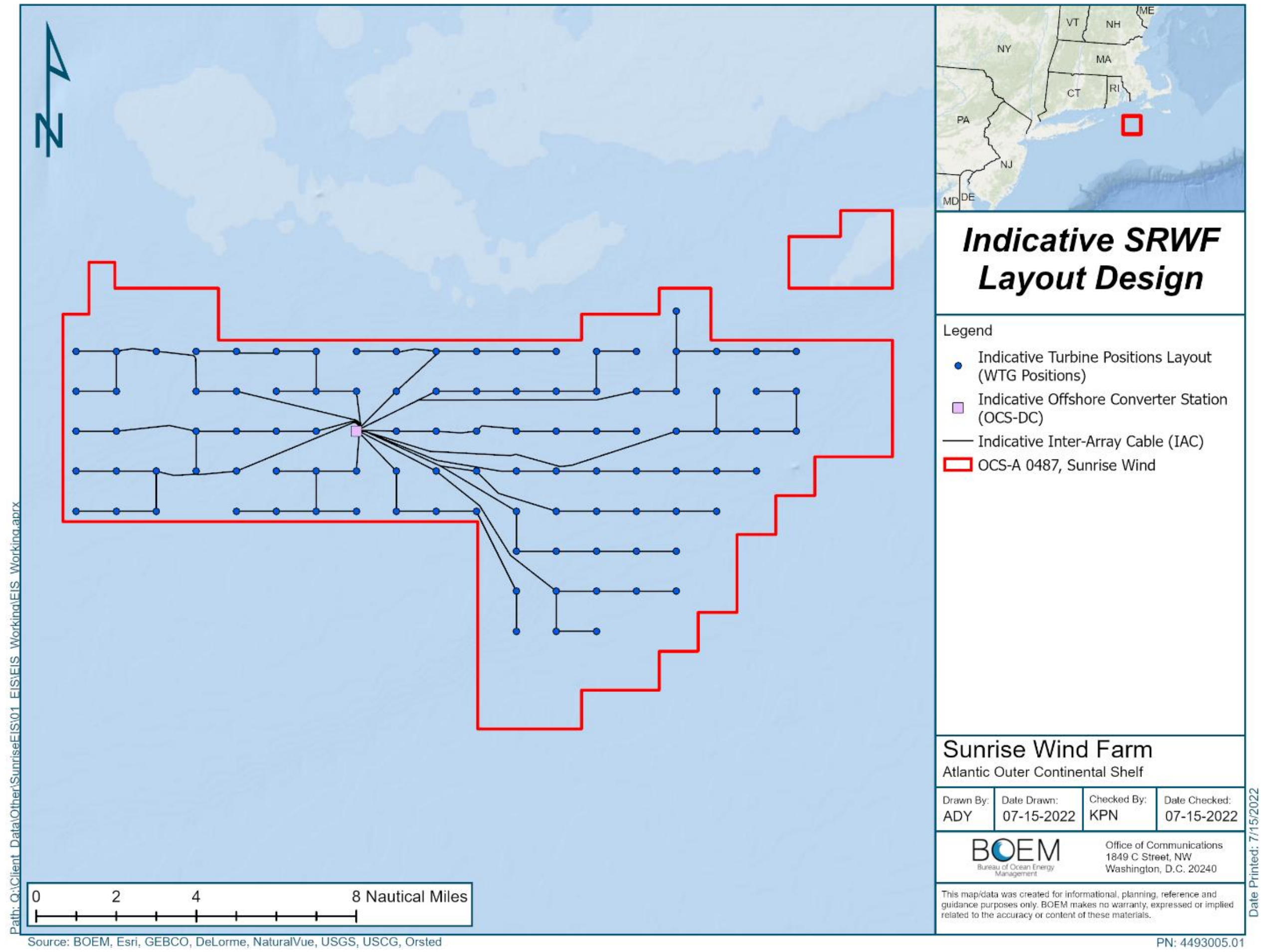

Figure 2.1-5. Indicative Layout of the Sunrise Wind Farm

2.1.2.1.2.4.1 Design

Sunrise Wind has selected the Siemens Gamesa Renewable Energy SG DD-200 11-MW turbine as the machine that would be installed for the Project. The 11-MW turbine is considered to be the WTG model that would be best suited for the Project and is commercially available to support the Project schedule. With selection of the 11-MW turbine, Sunrise Wind has determined that up to 94 11-MW WTGs (within 102 potential positions) would be sufficient to meet the Project purpose.

The Siemens 11-MW turbine follows the traditional offshore WTG design with three blades and a horizontal rotor axis. Specifically, the blades would be connected to a central hub, forming a rotor that turns a shaft connected to the generator. The generator would be located within a containing structure known as the nacelle situated adjacent to the rotor hub. The nacelle would be supported by a tower structure affixed to the foundation. The nacelle would be able to rotate or “yaw” on the vertical axis to face the oncoming wind direction. Figure 3.3.8-1 of the COP (Sunrise Wind 2023) shows a conceptual rendering of the 11-MW WTG dimensions.

Table 2.1-5 provides a summary of the physical parameters of the 11-MW turbine selected for the proposed Project. The WTGs would be designed following Class S based on the International Electrotechnical Commission (IEC) with turbulence classes B and C specifications of the standards IEC-61400-1/IEC-61400-3. The design is specifically suited for offshore wind sites with referenced wind speeds of 121 miles per hour (mph) (54 meters per second [m/s] over a 10-minute average) and 50-year extreme gusts of 145 mph (65 m/s over a 3-second average) as well as air temperatures greater than -4 degrees Fahrenheit (°F) (-20 degrees Celsius [°C]) and less than 122°F (50°C). However, standard environmental operating conditions for the proposed WTGs include cut-in wind speeds of 7 to 11 mph (3 to 5 m/s) and cut-out wind speeds of 56 to 63 mph (25 to 28 m/s), and air temperatures between 14°F and 104°F (-20°C and +40°C). The WTGs would automatically shut down outside of the operational criterial for the WTG design.

Table 2.1-5. WTG Design Specifications (from Sunrise Wind 2023, Table 3.3.8-1)

WTG Component/Parameter	Selected Turbine (11-MW)
Turbine Height (from MSL)	787 ft (240 m)
Hub Height (from MSL)	459 ft (140 m)
Air Gap (from MSL) to the Bottom of the Blade Tip	131.2 ft (40 m)
Base Height (foundation height – top of TP) (from MSL)	89 ft (27 m)
Base (tower) Width (at the bottom)	23 ft (7 m)
Base (tower) Width (at the top)	16 ft (5 m)
Nacelle Dimensions (length by width by height)	69 ft by 33 ft by 36 ft (21 m by 10 m by 11 m)
Blade Length	318 ft (97 m)

Source: Sunrise Wind 2023
Notes: WTG = wind turbine generator, MW = megawatts, ft = feet, m = meters, MSL = mean sea level

2.1.2.1.2.4.2 Construction

The proposed sequence for WTG installation is summarized in Table 3.3.8-3 of the COP (Sunrise Wind 2023). It is currently estimated that the construction of each WTG may take up to 36 hours allowing for vessel positioning and completion of all lifts; however, to allow time for vessel maneuvering between WTG locations as well as weather downtime, the total duration of the installation campaign for the WTGs is presented in Section 3.2 of the COP (Sunrise Wind 2023). Monopiles would be installed using an impact pile driver with a maximum hammer energy of 4,000 kJ to a maximum penetration depth of 164 ft (50 m).

Vessel activity during installation of WTGs would occur within area cleared during seafloor preparations as described in Section 3.3.6 of the COP (Sunrise Wind 2023). Seafloor disturbance associated with installation of WTGs would result from jack-up vessel spudcans. Seafloor disturbance associated with WTG foundations is summarized in Table 3.3.5-2 of the COP (Sunrise Wind 2023).

2.1.2.1.2.5 Measurement Equipment

Sunrise Wind plans to install a series of monitoring instrumentation to monitor metocean conditions as part of the Project's construction and operation activities. The monitoring instrumentation may consist of Acoustic Doppler Current Profiler (ADCP), ground-based light detection and ranging (LIDAR), wave radar sensor, and weather stations measuring air temperature, air pressure, humidity, wind speed and direction, and visibility readings. Each type of measurement equipment is described below in further detail.

2.1.2.1.2.5.1 Wave Buoys

Up to two wave buoys would be deployed to support the SRWF installation stage with one wave buoy within the SRWF proximate to the WTGs in the eastern region of the windfarm and one wave buoy deployed near shore along the SRWEC-NYS near the HDD exit pit location within the Anchoring Area depicted in Appendix F of the COP. The wave buoys would collect information about the wave and current information to be transmitted in real time to the installation vessel(s) for monitoring the safety of operations and also to feed into a forecasting system for real time calibration and accuracy improvement of the local forecast. The number and exact coordinates of the wave buoys would be determined at a later date. The wave buoys would be installed during the construction phase. The nearshore wave buoy would only remain deployed during the cable installation process (i.e., approximately 7 months). The wave buoy in the SRWF would be installed at the beginning of offshore construction (i.e., Q1 2024) and remain in place during the installation works and may remain deployed in the water after windfarm commissioning, until Sunrise Wind has reviewed and confirmed calibration of the data (i.e., potentially into Q1 2026). The exact time and duration of deployment is dependent upon the construction schedule and receipt of permits. During the operations phase, the wave radar sensor, together with the weather and wave forecast service, would support asset management, structural monitoring, and marine transfer operations. Data collected would be stored locally and transmitted via telemetry to a satellite gateway to an onshore server.

The wave buoys would measure wave heights, periods, and directions and may also be equipped with a downward facing current profiler, which measures water velocity and direction through the water column. The top side of the wave buoy is comprised of a tall mast (approximately 7 ft [2 m] above sea level) where a set of equipment is fixed: navigational light, navigation radar, solar panels, antenna, visibility sensors and ultra-sonic anemometer. Generally, wave buoy diameters range from 1.6 to over 5 ft (0.5 to over 1.5 m) and range in weight from 440 to 1,320 lbs (200 to 600 kg). The mooring configuration would be dependent on buoy type, water depth, and environmental considerations, but generally consists of an anchor weight (approximately 11 ft^2 [1 m^2] and 1,765 lbs [800 kg]), mooring line, and are equipped with navigational lighting. The wave buoys would be powered by lead acid and lithium batteries that are charged through solar panels but would operate using only solar power when available. Deployment of the wave buoys would occur from vessels equipped with a crane or A-Frame and winch and would be conducted in accordance with manufacturer specifications by trained personnel.

2.1.2.1.2.5.2 Acoustic Doppler Current Profiler

Sunrise Wind had previously anticipated up to three ADCPs would be deployed during construction along the SRWEC in anticipation of one being installed in the nearshore portion of the SRWEC-NYS to support the Landfall HDD, one installed in the offshore portion of the SRWEC-OCS to support cable installation, and one installed along the SRWEC-NYS to comply with Sunrise Wind's Article VII Condition #118(b). However, Sunrise Wind now would anticipate installing downward looking ADCP on the wave buoy in the nearshore portion of the SRWEC-NYS to support the Landfall HDD, the bottom-mounted ADCP in the offshore portion of the SRWEC-OCS is no longer anticipated, and the ADCP required by Article VII is anticipated to be boat-based, and not bottom-mounted. Thus, Sunrise Wind would not anticipate the need to install any bottom-mounted (upward facing) ADCP). Any ADCPs deployed would only be used during the installation period, and recovery of the ADCPs would occur within a few months of installation completion. ADCPs collect current measurements, including direction and velocity through the water column by sending pulses through the water column at varying frequencies. This data may be stored internally and transferred upon equipment recovery or, for real-time monitoring, the data may be transmitted via telemetry to a satellite gateway to an onshore server using a transmission buoy. The number and locations of ADCPs would be determined as the cable route, seabed conditions, and ocean dynamics are further defined and in coordination with stakeholders.

The adopted ADCP configuration could consist of two solutions, which are described below. Although Sunrise Wind would not anticipate using bottom-mounted (upward-facing) ADCP, it is maintained within the PDE:

- An upward facing ADCP mounted on a seabed frame, a groundline connecting the frame to the ground weight, and a data storage/recovery system. The groundline would be relatively taut, with generally no sweep occurring throughout the tides. The seabed frame has an approximately 11 ft^2 (1 m^2) footprint. It is 1.6 to 3.3 ft (0.5 to 1 m) in height and weighs 220 to 1,100 lbs (100 to 500 kg). The frame may consist of simple tripod designs with gimbal and/or trawl resistant features such as low profile and protected sides. ADCPs are powered by alkaline or lithium batteries. There are two standard mooring configurations that may be used. One includes a surface marker buoy that can be used for telemetry in real time and navigation and acts as the primary recovery method. If used, the marker buoy may be affixed to the ground weight by chain or rope mooring. The second configuration does not have a surface marker and relies on an acoustic system to release floats, which are attached to the ADCP frame. ADCP deployment would be conducted in accordance with manufacturer specifications by trained personnel. Deployment and recovery of ADCP frames and moorings can generally be conducted on a small workboat or cat equipped with on-deck crane, winch, and bow roller.
- An alternative setup is using a standard wave buoy (as described in the section above), and installing a bottom-mounted ADCP to the lower part of the submerged hull of the buoy.

2.1.2.1.2.5.3 Ground-based Light Detection and Ranging

The LIDAR wind measurements would be taken using ground-based LIDAR equipment and anemometers. During construction, ground-based LIDAR includes LIDAR installation at some ports, on decks of installation of work vessels, or on the OCS-DC.

The lidars used for some port facilities and installation or work vessels are aimed at supporting lifting operations to ensure safety and to minimize risk to equipment, vessels, and crew.

There would be:

- Three LIDAR devices at different ports (specific locations to be confirmed)
- Two LIDAR devices on two installation vessels (foundation vessel and WTG vessel)

The OCS-DC LIDAR is not yet confirmed. The design for the OCS-DC may include a LIDAR mount and connection point to support potential installation of a sensor.

2.1.2.1.2.5.4 Wave Radar Sensors

Up to one directional wave radar sensor would be installed in the SRWF located at the OCS-DC. This would be installed when the OCS-DC is energized and would stay in place for the entire operational life of the windfarm.

2.1.2.1.2.5.5 Weather Stations

Weather stations with anemometers would be installed on the OCS-DC and selected WTG(s) as per NYISO requirements. The units to be placed on the OCS-DC shall be part of a single weather station installed in the roof of the upper level of the converter station. The weather station would include measurements of air temperature; air pressure; humidity; visibility; and wind speed and direction.

2.1.2.1.2.6 Unexploded Ordnance/Munitions, Explosives of Concern (UXO/MEC)

Within the SRWF there is potential for construction activities to encounter UXO/MEC on the seabed. These include explosive munitions such as bombs, shells, mines, torpedoes, etc. that did not explode when they were originally deployed or were intentionally discarded in offshore munitions dump sites to avoid land-based detonations. The risk of incidental detonation associated with conducting seabed-altering activities such as cable laying and foundation installation in proximity to UXO/MECs jeopardizes the health and safety of project participants. Sunrise Wind followed an industry standard As Low as Reasonably Practical (ALARP) process that minimizes the number of potential detonations (COP Appendix G2; Ordtek 2022).

For UXO/MECs that are positively identified in proximity to planned activities on the seabed, several alternative strategies would be considered. These may include relocating the activity away from the (avoidance), moving the UXO/MEC away from the activity (lift and shift), cutting the UXO/MEC open to apportion large ammunition or deactivate fused munitions, using shaped charges to reduce the net explosive yield of a UXO/MEC (low-order detonation), or using shaped charges to ignite the explosive materials and allow them to burn at a slow rate rather than detonate instantaneously (deflagration). Only after these alternatives are considered would a decision to utilize in-situ UXO/MEC disposal. To detonate a UXO/MEC, a small charge would be placed on the UXO/MEC and detonated causing the UXO/MEC to then detonate.

As part of the 2022 geophysical surveys completed by Sunrise Wind, inspections for potential MEC/UXO occurred for the SRWF. MEC/UXO surveys did not occur for the SRWEC since any potential MEC/UXO could be avoided through micrositing of the cable. One confirmed MEC (cMEC) was identified in the SRWF during geophysical surveys; however, it was determined that the cMEC could be avoided. Additional details can be found in the MEC/UXO Investigation Survey Report (Supporting Documentation to ALARP Phase 4/5), which was provided to BOEM in April 2022, and the MEC/UXO Identification Survey Report (Supporting Documentation to ALARP Phase 6/7), which was provided to BOEM in July 2023.

To account for unanticipated emergent finds of MEC/UXO, Sunrise Wind plans for up to three MEC/UXO requiring detonation in place. In the event that detonation is determined to be the preferred and safest method of disposal, all activities would occur within the Project Area and during daylight hours. Sunrise Wind would implement environmental protection measures as necessary to reduce potential impacts from detonation. Sunrise Wind would provide BOEM with ALARP sign-off certificates for all inspected locations prior to construction.

2.1.2.2 Operations and Maintenance

Per the Lease, the operations term of the proposed Project is 25 years but could be extended to 30 or 35 years. The operations term would commence on the date of COP approval. It is anticipated that Sunrise Wind would request to extend the operations term in accordance with applicable regulations in 30 *CFR* 585.235.

The O&M Plan for both the Project's onshore and offshore infrastructure would be finalized as a component of the FDR/FIR review process; however, a preliminary O&M plan for the onshore facilities, offshore transmission facilities (e.g., the SRWEC, IAC, and the OCS-DC electrical components) and WTGs is provided in the following sections. As noted previously, various existing ports are under consideration to support offshore construction, assembly and fabrication, crew transfer and logistics (including for O&M activities) (see Section 3.5.5 and Table 3.3.10-1 in the COP; Sunrise Wind 2023).

To support O&M, the Project would be controlled 24/7 via a remote surveillance system (i.e., SCADA).

2.1.2.2.1 Onshore Activities and Facilities

Sunrise Wind would monitor the OnCS-DC remotely on a continuous basis. The equipment in the OnCS-DC would be configured with a condition monitoring system that would sound an alarm upon detecting equipment faults, unintended shutdowns, or other issues. In addition, the OnCS-DC would be inspected for anomalies with the equipment operation in accordance with manufacturers' recommendations. Sunrise Wind would put in place an established and documented program for the maintenance of all equipment critical to reliable operation. Maintenance programs would conform to the equipment manufacturer's recommendations.

Sunrise would implement a reliability maintenance program which would include preventative maintenance on the OnCS-DC, onshore transmission cable, and onshore interconnection cable, and planned outages would be conducted in accordance with the North American Electric Reliability Corporation (NERC)/Northeast Power Coordinating Council, Inc. (NPCC) Standard-TOP-003-1, and protective system maintenance would be performed in accordance with the NPCC PRC 005-2 standard.

Vegetation would be managed to ensure safe operation of and access to the onshore transmission cable and onshore interconnection cable, as needed. To support operation and maintenance of the onshore section of the SRWEC and portions of the onshore transmission cable, a 30 ft (6-m)-wide Project Easement for Operational ROW centered on the cables would be requested, per EM&CP 1. As described in Appendix Z of EM&CP 1, an Integrated Vegetation Management program would be developed to address vegetation removal and control along the Onshore Facilities, including manual cutting, mowing, and the prescriptive use of federally approved and state-registered herbicides to eliminate targeted species within vegetated areas of the ROW.

2.1.2.2.2 Offshore Activities and Facilities

2.1.2.2.2.1 Offshore Transmission Facilities

A summary of the proposed offshore transmission facility routine maintenance activities and the anticipated frequency at which they may occur is provided in Table 3.5.2-1 of the COP (Sunrise Wind 2023). Routine maintenance requirements (including frequencies) referenced in this table are subject to change based on final design specifications and manufacturer requirements. Detailed information regarding maintenance and required frequencies would be included in the FDR/FIR, to be reviewed by the CVA and submitted to BOEM and BSEE prior to construction.

Sunrise Wind would employ a proprietary state-of-the-art asset management system to inspect offshore transmission assets including the OCS-DC (electrical components), SRWEC, and IAC. This system provides a data-driven assessment of the asset condition and allows for prediction and assessment of whether inspections and/or maintenance activities should be accelerated or postponed. This approach would allow the Project to maximize O&M efficiencies.

The SRWEC and IAC would typically have no maintenance requirements unless a fault or failure was to occur. To evaluate integrity of the assets, Sunrise Wind intends to conduct a bathymetry survey along the entirety of the cable routes immediately following installation (scope of installation contractor), and at 1 year after commissioning, 2–3 years after commissioning, and 5–8 years after commissioning. Survey frequency thereafter would depend on the findings of the initial surveys (i.e., site seabed dynamics and soil conditions). A survey may also be conducted after a major storm event (i.e., greater than 10-year event). Surveys of the cables may be conducted in coordination with scour surveys at the foundations.

Should the periodic bathymetry surveys completed during the operational lifetime of the Project indicate that the cables no longer meet an acceptable burial depth (as determined by the Cable Burial Risk Assessment), the following actions may be taken:

- Alert the necessary regulatory authorities, as appropriate;
- Undertake an updated Cable Burial Risk Assessment to establish whether cable is at risk from external threats (i.e., anchors, fishing, dredging);
- Survey monitoring campaign for the specific zone around the shallow buried cable; and
- Assess the risk to cable integrity.

Based on the outcome of these assessments, several options may be undertaken, as feasible, permitted and practical, such as remedial burial, addition of secondary protection (rock protection, rock bags or mattresses), and increased frequency of bathymetric surveys to assess reburial.

It is possible submarine cables may need to be repaired or replaced due to fault or failure. Also, it is expected that a maximum of 10 percent of the cable protection placed during installation may require replacement/remediation over the lifetime of the Project. These maintenance activities are considered non-routine. If cable repair/replacement or remedial cable protection are required, the Project would complete any necessary surveys of the seafloor in areas where O&M activities would occur and obtain necessary approvals. These activities would result in a short-term disturbance of the seafloor similar to or less than what is anticipated during construction.

2.1.2.2.2.2 Foundations

A summary of WTG and OCS-DC foundation maintenance activities and the anticipated frequency at which they may occur is provided in Table 3.5.3-1 of the COP (Sunrise Wind 2023). Maintenance requirements (including frequencies) referenced in this table are subject to change based on final design specifications and manufacturer requirements. Detailed information regarding maintenance and required frequencies would be included in the FDR/FIR, to be reviewed by the CVA and submitted to BOEM and BSEE prior to construction.

2.1.2.2.2.3 WTGs

A summary of WTG maintenance activities and the anticipated frequency at which they may occur is provided in Table 3.5.4-1 of the COP (Sunrise Wind 2023). Maintenance requirements (including frequencies) referenced in this table are subject to change based on final design specifications and manufacturer requirements. Detailed information regarding maintenance and required frequencies would be included in the FDR/FIR, to be reviewed by the CVA and submitted to BOEM and BSEE prior to construction. As discussed previously, WTGs would be continuously remotely monitored via the SCADA systems from shore. Preventative maintenance activities would be planned for periods of low wind and good weather (typically corresponding to the spring and summer seasons). The WTGs would remain operational between work periods of the maintenance crews. Certain O&M activities may require presence of either a jack-up vessel or anchored barge vessel. These activities would result in a short-term disturbance of the seafloor similar to or less than what is anticipated.

The WTGs would also be designed to minimize the effects of potential icing conditions in the SRWF. The SCADA monitoring system and turbine control management system would be designed to detect the buildup of ice and/or snow on the WTG and shut down operations, as necessary. The WTGs would be type certified according to IEC standards. The WTGs would comply with EC machinery directive (CE marked). Sunrise Wind would seek compliance with BOEM and BSEE regulations that directly govern operations and in-service inspections for offshore wind facilities in the United States.

Each of the WTGs would require various oils, fuels, and lubricants to support the operation of the WTGs. Table 3.3.8-2 of the COP (Sunrise Wind 2023) provides a summary of the maximum potential quantities of oils, fuels, lubricants per WTG. The spill containment strategy for each WTG would be comprised of preventative, detective, and containment measures. These measures include 100 percent leakage-free joints to prevent leaks at the connectors; high pressure and oil level sensors that can detect both water and oil leakage; and appropriate integrated retention reservoirs capable of containing 110 percent of the volume of potential leakages at each WTG.

Each WTG would have its own control system to carry out functions like yaw control and ramp down in high wind speeds. Each turbine would also connect to a central SCADA system for control of the wind farm remotely. This would allow functions such as remote turbine shutdown if faults occur. The Project would be able to shut down a WTG within two minutes of initiating a shutdown signal. The SCADA system would communicate with the wind farm via fiber optic cable(s), microwave, or satellite links. Individual WTGs can also be controlled manually from within the nacelle or tower base to control and/or lock out the WTG during commissioning or maintenance activities. In case of a power outage or during commissioning, the turbine would be powered by a permanent battery back-up power solution with integrated energy harvest from the rotor or by a diesel generator located temporarily on each WTG.

The WTGs would also be protected both externally and internally by a lightning protection system. The external lightning protection system is comprised of lightning receptors located within both the nacelle and blade tips, which are designed to handle direct lightning strikes and would conduct the lightning's peak current through a conductive cabling system that leads through the tower into the WTG grounding/earthing system. To avoid and/or minimize internal damage from the secondary effects of lightning (e.g., power surges), the internal electrical systems would be protected by equipotential bonding, overvoltage protection, and electromagnetic coordination.

WTGs would be accessed either from a vessel via a boat landing or alternative means of safe access (e.g., Get Up Safe). The WTGs would be lit and marked in accordance with Federal Aviation Administration (FAA), BOEM, and USCG requirements for aviation and navigation obstruction lighting, respectively. The lights would be equipped with back-up battery power to maintain operation should a power outage occur on a WTG. Additional operational safety systems on each WTG would include fire suppression, first aid, and survival equipment.

2.1.2.2.2.4 Offshore Converter Station

The OCS-DC would require various oils, fuels, and lubricants to support its operation. Table 3.3.6-2 of the COP (Sunrise Wind 2023) provides a summary of the maximum potential volumes of oils, fuels, and lubricants for the OCS-DC. The spill containment strategy for the OCS-DC would be comprised of preventative, detective, and containment measures. The OCS-DC would be designed with a minimum of 110 percent of secondary containment of all identified oils, grease, and lubricants. These measures are discussed in more detail in Appendix E-1 of the COP (Sunrise Wind 2020) OCS-DC gas-insulated switchgears containing sulfur hexafluoride (SF_6) would be equipped with gas density monitoring devices to detect SF_6 gas leakages should they occur. Any chemicals used in the auxiliary systems would be brought onto and taken off the platform during O&M and are not anticipated to be stored on the platform.

The OCS-DC would be centrally located within the Lease Area and house the alternating current (AC) and DC equipment rated up to ±320 kV. The main equipment for the OCS-DC to convert the high voltage alternating current (HVAC) generated by WTGs prior to onshore transmission includes medium voltage AC (66 kV) gas-insulated switchgear, one or more converter transformers, converter reactors, and SCADA and protection systems. The approximate dimensions of the main OCS-DC topside platform would be 253 ft (77 m) long, 171 ft (52 m) wide, and 197 ft (60 m) tall. The topside platform would be located approximately 78 ft (23.8 m) above the mean higher high water (MHHW) elevation. The total height of the OCS-DC platform and equipment, including lightning protection and ancillary structures, would extend approximately 295 ft (90 m) from the lowest astronomical tide. The OCS-DC platform would be founded on a steel jacket pile structure. The placement of gravel material would be required to the level the seafloor (pre-installation seafloor grade) where the jacket pile structure would be installed.

The OCS-DC would be placed on an up to four-legged piled jacket foundation. A piled jacket foundation is formed of a steel lattice construction (comprising tubular steel members and welded joints) secured to the seafloor by means of hollow steel pin piles attached to the jacket. Schematic drawings and renderings of the conceptual monopile foundation with secondary structure after installation and the piled jacket foundations are included in COP Section 3.3.5 (Sunrise Wind 2023). When required, scour protection would be placed around foundations to stabilize the seabed near the foundations as well as the foundations themselves. The OCS-DC requires the withdrawal of raw seawater through a CWIS to dissipate heat produced through the AC to DC conversion and then discharge this water as thermal effluent to the marine receiving waters. The DIF for the OCS-DC is 7.8 mgd; however, the actual intake flow would generally range from 4.0 mgd to 5.3 mgd.

2.1.2.3 Conceptual Decommissioning

Pursuant to 30 *CFR* 285 and other BOEM and BSEE requirements, Sunrise Wind would be required to remove or decommission all facilities, projects, cables, pipelines, and obstructions and clear the seabed of all obstructions created by the Project. Methods of site clearance have involved trawling, sonar, or ROV or diver verifying that the site is clear. Other methods may be used if approved from BSEE/BOEM.

In accordance with applicable regulations and a BSEE-approved conceptual decommissioning plan, Sunrise Wind would have up to 2 years to decommission the Project after the 25-year lease ends, unless the lease is extended, which would return the area to pre-construction conditions, as feasible.

Sunrise Wind would need to obtain separate and subsequent approval, via a decommissioning application from BSEE, to retire any portion of the Project in place. Sunrise Wind would submit a decommissioning application prior to any conceptual decommissioning activities. BOEM would conduct a NEPA review at that time, which could result in the preparation of a NEPA document. If the COP is approved or approved with modifications, Sunrise Wind would have to submit a bond that would be held by the United States government to cover the cost of conceptually decommissioning the entire facility.

Conceptual decommissioning may not occur for all Project components. However, for the purposes of the Final EIS, all analyses assume that conceptual decommissioning would occur as described in this section.

2.1.2.3.1 Onshore Activities and Facilities

Within Town / County jurisdiction, full removal of cable and fiber is anticipated during decommissioning with non-hazardous underground structures to remain in place, except for in the Carmans River crossing location. Cable would be removed, likely using truck-mounted winches and handling equipment. Within NYSDOT jurisdictional areas, it is assumed all cable and duct bank would be removed unless in the interest of NYSDOT to remain. Where applicable in NYSDOT jurisdiction, disturbed pavement would be restored to the width of the trench plus 1-2 ft (0.3-0.6 m) on either side depending on the location. Any additional restoration shall be limited to resurfacing with the curb limits (EM&CP 2 Appendix WW, 2023).

2.1.2.3.2 Offshore Activities and Facilities

WTGs and foundations (along with their associated transition pieces), now have an expected operating life of at least 25 years, and substantially longer with prudent inspection and maintenance practices. This timeframe is applicable to offshore wind facilities worldwide, including the SRWF. At the end of the proposed Project's operational life, it would be decommissioned in accordance with a detailed Project decommissioning plan that would be developed in compliance with applicable laws, regulations, and best management practices (BMPs) at that time. All facilities would need to be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 *CFR* 285.910). It is expected that as part of decommissioning, Sunrise Wind shall survey and use best efforts to remove the installed cable protection measures that are within 2 ft (0.6 m) of the seabed surface. However, if at the time of decommissioning, after gathering input from the appropriate regulatory agency(ies), it may be agreed that it is in the best interest of the federal and state agencies to allow any such equipment to remain. For instance, there may be potential environmental and fisheries impacts associated with removal of cable protection. The current assumption is that the SRWEC would either be fully or partially removed from the seabed or decommissioned in situ as returning the seabed to its original state is generally the preferred method. Care would be taken to handle waste in a hierarchy that prefers re-use or recycling and leaves waste disposal as the last option. Absent permission from BOEM, Sunrise Wind would complete decommissioning within 2 years of termination of the Lease.

BSEE would require Sunrise Wind to submit a decommissioning application upon the earliest of the following dates: 2 years before the expiration of the lease; 90 days after completion of the commercial activities on the commercial lease; 90 days after completion of your approved activities under a limited lease on a ROW grant or right-of-use and easement (RUE) grant; or 90 days after cancellation, relinquishment, or other termination of the lease (see 30 *CFR* 285.905). Upon completion of the technical and environmental reviews, BSEE may approve, approve with conditions, or disapprove the Lessee's decommissioning application. This process would include an opportunity for public comment and consultation with municipal, state, and federal management agencies. Sunrise Wind would need to obtain separate and subsequent approval from BOEM to retire in place any portion of the proposed Projects. Approval of such activities would require compliance under NEPA and other federal statutes and implementing regulations.

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

2.1.3 Alternative C – Fisheries Habitat Impact Minimization Alternative (Preferred Alternative)

Between the Draft EIS and Final EIS, Sunrise Wind completed additional site investigations and studies to quantify the extent of glauconite deposits across the Lease Area as well as its potential impact on pile drivability. BOEM and National Renewable Energy Laboratory (NREL) (NREL 2023) independently reviewed Sunrise Wind's analysis and, based on this review, determined that Alternative C-1 and C-2 would no longer meet the purpose and need because selection of Alternative C-1 and C-2 would not allow Sunrise Wind to install the minimum number of WTGs necessary to fulfill Sunrise Wind's contractual obligations with NYSERDA. See Section 2.1.3.3 for additional information on the extent of glauconite in the Lease Area and potential impacts on pile drivability. BOEM developed Alternative C-3 to address concerns regarding pile refusal due to glauconite sands in the southeastern portion of the Lease Area while still minimizing impacts to benthic and fisheries resources. Alternative C-3a, C-3b, and C-3c consider different WTG configurations to avoid sensitive habitats and engineering constraints while still meeting the NYSERDA OREC. BOEM has identified Alternative C-3b as its Preferred Alternative. Section 2.1.3.3 and Section 3.7.8 provide additional details on the number of WTG positions and layouts considered for each of the sub-alternatives for Alternative C-3.

Through a competitive leasing process under 30 *CFR* 585.211, Sunrise Wind was awarded commercial Renewable Energy Lease OCS-A 0487 covering an area offshore of Massachusetts, Rhode Island, and New York (Lease Area). Under the terms of the lease, Sunrise Wind has the exclusive right to submit a COP for activities within the Lease Area, and it has submitted a COP to BOEM proposing the construction and installation, O&M, and conceptual decommissioning of up to a 1,034-megawatt (MW) offshore wind energy facility in accordance with BOEM's COP regulations under 30 *CFR* 585.626, et seq. (Figure 2.1-1). Under Alternative C, the construction, O&M, and conceptual decommissioning of the Sunrise Wind Project within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, Alternative C is proposed with the intent to minimize impacts to fisheries habitats in the proposed Project Area that are the most vulnerable to long-term impacts. This alternative considered and prioritized contiguous areas of complex bottom habitat to be excluded from development to potentially avoid and/or minimize impacts to complex fisheries habitats, while still meeting BOEM's purpose and need for the project. Areas for prioritization were identified by NMFS on May 2, 2022, based upon recent, preliminary data of Atlantic cod spawning activity in the vicinity of the Project Area, assumed hard bottom complex substrate, and the presence of large boulders (Figure 2.1-7). Priority Area 1 was deemed the higher priority by NMFS due to close proximity to Cox Ledge, and documented Atlantic cod spawning activity based upon recent acoustic and telemetry data. Cox ledge is approximately 3.1 to 6.2 mi (5 to 10 km) north of Priority Area 1 (Figure 2.1-6) (USGS 2022). Priority Area 1 includes 18 WTG positions as well as the OCS-DC. Priority Area 2 includes 18 WTG positions and contains areas of high reflectance (indicative of hard substrates), large boulders, and is adjacent to detected Atlantic cod spawning activity. Priority Area 3 includes 14 WTG positions and areas of high reflectance but fewer large boulders. Priority Area 4 includes 4 WTG positions and mid to high reflectance with large boulders.

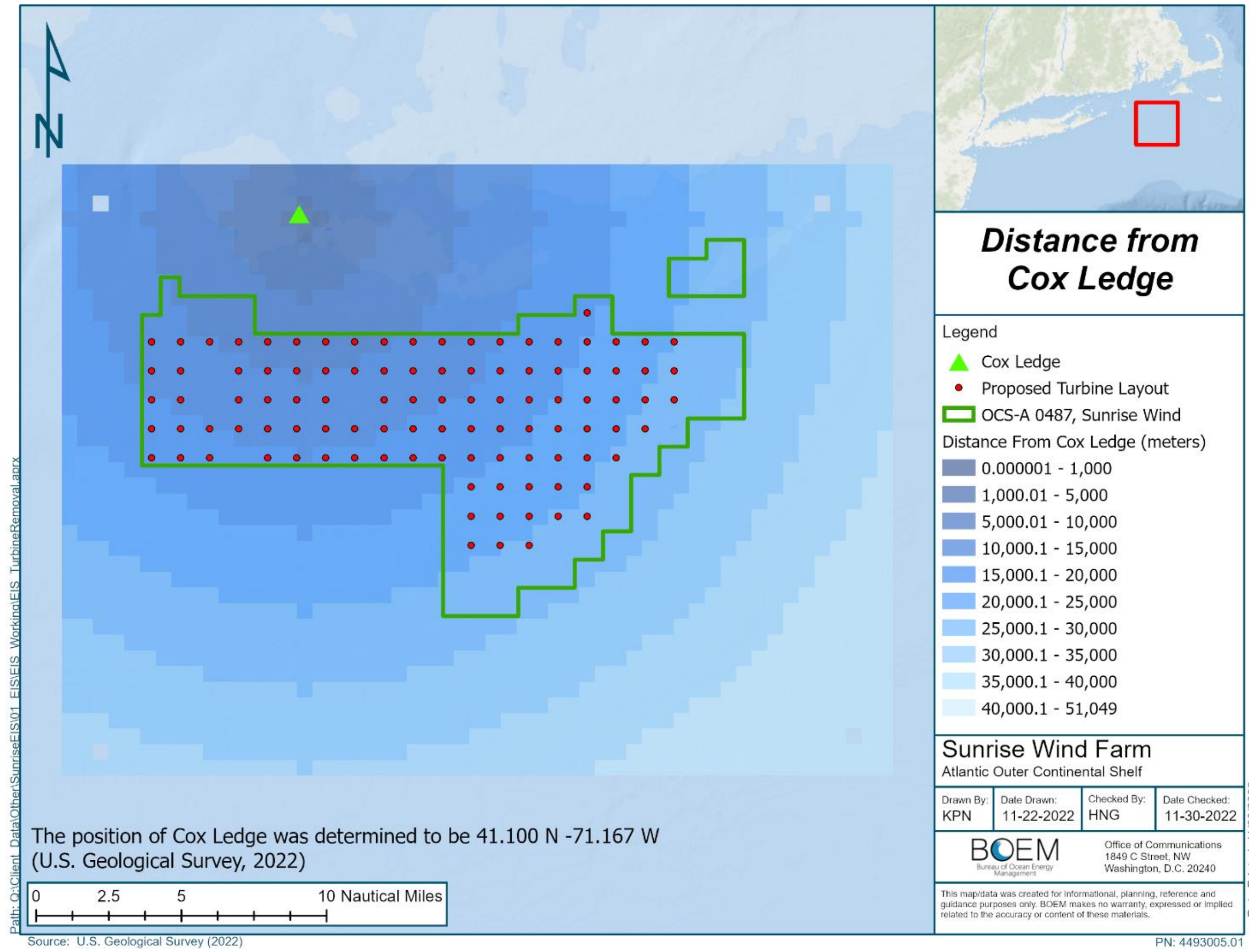

Figure 2.1-6. Distance of the Sunrise Wind Farm from Cox's Ledge

2.1.3.1 Alternative C-1 - Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions

Sunrise Wind's proposed layout includes up to 102 WTG positions; however, only 94 11-MW WTGs would be needed to meet the Project's maximum capacity of up to 1,034 MW. Under Alternative C-1, the construction and installation, O&M, and eventual decommissioning of a wind energy facility, and an OCS-DC would occur within the design parameters outlined in the Sunrise Wind Project COP (Sunrise Wind 2023) subject to applicable mitigation measures. However, certain WTG positions would be excluded from the identified Priority Areas in order to reduce impacts to sensitive benthic habitat and areas where Atlantic cod spawning has been detected. Under this alternative the Project would maintain a uniform east-west and north-south grid of 1 by 1-nm spacing between WTGs. Alternative C-1 would result in the exclusion of up to 8 WTG positions from development within the identified Priority Areas (Figure 2.1-7 *NMFS Priority Areas and WTG Positions Identified for Removal under Alternative C-1)*. The specific 8 WTG positions that would be excluded from the identified Priority Areas are informed through the impact analyses described in Chapter 3 (see *Benthic Resources* Section 3.7.6).

This alternative was determined to be infeasible following additional geotechnical and geophysical surveys that were undertaken by SRW in 2022 on the eastern portion of the lease area. Following the publication of the DEIS and analysis of Alternative C-1, the additional geotechnical and geophysical survey data was analyzed and published, which informed the infeasibility of Alternative C-1 due to glauconite sands (see COP Appendix G-3 Foundation Feasibility Assessment dated June 30, 2023, Public Facing Version; Ørsted Offshore North America 2023b). Under Alternative C-1, 94 WTGs were proposed for installation in 102 positions, excluding 8 positions from Priority Area 1. However, due to glauconite sands, only 72 of the proposed positions are available for installation under this alternative, which would only produce 792 MW (Table 2.1-6). This renders Alternative C-1 infeasible and led to the development of Alternative C-3 (see Section 2.1.3.3).

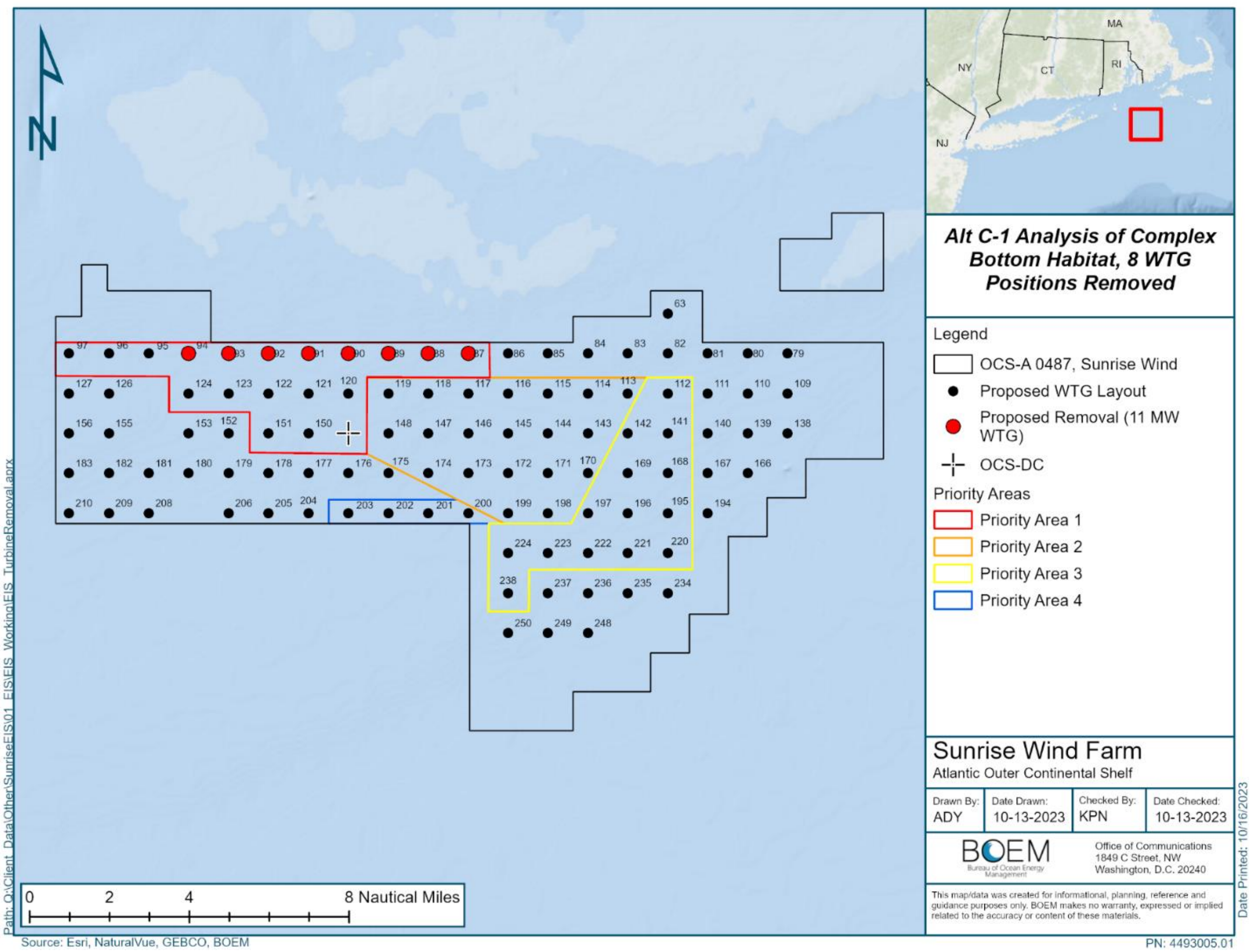

Figure 2.1-7. NMFS Priority Areas and WTG Positions Identified for Removal under Alternative C-1

2.1.3.2 Alternative C-2 - Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions and Relocation of up to 12 WTG Positions to the Eastern Side of the Lease Area

Under Alternative C-2, the 8 WTG positions identified for exclusion from development in Alternative C-1 would remain the same, and up to an additional 12 WTG positions would be removed from the Priority

Areas and relocated to the eastern side of the Lease Area. Alternative C-2 considers 4 WTG position configurations (C-2a, C-2b, C-2c, and C-2d) to address NMFS Priority Areas, provide continuous habitat, and avoid boulder fields. The specific WTG positions that would be excluded from the identified Priority Areas are informed through the impact analysis described in Chapter 3, Section 3.7.7. Alternative C-2 assumes that habitat on the eastern side of the Lease Area is suitable for development and positions for relocation are identified in Figure 2.1-8 *Potential locations for WTG Relocations under Alternative C-2.* The construction and installation, O&M, and eventual decommissioning of a wind energy facility, and an OCS-DC would occur within the design parameters outlined in the Sunrise Wind Project COP (Sunrise Wind 2023) subject to applicable mitigation measures. The Project would maintain a uniform east-west and north-south grid of 1 by 1-nm spacing between WTGs.

Alternative C-2 was determined to be infeasible following additional geotechnical and geophysical surveys. Following the publication of the DEIS and analysis of Alternative C-2, the additional geotechnical and geophysical survey data was analyzed and published, which informed the infeasibility of Alternative C-2 due to glauconite sands (see COP Appendix G-3 Foundation Feasibility Assessment, June 30, 2023, Public Facing Version; Ørsted Offshore North America 2023b). Under Alternative C-2, 94 WTGs were proposed for installation, with the removal of 8 and relocation of 12 WTGs (see Section 3.7.7 for Alternative C-2a-d layouts). Out of the 12 WTG positions identified for relocation, due to glauconite sands, only 3 are feasible for development. Additionally, 22 positions that were part of the original layout were determined to be infeasible for development, resulting in a total of 31 infeasible WTG positions under this alternative. Therefore, only 63 of the proposed positions are available for installation, resulting in only 693 MW, which does not meet the OREC agreement (Table 2.1-6). This renders Alternative C-2 infeasible and led to the development of Alternative C-3 (see Section 2.1.3.3).

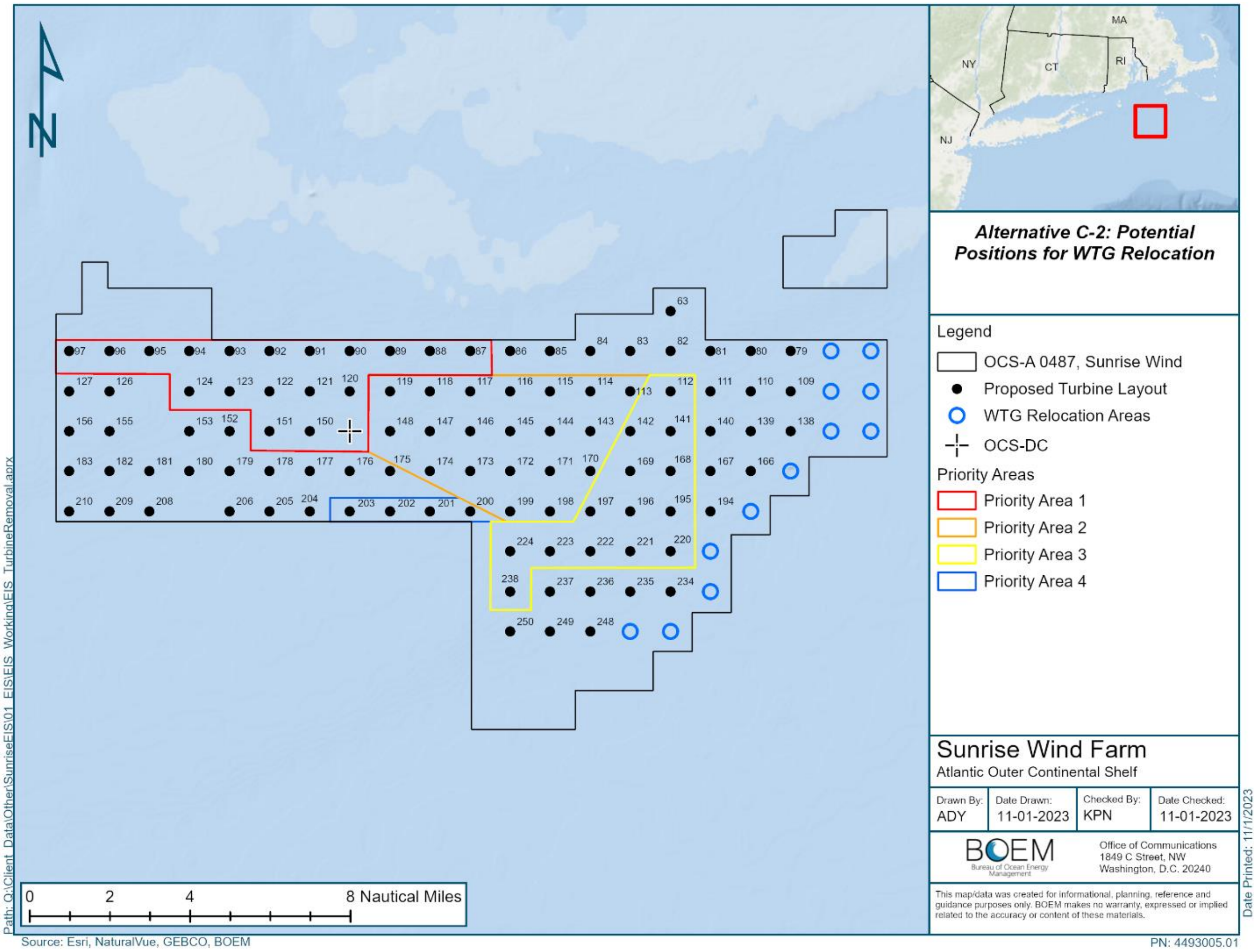

Figure 2.1-8. Potential locations for WTG Relocations under Alternative C-2

2.1.3.3 Alternative C-3 – Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands

Additional geotechnical and geophysical surveys undertaken by SRW in 2022 informed the infeasibility of Alternative C-1 and C-2, which led to the development of Alternative C-3. Alternative C-3 was developed to address concerns regarding pile refusal due to glauconite sands in the eastern portion of the Lease Area while still minimizing impacts to benthic and fisheries resources within the NMFS Priority Areas. Alternative C-3a, C-3b, and C-3c consider different WTG configurations to avoid sensitive habitats and engineering constraints. WTGs in the southeastern portion of the Lease Area are considered unsuitable for development based on the presence of glauconite sandsFigure 2.1-9. An ancillary habitat impact minimization benefit of this alternative is that 13 WTGs would be removed from Priority Areas 2 and 3 because of the glauconite sands. Under Sub-Alternative C-3a, up to 87 WTGs would be installed within the 87 potential positions. Under Sub-Alternative C-3b, up to 84 WTGs would be installed within the 87 potential positions. Under Sub-Alternative C-3c, 80 WTGs would be installed within the 87 potential positions.

Under the initial development of Alternative C-3, 80 WTG positions were known to be feasible for installation, and 7 additional WTG positions (WTG positions No. 77, 78, 107, 108, 136, 137, and 154) were still undergoing geotechnical analysis. Following geotechnical and geophysical surveys conducted in January 2023 and discussions with the CB-1 cable owner, WTG No. 154 was deemed feasible if microsited to the west. WTG No. 207 and 125, also located in the path of the CB-1 cable, were still too close to the cable and therefore were not considered for development or further analysis.

On June 30, 2023, SRW provided the final geotechnical feasibility in Appendix G-3 Foundation Feasibility Assessment (Public Facing Version; Ørsted Offshore North America 2023b). WTG positions No. 77, 107, and 137 were determined to be infeasible primarily due to presence of thick layers of glauconitic sands and in one case dense sands below the glauconite layer. Under Alternatives C-3b and C-3c, some WTG positions still could be removed from Priority Area 1 even though only 84 positions are technically feasible. The impact analysis that informed WTG layouts for Alternatives C-3b and C-3c is provided in Section 3.7.8 (*Benthic Resources*).

Table 2.1-6. Alternative C Feasible WTG Positions and MW Capacity Based on Glauconite Sands Feasibility Issues

Alternative C Sub-Alternative	Proposed WTGs	Feasible Positions for WTGs	Resulting Project Capacity (11 MW WTG)
C-1	94	72	792
C-2a	94	63	693
C-2b	94	63	693
C-2c	94	63	693
C-2d	94	63	693
C-3a	87	84	957
C-3b	84	84	924
C-3c	80	84	880

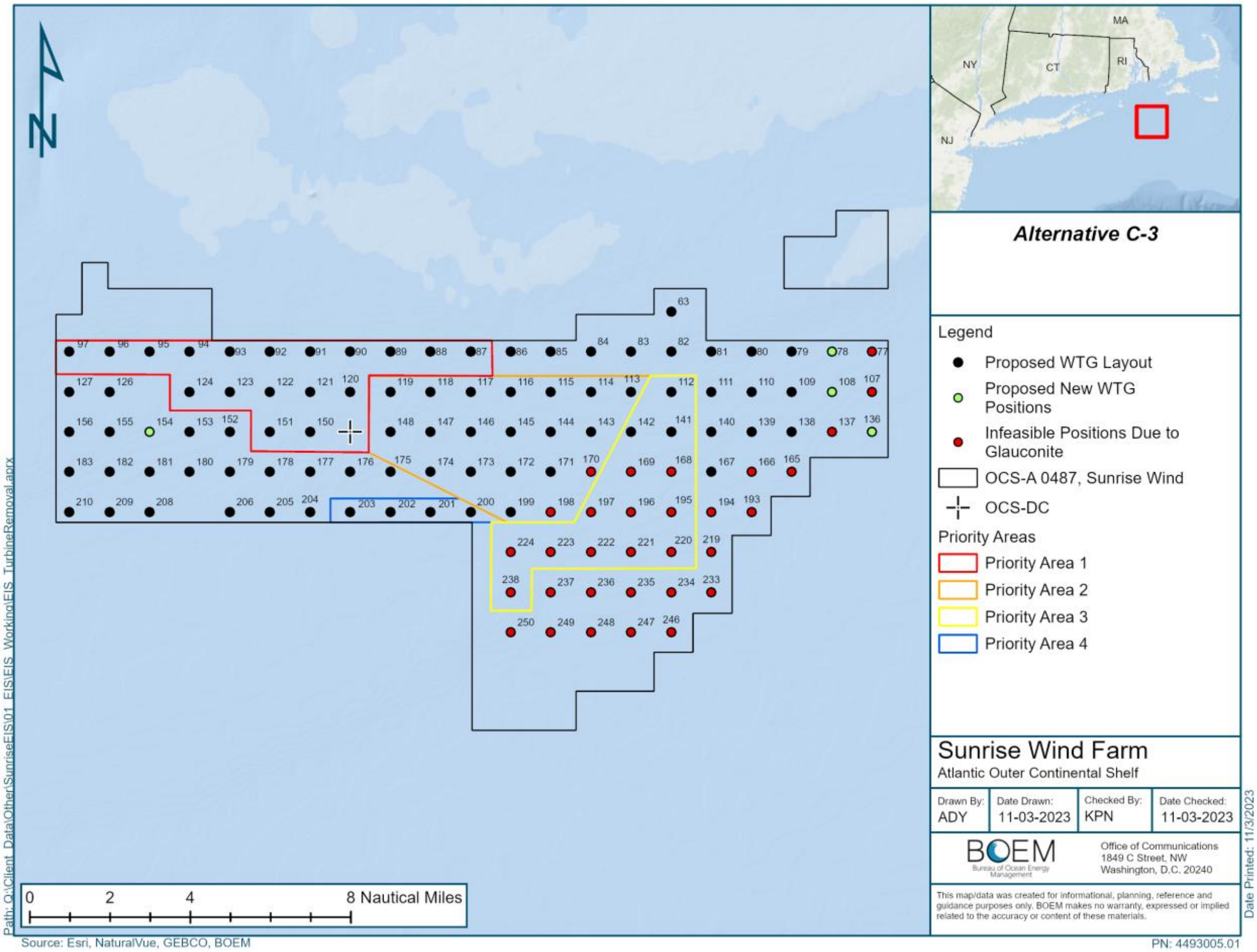

Figure 2.1-9. Alternative C-3 Potential Layout Due to Glauconite Sands

2.1.3.3.1 C-3a: Up to 87 WTGs in 87 potential positions

Under Alternative C-3a, the construction, O&M, and conceptual decommissioning of the SRWF within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, BOEM would only approve 87 11-MW WTGs in the 87 potential positions[15]. The lower eastern portion of the Lease Area would not be developed due to presence of glauconite sands which may result in pile refusal. This alternative considers development of the northeastern portion of the Lease Area and WTG No. 154, which are not considered in the Proposed Action. Appendix G-3 Foundation Feasibility Assessment (Public Facing Version; Ørsted Offshore North America 2023b) dated June 30, 2023, suggested that all 87 WTG positions might not be installable due to glauconite feasibility issues. BOEM later confirmed WTG Positions 77, 107, and 137 were considered infeasible based on the Foundation Feasibility Assessment,

[15] Based on Appendix G-3 Foundation Feasibility Assessment dated June 30, 2023, only 84 WTGs out of the 87 WTG analyzed are feasible for development. WTG positions No. 77, 107, and 137 were determined to be infeasible due to presence of glauconitic sands (Public Facing Version; Ørsted Offshore North America 2023b).

leaving only 84 feasible positions available for this alternative (Figure 2.1-10). As originally developed, the analysis in the EIS for Alternative C-3a is presented as installation of 87 WTGs.

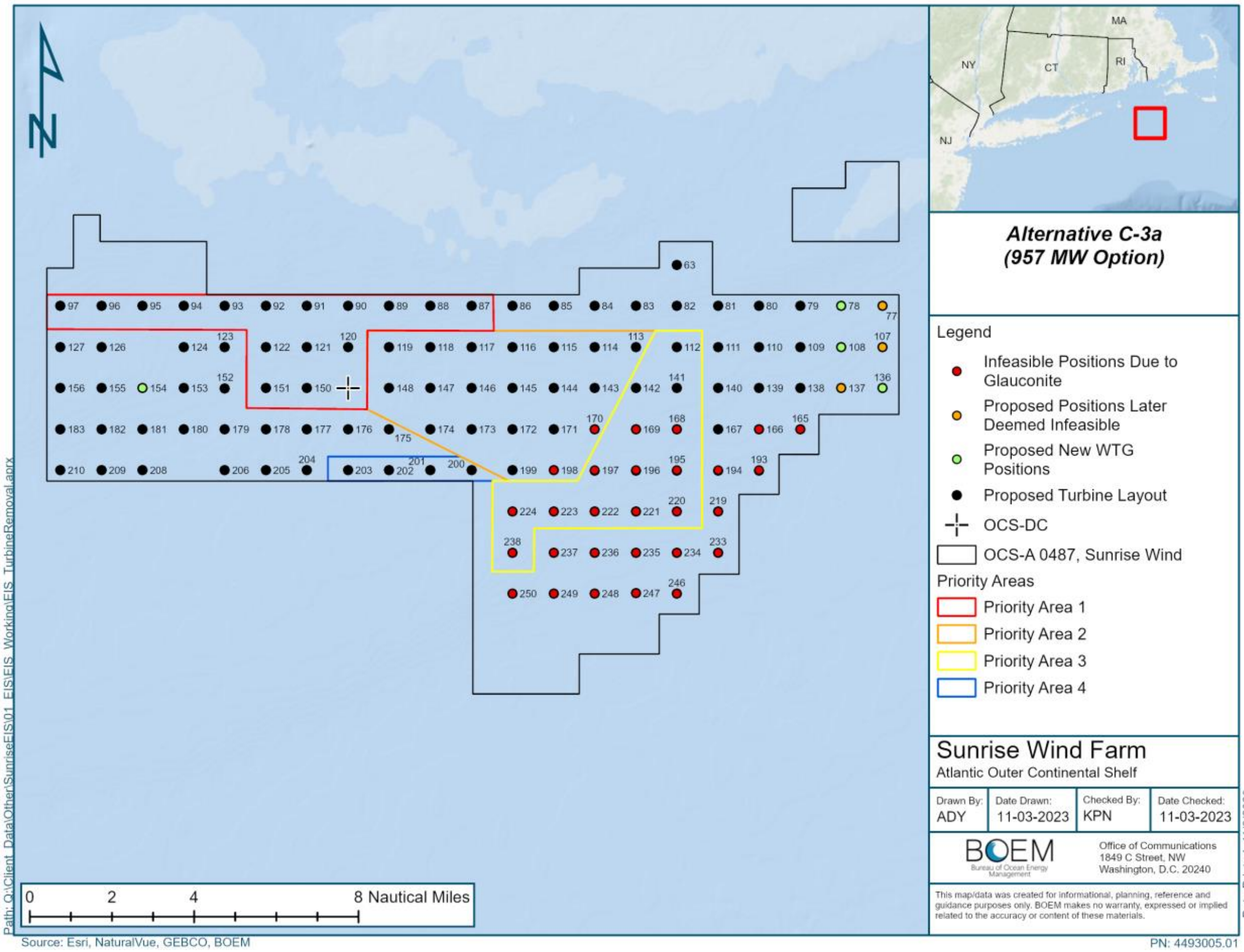

Figure 2.1-10. Alternative C-3a WTG Layout with Priority Areas

2.1.3.3.2 C-3b: Up to 84 WTGs in 87 potential positions: Reduced Layout from Priority Areas by exclusion of 3 WTGs (Preferred Alternative)

Under Alternative C-3b, the construction, O&M, and conceptual decommissioning of the SRWF within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, BOEM would only approve up to 84 WTGs in the 87 potential positions[16]. The lower eastern portion of the Lease Area would not be developed due to presence of glauconite sands which may result in pile refusal. This alternative considers development of the northeastern portion of the Lease Area and WTG No. 154, which are not

[16] Based on Appendix G-3 Foundation Feasibility Assessment dated June 30, 2023, only 84 WTGs out of the 87 WTGs analyzed are feasible for development. WTG positions No. 77, 107, and 137 were determined to be infeasible due to presence of glauconitic sands (Public Facing Version; Ørsted Offshore North America 2023b).

considered in the Proposed Action (Figure 2.1-11). The impact analysis that informed which WTGs could be removed from development is described in Section 3.7.8 *Benthic Resources*. WTGs within NMFS Priority Area 1 are ranked for removal after consideration of boulder density, complex habitat and Atlantic cod data collected from 2018, 2019, 2021 and 2022.

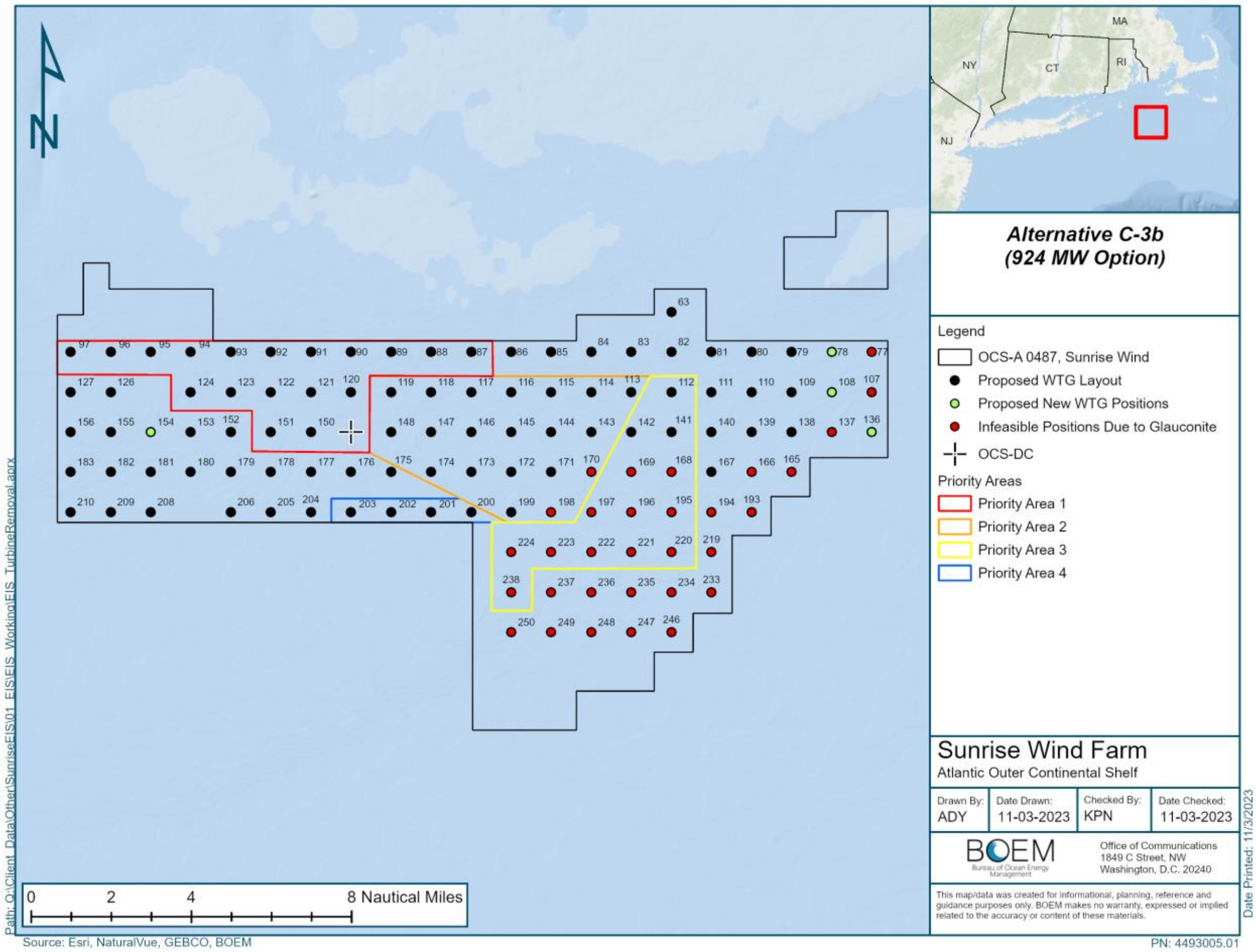

Figure 2.1-11. Alternative C-3b WTG Layout with Priority Areas

2.1.3.3.3 C-3c: 80 WTGs in 87 potential positions: Reduced Layout from Priority Areas by exclusion of 7 WTGs

Under Alternative C-3c, the construction, O&M, and conceptual decommissioning of the SRWF within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, BOEM would approve only 80 WTGs in the 87 potential positions[17]. The lower eastern portion of the Lease Area would not be developed due to

[17] Based on Appendix G-3 Foundation Feasibility Assessment dated June 30, 2023, only 84 WTGs out of the 87 WTG analyzed are feasible for development. WTG positions No. 77, 107, and 137 were determined to be infeasible due to presence of glauconitic sands (Public Facing Version; Ørsted Offshore North America 2023b).

presence of glauconite sands which may result in pile refusal. This alternative considers development of the northeastern portion of the Lease Area and WTG No. 154, which are not considered in the Proposed Action (Figure 2.1-12). The impact analysis that informed which WTGs would be removed from development is described in Section 3.7.8 *Benthic Resources*. WTGs within NMFS Priority Area 1 are ranked for removal after consideration of boulder density, complex habitat and Atlantic cod data collected from 2018, 2019, 2021 and 2022.

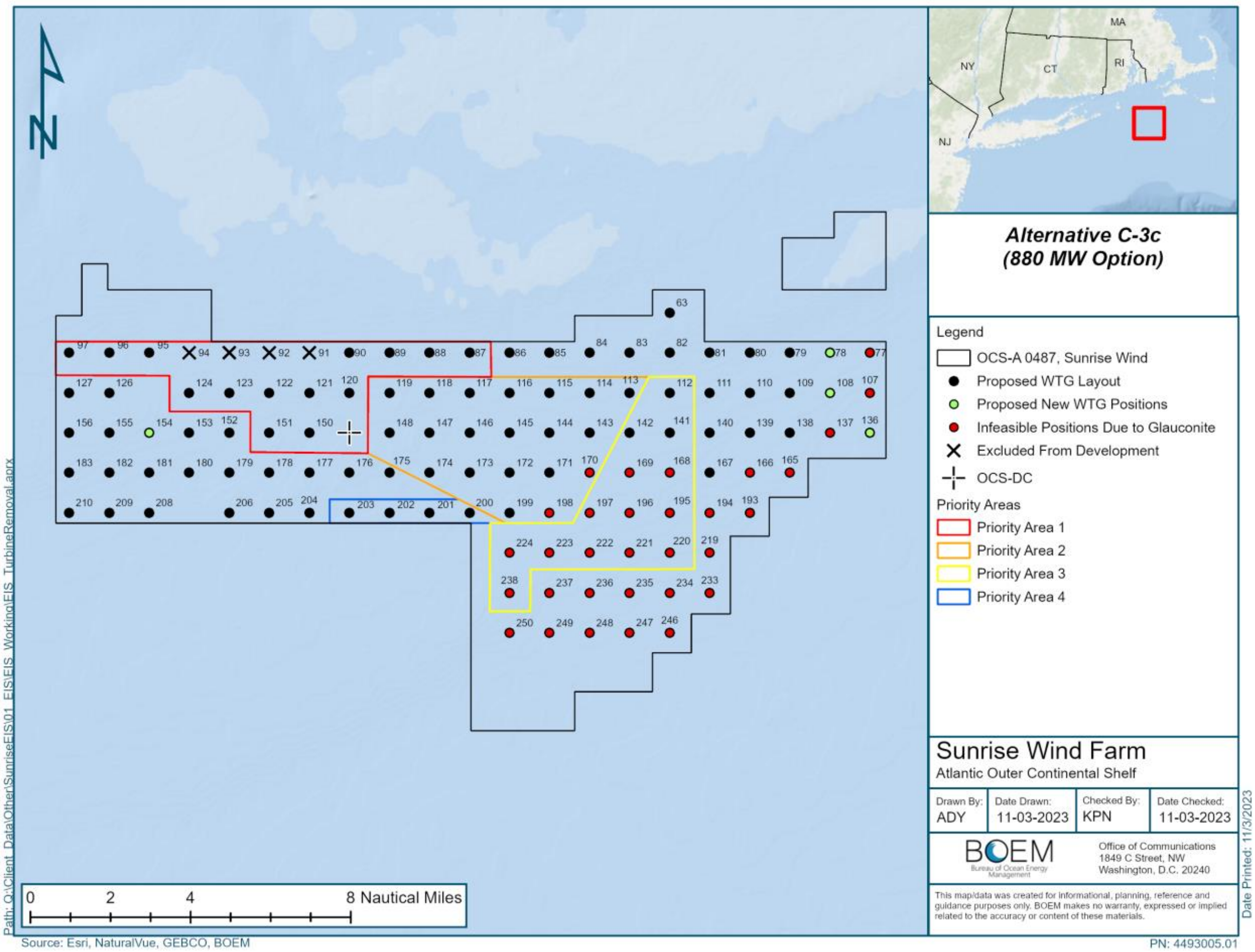

Figure 2.1-12. Alternative C-3c Layout with Priority Areas

2.1.4 Preferred Alternative

The CEQ NEPA regulations require the identification of a Preferred Alternative in the Final EIS. BOEM has identified Alternative C-3b as the Preferred Alternative.

2.2 Alternatives Considered but Not Analyzed in Detail

Under NEPA, a reasonable range of alternatives framed by the purpose and need must be developed for analysis for any major federal action. The alternatives should be "reasonable," which the Department of the Interior has defined as those that are "technically and economically practical or feasible and meet the purpose and need of the Proposed Action."[18] There should also be evidence that each alternative would avoid or substantially lessen one or more potential, specific, and significant socioeconomic or environmental effects of the project.[19] Alternatives that could not be implemented if they were chosen (for legal, economic, or technical reasons), or do not resolve the need for action and fulfill the stated purpose in taking action to a large degree, are therefore not considered reasonable.

BOEM considered alternatives to the Proposed Action that were identified through coordination with cooperating and participating agencies and through public comments received during the public scoping period for the EIS. BOEM then evaluated the alternatives and dismissed from further consideration alternatives that did not meet the purpose and need, did not meet the screening criteria, or both (BOEM 2022). Alternatives C-1 and C-2 were also determined to be infeasible through the EIS process as data was further collected and analyzed. However, BOEM determined that including all variants of Alternative C in Section 2.1 provided important context regarding the development of the Preferred Alternative C-3(b).

Table 2.2-1 lists the alternatives and the rationale for their dismissal. These alternatives are presented below with a brief discussion of the reasons for their elimination as prescribed in CEQ regulations at 40 *CFR* 1502.14(a) and Department of the Interior regulations at 43 *CFR* 46.420(b)–(c).

[18] 43 CFR 46.420(b). The terms "practical" and "feasible" are not intended to be synonymous (73 Federal Register 61331, October 15, 2008).

[19] 43 CFR 46.415(b).

Table 2.2-1. Alternatives Considered but Not Analyzed in Detail

Alternative	Objective	Rationale for Dismissal
Consider air cooling or evaluation of emergent technologies to cool the OCS-DC.	Reduce impacts to marine resources	Air cooling is technically infeasible because of ambient air temperatures at the Project location. One technology suggested was the "EU-funded COOLWIND Project"; this technology does not require seawater pumps, filters, heat exchangers or expensive saltwater piping, nor chlorination of seawater. Instead of pumping cold seawater to the transformer platform, heated water from the converters is circulated and chilled in a subsea mounted cooler with less environmental pollution, less power consumption, and less emissions. However, this subsea mounted cooler is technically infeasible as it is still an experimental/emerging technology still under development and is not proven at a commercial windfarm scale.
Alternative foundation types to monopiles including: • Gravity foundations • Suction bucket foundations • 100% jackets or tripods • Floating foundation as an experimental part of the Project.	Reduce sound impacts to marine mammals from impact pile driving; Reduce impacts to benthic resources (floating only)	The COP, which BOEM has found to be technically sufficient, thoroughly analyzes different design parameters and technologies and includes rationale for what is proposed in the PDE and why the parameters outside of the PDE were not considered further. Specifically, during Project development, Sunrise Wind considered multiple design alternatives for *WTG foundations* that were ultimately not selected for inclusion in the PDE for the COP (see COP Vol. 1 Section 2.2.2.3). Alternative foundations considered but not carried forward included monopod suction caisson foundations, suction bucket jacket foundations, gravity-based turbines. These alternative foundation types are not technically feasible because they are more difficult to site due to the requirement for a large level areas with no boulders which are not present in a sufficient quantity throughout the Lease Area; the supply chain for these alternative foundations is not mature; and these alternative foundations have not been used at a commercial-scale for a project the size of the Sunrise Wind Project and are therefore still an emerging technology. Notably, while these alternative foundation types would eliminate the sounds associated with impact pile driving, they would all have a larger footprint on the seabed and consequently result in increased impacts to benthic resources. In addition, floating foundations were considered as an alternative to jacket foundations or pile foundations in the Sunrise Wind COP. Floating platforms are a much less proven technology than jacket foundations or pile foundations for a commercial project at the scale of the Sunrise Wind Project. Additionally, the water depth at the Sunrise Wind Project is not deep enough to justify the additional costs to the developer for floating technologies (it is cost prohibitive). Floating foundations are dismissed as an alternative for the EIS because they are technically and economically infeasible at this stage of technology development, particularly for shallower waters suitable for fixed bottom foundations. Finally, jacket foundations require a custom-made jacket to match the seabed and water depth at the siting location; thus, the logistics for construction and transportation of jacket foundations were cost prohibitive for this project, therefore

Alternative	Objective	Rationale for Dismissal
		the COP includes only the monopile foundation design for the WTGs. Sunrise Wind has eliminated the monopile foundation from further consideration for the OCS-DC due to the topside size and weight, water depth, and equipment sensitivity, which require a stiffness of the support structure that can only be achieved by means of a jacket foundation (a monopile foundation would be technically infeasible).
Alternative to consider onshore substation locations other than Holbrook.	Reduce socioeconomic impacts	According to the COP, the Long Island Power Authority Holbrook Substation was specifically designated as the interconnection point in the Offshore Wind Renewable Energy Certificate (OREC) that Sunrise Wind Farm (SRWF) signed with New York State Energy Research and Development Authority (NYSERDA) for the Sunrise Wind Project. Thus, a change to the onshore substation would constitute a potential breach of the agreement, which would be economically infeasible and impracticable because the competitive nature of the NYSERDA award process and the importance of the award as the primary revenue generator for the Sunrise Wind Project.
Alternative to consider transit lanes that are at least 4 nm wide.	Reduce impacts to navigation	The 1 by 1-nm grid is consistent with the findings in Massachusetts (MA)/Rhode Island (RI) Port Access Study (MARIPAS) and maximizes safety and navigation consistency. United States Coast Guard (USCG) also asserted that 1 by 1-nm spacing provides ample maneuvering space for typical fishing vessels expected in the Project Area. Additionally, the northeast leaseholders' agreement was reached to align Project layouts and avoid irregular transit corridors. Adding transit corridors could erode Project economics and logistics and potentially lead the Lessee to retract from the agreement, which it committed to assuming that no additional transit lanes would be required.
Alternative to consider using AC technology for OSSs (vs high voltage direct current [HVDC]).	Reduce impacts to marine resources	This Proposed Alternative would require additional infrastructure in comparison to the HVDC technology in the Proposed Action: • Requires a second offshore export cable to be installed spaced approximately 112.5 to 220.5 m apart, which would double the seafloor disturbance and double the required cable crossings from eight to sixteen. • Requires a booster station, of a similar size as an OSS, located approximately midway between the OSSs and onshore substation, to provide reactive compensation to stabilize the voltage and minimize electrical loses along the export cables. Use of HVDC does not require this additional booster station. • Requires two OSSs (platforms) (instead of a single offshore converter substation platform within Lease OCS-A 0487), and the two OSSs would require a 9 mi (15 km) interlink cable to be installed between them using the same installation and burial methods as an export cable. Use of HVDC does not require this additional cable.

Alternative	Objective	Rationale for Dismissal
		Due to the length of the Project's transmission system, a DC option provides a more efficient electrical design that would reduce losses – providing a more effective transmission system for the Project. The DC system is also expected to result in greater overall grid stability when compared to an AC system due to the way a DC system is able to decouple any electrical disturbances present from the onshore grid to the WTGs and vice versa. Therefore, an HVDC system is more technically and economically feasible and practical, and within the Applicant's PDE, which eliminated high voltage alternating current (HVAC) transmission due to environmental and technical concerns.
Alternative to consider a closed loop cooling system for the OCS-DC.	Reduce impacts to marine resources	Closed loop systems, while technically feasible for some applications, are not market ready with a proven historical use in offshore applications. Use of prefabricated commercially available chillers with 1 million gallons per day (mgd) nominal flow rate (not designed for offshore use) were even considered. However, application of these for offshore converter station (OCS-DC) design would require eight units in parallel, with spacing requirements of 20' x 20'. This would result in less energy efficient OCS-DC, larger and more robust OCS-DC topside and support structure, and significant increases in capital expenditures and operational expenditures. For these reasons, consideration of a closed loop cooling system is not technically and economically feasible or practical.
Alternative to consider shared export cables and/or common cable corridors that can benefit multiple Projects to reduce Project impacts and costs and increase efficiency and predictability.	Reduce impacts to benthic and marine resources	There are currently no shared or regional cable corridors in which BOEM could require the Lessee to install its export cable. 30 *CFR* 585.200(b) states, "A lease issued under this part confers on the lessee the rights to one or more project easements without further competition for the purpose of installing gathering, transmission, and distribution cables; pipelines; and appurtenances on the OCS as necessary for the full enjoyment of the lease." While BOEM could require a lessee to use a previously existing shared cable corridor established by a Right-of-Way grant (30 *CFR* 585.112) when the use of the shared cable corridor is technically and economically practical and feasible alternative for the project, BOEM cannot limit a lessee's right to a project easement when such a cable corridor does not exist and there is no way of determining if the use of a future shared cable corridor would be a technically and economically practical and feasible alternative for the project. Therefore, BOEM cannot require Sunrise Wind to use a non-existent shared cable corridor for this Project. Furthermore, Sunrise Wind's export cables would connect to the power grid via different onshore substations than any other projects that are sufficiently mature in their permitting processes. Developing a shared export cable corridor would not be technically or economically practicable because the Sunrise Wind Project and Empire Wind 1 and 2 projects have distinct interconnection points to the electric power grid. At this time, BOEM considers this alternative speculative and economically infeasible and impractical.

Alternative	Objective	Rationale for Dismissal
Alternative to consider use of 14-MW WTGs.	Reduce impacts to fisheries habitat	Use of a 14-MW WTG is outside the PDE, as supplied by Sunrise Wind in their October 2021 COP. Sunrise Wind has executed a contract with Siemens Gamesa as the supplier of the WTGs for the SRWF. The foundation design is nearing completion to support steel procurement in Q4 2022, and fabrication starts in Q1 2023. Sunrise Wind provided business confidential documentation to BOEM that sufficiently demonstrated that if Sunrise were to procure the 14-MW WTG there would be a multiple year Project delay. Several construction/installation contracts have also been executed or are being negotiated. One key example of a contractual consequence of a Project delay would be related to WTG installation. A project delay would be extremely detrimental as Sunrise Wind would need to find a second WTG installation vessel setup to complete the scope—one that is not U.S.-built and resulting in a significant delay to the Project's Commercial Operation Date due to the lack of availability of Jones Act compliant WTG installation vessels. Additionally, system reliability changes caused by changing to a 14-MW WTG would have to be assessed by a New York Independent System Operator (NYISO). Modifying wind turbine type from 11-MW to 14-MW would require Sunrise Wind to submit a modification request to NYISO to redo the System Reliability Impact Studies and Class Year Facilities Studies, which would delay the critical path Large Generator Interconnection Agreement negotiations for Sunrise Wind. Because this alternative is not operationally, technically, and economically feasible and implementable, it was eliminated from further consideration.
Alternative to consider relocation of the offshore converter station (OCS-DC).	Reduce impacts to fisheries habitat	The location of the OCS-DC was selected specifically because of it is centrally located to balance length of the export and collection infrastructure and account for the electrical constraints on the number of WTGs that can be connected to a single IAC. Moving the OCS-DC to another location within the Lease Area would require a full redesign of the OCS-DC topside and jacket foundation and result in significant delays to the Project that are not compatible with meeting the Project purpose and need. The designs of the topside and jacket foundation are complete/nearing completion and are based specifically on the current location. Fabrication of the topside, in coordination with BOEM and the CVA, started in Q1 2022; orders have been placed for the jacket foundation materials, and fabrication would start in Q4 2022. Additionally, moving the OCS-DC would result in full design of the electrical infrastructure and potentially result in the need for longer and larger cross-section export cables and/or array cables, with associated increased installation footprint and associated seabed impacts. Because this alternative is not operationally, technically, or economically feasible or implementable, it was eliminated from further consideration.
Alternative to consider other	Reduce impacts to land use, sensitive environmental	The Long Island Power Authority (LIPA) Holbrook Substation was specifically designated as the interconnection point in the Offshore Wind Renewable Energy Certificate (OREC) that SRWF signed with

Alternative	Objective	Rationale for Dismissal
onshore transmission cable routes.	habitat, and cultural resources	NYSERDA for the Sunrise Wind Project. Alternative routes to this Substation from the landfall site at Smith Point County Park were evaluated for the most suitable route during the COP phase. Potential routes were considered based on publicly available information and local stakeholder engagement. Factors considered during the evaluation included route length, constructability (e.g., route length, number of roadway and railroad crossings, width of corridor), adjacent land uses (e.g., developed parcels, number of residences, public lands), and proximity to environmental and cultural resources (e.g., streams, wetlands, floodplains, unique habitats, cultural and historic properties). During analysis, five routes were considered (COP Section 2.2.1 of the COP) but there were several technical, commercial, stakeholder, cultural, and environmental constraints with the alternative routes. The Montauk Highway Route was eliminated from consideration due to proximity to sensitive natural and cultural resources, including the Yaphank Creek and the Wertheim National Wildlife Refuge as well as proximity to residences and higher traffic volumes. The Peconic Avenue Route was excluded from further consideration based on the proximity to residences and narrow road ROW. The Woodside Avenue Route was excluded from further consideration based on constructability constraints and length of route; proximity to stream and wetlands; and proximity and quantity of residences in some areas. The Smith Road Route was excluded from further consideration based on proximity to residences; narrow ROW; potential utility conflicts; ownership of underlying land under federal and private control; and proximity to natural resources and historic and cultural resources. The Long Island Expressway LIE Service Road was designated as the most optimal route for the onshore transmission cable route. This route was selected because of location primarily within existing ROW; minimal presence of sensitive natural resources; limited presence of potential cultural resources; and limited residential impacts. These impacts are evaluated further in Appendix P – USACE Summary Table of Alternatives Analysis. BOEM and the operator did not identify onshore transmission cable route alternatives during Project development that would further reduce or avoid impacts to land use, sensitive environmental habitat, and cultural resources. Changes to the proposed cable route would likely result in substantial cost for the Applicant and have not been determined as necessary based on stakeholder feedback provided to date. No alternative cable route(s) have been proposed that are meaningfully different from those already evaluated, which also include supporting evidence of significantly reducing impacts when compared to the Proposed Action.
Alternative to consider other offshore transmission cable routes.	Reduce impacts to benthic resources	Sunrise Wind conducted a desktop study between the Lease Area and Long Island, NY to determine suitable offshore cable routes. Sunrise Wind also evaluated recent Automatic Identification System (AIS) and Vessel Monitoring System (VMS) data and navigational features, including identifying high vessel density areas and existing

Alternative	Objective	Rationale for Dismissal
		routes where multiple vessels regularly utilize a similar passage and assessed potential future scenarios of vessel traffic based on the establishment of the Atlantic Coast Port Access Route Study (ACPARS) tug and tow lanes. Based on that evaluation, analysis was further refined based on mapped geology, shipwrecks, artificial reefs, sand borrow pits, existing cables, and other mapped resources. These impacts are evaluated further in Appendix P – USACE Summary Table of Alternatives Analysis. BOEM and the operator did not identify cable route alternatives during Project development that would further reduce or avoid benthic impacts (see Section 2.2.1.2 of the COP). Changes to the proposed export cable would likely result in substantial cost for the Applicant, could be counter to BOEM policy objectives of responsible and orderly development of the OCS under the OCSLA, and have not been determined as necessary based on stakeholder feedback provided to date. In addition, a site-specific cable burial risk assessment would be completed with additional approvals conducted at the facility design report/facility installation report stage prior to installation of any cables. No alternative cable route(s) have been proposed that are meaningfully different from those already evaluated, which also include supporting evidence of significantly reducing impacts when compared to the Proposed Action or that address impacts that could not be addressed in the site-specific cable burial risk assessment.
Alternative to consider co-locating a portion of the export cable on the Smith Point Bridge (BIN 3-30077-0) in the Town of Brookhaven, New York.	Minimizing impacts to sensitive environmental resources in Great South Bay, including but not limited to, complex benthic habitats, saltmarshes, submerged aquatic vegetation (SAV), etc.	Co-locating the export cable on the replacement bridge was deemed infeasible due to technical and logistical constraints. As currently designed, the proposed bridge could not support the additional space and load needed to accommodate a required cable utility bay without modifying the spans and substructure support beams nor would there be enough space to safely conduct bridge inspections or maintenance activities in proximity to the high-voltage cable. The cable would interfere with the bridge abutments and backwalls, likely requiring modifications to the proposed vehicle entrances and exits. Additionally, logistical constraints proved too great to overcome given that, as currently designed, the bridge would not be completed until 2026, more than two years after the cable is installed. Finally, bridge design revisions to accommodate a suitable utility bay would substantially delay construction of the new bridge beyond the desired operation timeline of the existing bridge.

Five alternative landfall sites were considered but dismissed from further analysis in the Final EIS: the Village of Quogue Beach, Coopers Beach, Rogers Beach, Bellport Bay, and Bluepoint Marina (Figure 2.2-1). Additionally, two landfall routes at the Smith Point County Park were dismissed from further consideration. Bellport Bay and Bluepoint Marina were excluded from further consideration because access to these sites would require crossing of Fire Island through the Otis Pike Fire Island High Dunes Wilderness Area. Legislation prohibit the placement of utility lines within the federally designated wilderness area. Rationale for dismissal for each site is discussed in Table 2.2-2 and further discussion for Coopers Beach, Rogers Beach, and Quogue Beach is below.

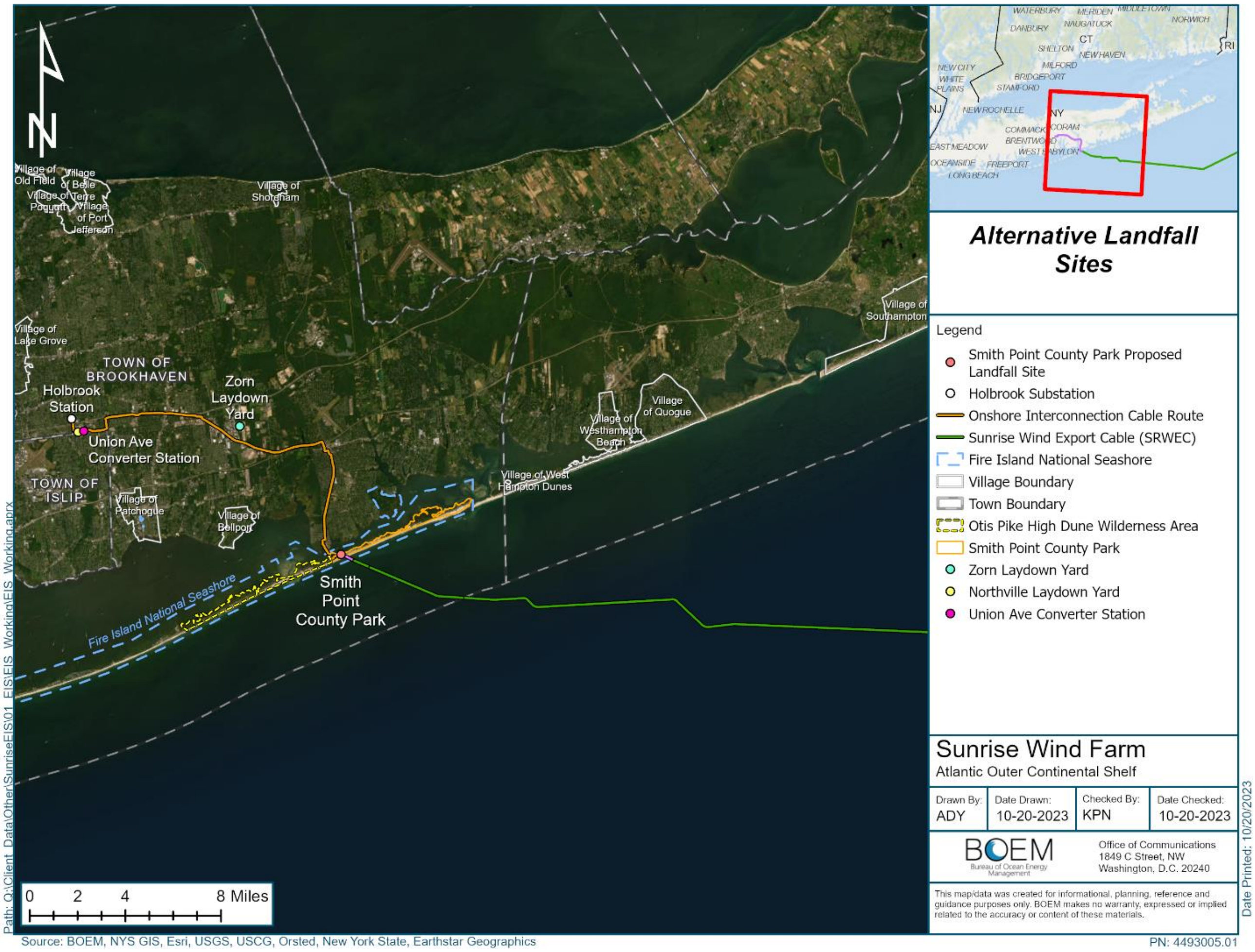

Figure 2.2-1. Alternative Landfall Sites and the Proposed Action Landfall Site with Cable Routes

Table 2.2-2. Alternative Landfall Sites Considered but Not Analyzed in Detail

	Assessment Criteria				
Location	**Logistics**	**Cost**	**Impacts to Aquatic Environment**	**Impacts to USACE Civil Works Projects**	**Impacts to Special Aquatic Sites**
Excluded Smith Point County Park Landfall HDD B	Landfall HDD route excluded due to onshore crossing of existing telecommunications cable. SRW prefers to cross the existing telecommunications cable with the HDD drill path.	Similar costs to the preferred landfall HDD route.	Similar impacts as preferred Landfall HDD.	Similar proximity to Fire Island Inlet to Montauk Point (FIMP) Project as preferred Landfall HDD.	Similar impacts as preferred Landfall HDD.
Excluded Smith Point County Park Landfall HDD C	Landfall HDD route excluded due to offshore crossing of existing telecommunications cable.	Would have required additional logistics, secondary cable protection, and a longer route to cross the existing telecommunications cable, which would have cost more than the preferred Landfall HDD route. The additional cable protection at the location of the cable crossing would have also required a more costly solution due to the shallow water and high energy at the location.	The additional length of export cable and additional cable protection measures would have resulted in increased impacts to the aquatic environment.	Similar proximity to FIMP Project as preferred Landfall HDD.	Similar impacts as preferred Landfall HDD.

Location	Logistics	Cost	Impacts to Aquatic Environment	Impacts to USACE Civil Works Projects	Impacts to Special Aquatic Sites
Village of Quogue Beach	Site excluded from further consideration based on limited space available for temporary work areas, the presence of floodplain and significant coastal and fish wildlife habitat, and the fact that the onshore portion of the cable would be longer than the Preferred Alternative. Quogue Beach would have approximately 30 mi (48 km) of onshore cable route to the Holbrook Station which is approximately 76% longer than the preferred route between Smith Point County Park and the Holbrook Station.	This landfall option would result in a longer onshore transmission cable route when compared to the Preferred Alternative; therefore, would result in higher overall costs. Given the cable is 76% longer than the route associated with the proposed landfall from Smith Point County Park, the costs would also be approximately 76% higher. It is unknown if a barge would be required at this site.	Site excluded due to the fact this route would result in greater terrestrial disturbance due to the increased length of the transmission route and/or potential conflicts with existing aquatic resources and anthropogenic uses . It is unknown if a barge would be required at this site.	The proposed landfall at Quogue Beach would potentially impact civil works beach renourishment projects such as FIMP Project. There are designated sand borrow areas spanning the length of approximately 4.7 mi (7.5 km), located 0.6 mi (1 km) offshore of the Quogue Beach, in order to access the potential landfall location cable routes would need to either traverse the borrow areas, which would not be permitted, or run parallel to shore for a significant length (1 to 1.5 mi [1.5 to 2.5 km]) in the nearshore area. Installation of a cable parallel to the shoreline in the nearshore, shallow, high-energy area would be extremely difficult and would have an increased likelihood of exposure	Similar impacts as preferred Landfall HDD. Route would potentially have higher impacts to floodplains and have significant coastal fish and wildlife habitat impacts in comparison to the preferred route.

Location	Logistics	Cost	Impacts to Aquatic Environment	Impacts to USACE Civil Works Projects	Impacts to Special Aquatic Sites
Coopers Beach	Site excluded from further consideration based on limited space available for temporary work areas, extended requirements for discretionary real estate approvals, and the fact that the onshore portion of the transmission cable would be longer than the Preferred Alternative. Holbrook. Coopers Beach would have approximately 38 mi (61 km) of onshore cable route to the Holbrook Station, which is approximately 124% longer than the preferred route between Smith Point County Park and the Holbrook Station.	This landfall option would result in a longer onshore transmission cable route when compared to the Preferred Alternative; therefore, would result in higher overall costs. Given the cable is 124% longer than the route associated with the proposed landfall from Smith Point County Park, the costs would also be approximately 76% higher. No barge would be required at this site.	Site excluded due to the fact this route would result in greater terrestrial disturbance due to the increased length of the transmission route and/or potential conflicts with existing aquatic resources and anthropogenic uses. No barge would be required at this site.	The proposed landfall at Coopers Beach would potentially impact civil works beach renourishment projects such as FIMP Project. There are designated sand borrow areas spanning the length of approximately 3.9 mi (6.3 km), located 0.5 mi (0.8 km) offshore of the Coopers Beach, in order to access the potential landfall location cable routes would need to either traverse the borrow areas, which would not be permitted, or run parallel to shore for a significant length (1 to 1.5 mi [1.5 to 2.5 km]) in the nearshore area. Installation of a cable parallel to the shoreline In the nearshore, shallow, high-energy area would be extremely difficult and would have an increased likelihood of exposure over the life of the project.	Similar impacts as preferred Landfall HDD. In the offshore vicinity of Cooper’s Beach there are constraints that limit potential cable placement including mapped shipwrecks and a scuba-diving area.

Location	Logistics	Cost	Impacts to Aquatic Environment	Impacts to USACE Civil Works Projects	Impacts to Special Aquatic Sites
Rogers Beach	Site excluded from further consideration based on limited space available for temporary work areas, close proximity to recreational areas, and the fact that the onshore portion of the transmission cable would be longer than the Preferred Alternative. Rogers Beach would have approximately 25 mi (40 km) of onshore cable route to the Holbrook Station, which is approximately 47% longer than the preferred route between Smith Point County Park and the Holbrook Station.	This landfall option would result in a longer onshore transmission cable route when compared to the Preferred Alternative; therefore, would result in higher overall costs. Given the cable is 47% longer than the route associated with the proposed landfall from Smith Point County Park, the costs would also be approximately 76% higher. It is unknown if a barge would be required at this site.	Site excluded due to the fact this route would result in greater terrestrial disturbance due to the increased length of the transmission route and/or potential conflicts with existing aquatic resources and anthropogenic uses. It is unknown if a barge would be required at this site.	The proposed landfall at Rogers Beach would potentially impact civil works beach renourishment projects such as FIMP Project. There are designated sand borrow areas spanning the length of approximately 4.7 mi (7.5 km), located 0.6 mi (1 km) offshore of the Rogers Beach, in order to access the potential landfall location cable routes would need to either traverse the borrow areas, which would not be permitted, or run parallel to shore for a significant length (1 to 1.5 mi [1.5 to 2.5 km]) in the nearshore area. Installation of a cable parallel to the shoreline in the nearshore, shallow, high-energy area would be extremely difficult and would have an increased likelihood of exposure over the life of the project.	Similar impacts as preferred Landfall HDD.

Location	Logistics	Cost	Impacts to Aquatic Environment	Impacts to USACE Civil Works Projects	Impacts to Special Aquatic Sites
Bellport Bay	Site excluded from further consideration because access to this site would require crossing of Fire Island through the Otis Pike Fire Island High Dunes Wilderness Area. Legislation prohibit the placement of utility lines here (or within any federally designated wilderness area). Additionally, this site was excluded due to private ownership and limited space available for temporary work areas as well as federal navigation channels. Stakeholder and regulatory communication also identified that selecting this area as a landfall site could negatively impact recreational and commercial fishing within Great South Bay.	Due to federal law and policy prohibiting NPS from granting permission for installation of a marine utility cable at any location within the Otis Pike Fire Island High Dune Wilderness Area, this landing was deemed infeasible; therefore, costs for this alternative landing were not evaluated.	Site excluded due to the fact this route would result in greater seabed disturbance due to the increased length of the export cable in NYS waters and the OCS and due to conflicts with existing anthropogenic constraints and uses including several additional existing cable crossings and recreational boating activity in Great South Bay. Crossing of the Great South Bay would likely exceed feasible HDD length and would require trenching, and crossing of the barrier island in NPS lands.	The proposed landfall at Bellport Bay would likely require trenching across the ICW, and would also potentially impact civil works beach renourishment projects such as FIMP Project.	Similar impacts as preferred Landfall HDD. Site proximal to federally designated wilderness area and in Great South Bay East where there is increased concentration of submerged aquatic vegetation in the SE portion of the bay.

Location	Logistics	Cost	Impacts to Aquatic Environment	Impacts to USACE Civil Works Projects	Impacts to Special Aquatic Sites
Bluepoint Marina/Corey Beach	Site excluded from further consideration because access to this site would require crossing of Fire Island through the Otis Pike Fire Island High Dunes Wilderness Area. Legislation prohibit the placement of utility lines here (or within any federally designated wilderness area). Additionally, this site was excluded due to limited space available for temporary work areas, as well as proximity to federal navigation channels. Stakeholder and regulatory communication also identified that selecting this area as a landfall site could negatively impact recreational and commercial fishing within Great South Bay.	Due to federal law and policy prohibiting NPS from granting permission for installation of a marine utility cable at any location within the Otis Pike Fire Island High Dune Wilderness Area, this landing was deemed infeasible; therefore, costs for this alternative landing were not evaluated.	Site excluded due to the fact this route would result in greater seabed disturbance due to the increased length of the export cable in NYS waters and the OCS due to conflicts with existing anthropogenic constraints and uses including several additional existing cable crossings and commercial recreational boating activity in Great South Bay. Crossing of the Great South Bay would likely exceed feasible HDD length and would require trenching, and crossing of the barrier island in NPS lands.	The proposed landfall at Bluepoint Marina/Corey Beach would likely require trenching across the ICW, and would also potentially impact civil works beach renourishment projects such as FIMP Project.	Similar impacts as preferred Landfall HDD. Site in close proximity to federally designated wilderness area and mapped submerged aquatic vegetation.

The entry location for Alternative Landfall HDD B would be located adjacent to the proposed Landfall HDD entry location (approximately 495 ft [151 m] landward of the FIMP Project), and the exit location and depth for Alternative Landfall HDD B would be the same as the proposed Landfall HDD (approximately 2,525 ft [770 m] seaward from the FIMP Project and approximately 60 ft [18 m] below the 0' datum).

The entry location for Landfall HDD C would be located just west of the proposed Landfall HDD entry location (approximately 541 ft [165 m] landward of the FIMP Project), and the exit location for Alternative Landfall HDD C would be just west of the proposed Landfall HDD (approximately 1,699 ft [518 m] seaward from the FIMP Project). The depth of Landfall HDD C would also likely be approximately 60 ft (18 m) below the 0' datum. The Landfall HDD B and C routes were ultimately excluded due to onshore crossing of the existing telecommunication cable.

The Village of Quogue Beach, Coopers Beach, and Rogers Beach landfall locations are also located in parking lots, and thus entry locations for those HDDs would likely be 272-374 ft (83-114 m) landward from the FIMP Project. HDD exit locations, while not specifically designed, would also likely be 3,280-4,921 ft (1,000-1,500 m) seaward from the FIMP Project, but would be restricted by the location of sand borrow areas. Detailed geophysical and geotechnical surveys or route engineering have not been conducted at other potential landfall locations, and thus precise length, locations and depths cannot be determined. Without detailed geophysical and geotechnical surveys and further engineering design, it also cannot be concluded that a single HDD would be able to be used. Up to three drills may need to occur at other potential landfall locations (i.e., one for each of the conduits and a spare, as was originally proposed for the Landfall HDD).

The Village of Quogue Beach would require use of the Quogue Bridge to transport HDD equipment to the barrier island. Based on a review of information from Suffolk County, Quogue Bridge has a posted load weight limit of 20 tons, and thus some equipment would not be able to cross the bridge. However, the barrier island in this area is also accessible by the Beach Lane Bridge and the West Bay Bridge, both located in the Town of Westhampton Beach, neither of which currently has a posted weight limit. A potential landfall at Rogers Beach would also require the use of Beach Lane Bridge or the West Bay Bridge. Discussions with relevant authorities would be required to confirm transport of oversize or overweight loads, but it is assumed that neither location would likely require the use of a barge system. Coopers Beach is not located on a barrier island, and thus would also not require the use of a barge system.

Assuming each of the alternative landfalls would utilize an HDD similar to that proposed at Smith Point County Park, each would drill beneath the FIMP Project boundary. It does not appear that sand placement is proposed at Coopers Beach, Rogers Beach, or Quogue Beach under the current proposed FIMP Project contracts.

As shown in Figure 2.2-2, there are designated sand borrow areas spanning a length of approximately 4.7 mi (7.5 km), located approximately 0.6 mi (1 km) offshore of the Village of Quogue Beach and Rogers Beach. Similarly, there is a sand borrow area spanning a length of approximately 4 mi (6.3 km) located approximately 0.5 mi (0.8 km) offshore of Coopers Beach. The borrow areas extend approximately 1.6 mi (2.5 km) west of Rogers Beach and approximately 1 mi (1.5 km) east of the Village of Quogue Beach, and approximately 1 mi (1.5 km) east of Coopers Beach. In order to access the potential landfall locations (i.e., the existing parking areas), cable routes would need to either traverse the borrow areas or run parallel for shore for a significant length (1 to 1.6 mi [1.5 to 2.5 km]) in the nearshore area. The USACE does not typically authorize crossing of borrow areas, and installation of a cable parallel to the shoreline in the nearshore, shallow, high-energy area would be extremely difficult and would have an increased likelihood of exposure over the life of the Project. Thus, these landfalls were eliminated from further consideration.

Figure 2.2-2. Sand Borrow Areas located near Quogue Beach, Coopers Beach, and Rogers Beach

2.3 Non-routine Activities and Low-probability Events

Non-routine activities and low-probability events associated with the Project could occur during construction and installation, O&M, or conceptual decommissioning. Although these activities or events are impossible to predict with certainty, examples of such activities and events and potential for Project impacts are briefly summarized below.

- **Corrective maintenance activities:** These activities could be required as a result of other low-probability events, or as a result of unanticipated equipment wear or malfunctions. Sunrise Wind would stock spare parts and have sufficient workforce available to conduct corrective maintenance activities, if required.
- **Collisions and allisions:** These activities could result in spills (described below) or injuries or fatalities to humans or wildlife (addressed in Chapter 3). Collisions and allisions may be minimized through USCG's requirement for lighting on vessels, temporary safety zones anticipated to be implemented by Sunrise Wind during construction, the implementation of NOAA vessel strike guidance, proposed spacing between WTGs and other facility components, and inclusion of Project components on nautical charts.
- **Cable displacement or damage by vessel anchors or fishing gear:** This could result in safety concerns and economic damages to vessel operators. However, such incidents would be minimized by inclusion of Project components on nautical charts and the cable burial or other protection measures.
- **Chemical spills or releases:** For offshore activities, these would include inadvertent releases from refueling vessels, spills from routine maintenance activities, and any more significant spills as a result of a catastrophic event. Sunrise Wind would comply with USCG and BSEE regulations relating to prevention and control of oil spills. Onshore, releases could occur from construction equipment or HDD activities. Sunrise Wind would prepare a Construction Spill Prevention, Control, and Countermeasure Plan in accordance with applicable requirements, and would outline spill prevention plans and measures to take to contain and clean up spills that may occur.
- **Severe weather (e.g., hurricanes) and natural events:** The design parameters for the WTGs are sufficient based upon historical data, site-specific measurements, and engineering design practices. There have been three Category 3 hurricanes (tropical cyclones) in the historical record in the area, and no Category 4 or 5 hurricanes. The Sunrise Wind Project would be designed in accordance with the IEC 61400-1 and 61400-3 standards. These standards require designs to withstand forces based on site-specific conditions for a 50-year return interval (2 percent chance occurrence in a single year) for the WTGs, which corresponds to a Category 3 hurricane in this area. This means that the WTGs are designed not merely for average conditions but for the higher end event that is reasonably likely to occur. The newly revised IEC standard now also recommends a robustness load case for extreme metocean conditions, where the WTG support structures are checked for a 500-year event (0.2 percent chance occurrence in a single year), which corresponds to wind gusts at the strength of a Category 5 hurricane, to ensure that the appropriate level of safety is maintained in case of a less likely event. The Project would be constructed using a CVA to ensure that all design specifications are met. It is possible that severe weather could cause blades to fail, but because of the construction design, it is highly unlikely that the towers would topple. However, severe flooding or coastal erosion could require repairs during construction and installation activities of onshore project components. Although

highly unlikely, structural failure of a WTG (i.e., loss of a blade or tower collapse) would result in short-term hazards to navigation for all vessels.

- **Terrorist attacks:** Impacts from terrorist attacks could greatly vary in magnitude and extent and, therefore, their analysis would be highly speculative. BOEM also considers terrorist attacks unlikely and therefore does not analyze them further in the EIS.

2.4 Summary and Comparison of Impacts by Alternative

Table 2.4-1 summarizes and compares the impacts from Chapter 3 by environmental resource and alternative. Where directionality (e.g., adverse or beneficial) is not specifically noted, the reader should assume the impact is adverse.

Table 2.4-1. Summary of Impacts on Resources from Proposed Action and Alternatives

Resource	No Action	Proposed Action	Alternative C-1	Alternative C-2	Alternative C-3	Preferred Alternative
Air Quality	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** to **moderate** adverse impacts on air quality from air emissions, climate change, and accidental releases. **Minor** to **moderate beneficial** indirect impact from reduced emissions from fossil-fueled energy sources and associated health benefits. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all other planned activities (including other offshore wind activities) would result in **minor** to **moderate** adverse cumulative impacts due to emissions of criteria pollutants, volatile organic compounds (VOCs), hazardous air pollutants (HAPs), and greenhouse gases (GHGs) from the continued use of fossil fuel electricity generation. Planned offshore wind activities would have an indirect **minor** to **moderate beneficial** impact on air quality after the offshore wind projects are operational.	*Proposed Action*: The Proposed Action would have a short-term **minor** to **moderate** adverse effect from air emissions, climate change, and accidental releases. While there would be emissions of GHGs and criteria pollutants during the construction, O&M, and decommissioning phases, these emissions would be less than the total avoided emissions possible from the proposed Project and would provide **minor** to **moderate beneficial** impacts. *Cumulative Impacts of the Proposed Action:* The potential emissions from onshore and offshore activities during the construction and installation, O&M, and decommissioning phases would have a **minor** to **moderate** adverse cumulative impact on air quality but would be short-term and dispersed throughout the construction, O&M, or decommissioning phases. BOEM anticipates that overall emissions from fossil fuel power generation would decrease and would contribute to a **minor** to **moderate beneficial** indirect impact on air quality through avoided emissions and health benefits.	*Alternative C-1*: Alternative C-1 would have a **minor** to **moderate** adverse effect from air emissions, climate change, and accidental releases. **Minor** to **moderate beneficial** indirect impact from reduced emissions from fossil-fueled energy sources and associated health benefits. *Cumulative Impacts of Alternative C-1*: The potential emissions from onshore and offshore activities during the construction and installation, O&M, and decommissioning phases would have a **minor** to **moderate** adverse cumulative impact on air quality but would be short-term and dispersed throughout the construction, O&M, or decommissioning phases. Ongoing and planned activities, including Alternative C-1, would have a **minor** to **moderate beneficial** impact on air quality because of reduced emissions from fossil-fuel powered electricity generation sources and the associated health benefits.	*Alternative C-2*: Alternative C-2 would have a **minor** to **moderate** adverse effect from air emissions, climate change, and accidental releases. **Minor** to **moderate beneficial** indirect impact from reduced emissions from fossil-fueled energy sources and associated health benefits. *Cumulative Impacts of Alternative C-2*: The potential emissions from onshore and offshore activities during the construction and installation, O&M, and decommissioning phases would have a **minor** to **moderate** adverse cumulative impact on air quality but would be short-term and dispersed throughout the construction, O&M, or decommissioning phases. Ongoing and planned wind projects, including Alternative C-2, would have a **minor** to **moderate beneficial** impact on air quality because of reduced emissions from fossil-fuel powered electricity generation sources and the associated health benefits.	*Alternative C-3*: Alternative C-3 would have a **minor** to **moderate** adverse effect from air emissions, climate change, and accidental releases. Impacts on air quality from offshore construction, O&M, and decommissioning would be slightly less than the Proposed Action, Alternative C-1, and Alternative C-2 because less construction, O&M, and decommissioning emissions would occur because less WTGs would be installed. **Minor** to **moderate beneficial** indirect impact from reduced emissions from fossil-fueled energy sources and associated health benefits. *Cumulative Impacts of Alternative C-3*: The potential emissions from onshore and offshore activities during the construction and installation, O&M, and decommissioning phases would have a **minor** to **moderate** adverse cumulative impact on air quality but would be short-term and dispersed throughout the construction, O&M, or decommissioning phases. Ongoing and planned wind projects, including Alternative C-3, would have a **minor** to **moderate beneficial** impact on air quality because of reduced emissions from fossil-fuel powered electricity generation sources and the associated health benefits.	*Preferred Alternative:* The Preferred Alternative has been identified as Alternative C-3b, and would have a **minor** to **moderate** adverse impact on air quality. These impacts would be slightly less under Alternative C-3 compared to the impacts described for the Proposed Action, Alternative C-1, and Alternative C-2 because less construction, O&M, and decommissioning emissions would occur due to fewer WTGs. The Preferred Alternative, C-3b, further reduces impact by having 10 fewer WTGs than the Proposed Action, or Alternatives C-1 and C-2 resulting in an 11 percent reduction in construction, and O&M emissions in comparison. **Minor** to **moderate beneficial** indirect impact from reduced emissions from fossil-fueled energy sources and associated health benefits. *Cumulative Impacts of Alternative C-3b*: The potential emissions from onshore and offshore activities during the construction and installation, O&M, and decommissioning phases would have a **minor** to **moderate** adverse cumulative impact on air quality but would be short-term and dispersed throughout the construction, O&M, or decommissioning phases. Ongoing and planned wind projects, including Alternative C-3, would have a **minor** to **moderate beneficial** impact on air quality because of reduced emissions from fossil-fuel powered electricity generation sources and the associated health benefits.

Resource	No Action	Proposed Action	Alternative C-1	Alternative C-2	Alternative C-3	Preferred Alternative
Water Quality	*No Action Alternative*: The No Action Alternative would result in overall **minor** adverse impacts on water quality through sediment suspension and deposition, anchoring, new cable emplacement, accidental releases or discharges, port utilization, presence of structures, or land/seafloor disturbance. *Cumulative Impacts of the No Action Alternative:* BOEM anticipates that the potential cumulative impacts on water quality from the Proposed Action would be **minor**.	*Proposed Action*: Impacts on water quality from the Proposed Action would be **minor** adverse. The risk of an accidental discharge or release of chemicals, oils, fuel, lubricants, trash, or debris is low during all phases of the Proposed Action, in the event a release was to occur, the impact on water quality would be minor or moderate depending on the volume of the spill and the type of material spilled. Impacts from port utilization or the presence of structures would be negligible or minor. Sediment suspension, deposition, and increased turbidity would have a minor impact during anchoring, cable emplacement and maintenance, and seafloor/land disturbance; sediment plumes would be localized and short-term. *Cumulative Impacts of the Proposed Action:* BOEM anticipates that the potential cumulative impacts on water quality from the Proposed Action would be **minor** adverse.	*Alternative C-1*: Impacts on water quality from onshore and offshore construction, O&M, and decommissioning would be similar to the Proposed Action. Alternative C-1 would have a **minor** adverse impact on water quality. *Cumulative Impacts of Alternative C-1*: BOEM anticipates that the cumulative impacts of Alternative C-1 would be **minor** adverse on water quality.	*Alternative C-2*: Impacts on water quality from construction, O&M, and decommissioning of the WTGs would be similar to the Proposed Action because the same number of WTGs would be installed. Alternative C-2 would have a **minor** adverse impact on water quality. *Cumulative Impacts of Alternative C-2*: BOEM anticipates that the cumulative impacts of Alternative C-2 would be **minor** adverse on water quality.	*Alternative C-3*: Impacts on water quality from onshore construction, O&M, and decommissioning would be the same as the Proposed Action. Impacts on water quality from offshore activities would be slightly less than the Proposed Action because of the smaller number of WTGs and shorter length of cable. Alternative C-3 would have a **minor** adverse impact on water quality. *Cumulative Impacts of Alternative C-3*: BOEM anticipates that the cumulative impacts of Alternative C-3 would be **minor** adverse on water quality.	*Preferred Alternative:* Under Alternative C-3b, impacts on water quality from onshore construction, O&M, and decommissioning would be the same as those described for the Proposed Action. Impacts on water quality from offshore activities would be slightly less under Alternative C-3b compared to the impacts described for the Proposed Action, Alternative C-1, and Alternative C-2 because of fewer WTGs and shorter length of cable. Alternative C-3b would have a **minor** adverse impact on water quality. *Cumulative Impacts of Alternative C-3b*: BOEM anticipates that the cumulative impacts of Alternative C-3b would be **minor** adverse on water quality.
Bats	*No Action Alternative*: BOEM anticipates that the overall impacts associated Alternative A, the No Action Alternative, when combined with all other ongoing activities (including ongoing offshore wind projects) in the geographic analysis area (GAA) would result in overall **minor** adverse. *Cumulative Impacts of the No Action Alternative:* BOEM anticipates that the overall impacts associated Alternative A, the No Action Alternative, when combined with all ongoing and planned activities (including offshore wind) in the GAA would result in **minor** adverse cumulative impacts.	*Proposed Action*: BOEM anticipates the impacts resulting from the Proposed Action alone would range from negligible to minor adverse impacts. Therefore, BOEM expects the overall impact on bats from the Proposed Action to be **minor** adverse, as the overall effect would be measurable but the impacts to individuals and their habitats would not lead to population-level effects. *Cumulative Impacts of the Proposed Action:* BOEM anticipates that the overall impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in **minor** adverse cumulative impacts to bats. Even though the overall effect would be detectable and measurable, the impacts to individuals and their habitats would not lead to population-level effects.	*Alternative C-1*: Alternative C-1 includes changes to turbine installation locations that would not alter any of the findings for bat compared to the Proposed Action. BOEM expects the overall impact on bats to be **minor** adverse, as the overall effect would be measurable but the impacts to individuals and their habitats would not lead to population-level effects. *Cumulative Impacts of Alternative C-1*: Alternative C-1 includes changes to turbine installation locations that would not alter any of the findings for bat compared to the Proposed Action. The conclusions for cumulative impacts of Alternative C-2 are the same as described under the Proposed Action. BOEM expects the cumulative impact on bats to be **minor** adverse, as the effect would be measurable but the impacts to individuals and their habitats would not lead to population-level effects.	*Alternative C-2*: Alternative C-2 includes changes to turbine installation locations that would not alter any of the findings for bats. BOEM expects the overall impact on bats to be **minor** adverse, as the overall effect would be measurable but the impacts to individuals and their habitats would not lead to population-level effects. *Cumulative Impacts of Alternative C-2*: Alternative C-2 includes changes to turbine installation locations that would not alter any of the findings for bats. The conclusions for cumulative impacts of Alternative C-2 are the same as described under the Proposed Action. BOEM expects the cumulative impact on bats to be **minor** adverse, as the effect would be measurable but the impacts to individuals and their habitats would not lead to population-level effects.	*Alternative C-3*: Alternative C-3 includes changes to turbine installation locations that would not alter any of the findings for bats. BOEM expects the overall impact on bats to be **minor** adverse, as the overall effect would be measurable but the impacts to individuals and their habitats would not lead to population-level effects. *Cumulative Impacts of Alternative C-3*: Alternative C-3 includes changes to turbine installation locations that would not alter any of the findings for bats. The conclusions for cumulative impacts of Alternative C-3 are the same as the Proposed Action. BOEM expects the cumulative impact on bats to be **minor** adverse, as the effect would be measurable but the impacts to individuals and their habitats would not lead to population-level effects.	*Preferred Alternative (C-3b):* Although Alternative C-3b would reduce the number of WTGs, the presence of WTGs could still increase the potential for collision, albeit at lower levels than the Proposed Action. The reduction in effects from impacts would not result in different impact level determinations. BOEM expects the overall impacts of these alternatives to bats would be similar to the Proposed Action: **minor** adverse. *Cumulative Impacts:* The overall impacts of Alternative C-3b when combined with past, present, and reasonably foreseeable activities would result in the same cumulative impacts as under the Proposed Action: **minor** adverse.

Resource	No Action	Proposed Action	Alternative C-1	Alternative C-2	Alternative C-3	Preferred Alternative
Benthic Resources	*No Action Alternative*: BOEM anticipates that the overall impacts associated with ongoing activities, including permitted offshore wind projects, and environmental trends in the GAA would result in **moderate** adverse impacts and could potentially include **minor beneficial** impacts on benthic resources due to the artificial reef effect (habitat conversion) *Cumulative Impacts of the No Action Alternative:* BOEM anticipates that future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, and reasonably foreseeable activities other than offshore wind would result in **moderate** adverse cumulative impacts and could potentially include **moderate beneficial** cumulative impacts on benthic resources due to the artificial reef effect (habitat conversion).	*Proposed Action*: BOEM anticipates the impacts resulting from the Proposed Action alone would range from negligible to moderate. Therefore, BOEM expects the overall impact on benthic resources from the Proposed Action and ongoing activities to be **moderate**, as the overall effect would be notable, but the resource would be expected to recover completely without remedial or mitigating action. Additionally, **minor beneficial** impacts may result due to the artificial reef effect (habitat conversion to hard bottom). *Cumulative Impacts of the Proposed Action:* BOEM anticipates that the overall impacts associated with the Proposed Action and future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, and reasonably foreseeable activities would result in **moderate** adverse cumulative impacts and could potentially include **moderate beneficial** cumulative impacts on benthic resources due to the artificial reef effect (habitat conversion).	*Alternative C-1*: Impacts to benthic resources would be slightly reduced as a result of the relocation of the 8 WTGs. BOEM expects the overall impact on benthic resources to be similar to the Proposed Action, **moderate** adverse and minor **beneficial**. *Cumulative Impacts of Alternative C-1*: BOEM anticipates that Alternative C-1 and future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, and reasonably foreseeable activities would result in **moderate** adverse cumulative impacts and could potentially include **moderate beneficial** cumulative impacts on benthic resources due to the artificial reef effect (habitat conversion).	*Alternative C-2*: Impacts to benthic resources would be slightly reduced as a result of the relocation of the 20 WTGs. BOEM expects the overall impact on benthic resources to be similar to the Proposed Action, **moderate** adverse and minor **beneficial**. *Cumulative Impacts of Alternative C-2*: BOEM anticipates that Alternative C-2 and future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, and reasonably foreseeable activities would result in **moderate** adverse cumulative impacts and could potentially include **moderate beneficial** cumulative impacts on benthic resources due to the artificial reef effect (habitat conversion).	*Alternative C-3*: Impacts resulting from the installation of up to 87 WTG positions could be reduced as compared to the other action alternatives. The magnitude of this reduction would likely be **minor**. BOEM expects the overall impacts to be similar to the Proposed Action, **moderate** adverse and minor **beneficial**. *Cumulative Impacts of Alternative C-3*: BOEM anticipates that Alternative C-3 and future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, including climate change, and reasonably foreseeable activities would result in **moderate** adverse cumulative impacts and could potentially include **moderate beneficial** cumulative impacts on benthic resources due to the artificial reef effect (habitat conversion).	*Preferred Alternative (C-3b):* Under Alternative C-3b, impacts on benthic resources from onshore construction would be the same as those described for the Proposed Action. Impacts on benthic resources from offshore activities including construction, O&M, and decommissioning would be slightly less under Alternative C-3b compared to the impacts described above for the Proposed Action, Alternative C-1, and Alternative C-2 because of fewer WTGs and reductions in cable length on the sea floor. These incremental decreases in impacts from Alternative C-3b may have minor beneficial impacts to the OCS habitat overall as compared to the Proposed Action. BOEM expects the overall impact on benthic resources to be similar to the Proposed Action and has characterized them as **moderate** adverse and minor **beneficial**. *Cumulative Impacts of Alternative C-3b*: BOEM anticipates that Alternative C-3b and future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, including climate change, and reasonably foreseeable activities would result in **moderate** adverse cumulative impacts and could potentially include **moderate** beneficial cumulative impacts on benthic resources due to the artificial reef effect (habitat conversion to hard bottom).
Birds	*No Action Alternative*: The IPFs associated with existing and ongoing projects are not expected to significantly alter bird populations. BOEM anticipates that impacts to birds due to ongoing activities associated with the No Action Alternative would include **minor** adverse impacts as well as the potential for **minor beneficial** impacts.	*Proposed Action*: BOEM anticipates adverse impacts resulting from the Proposed Action alone would range from negligible to minor with additional minor beneficial impacts to some species (diving seabirds) from the presence of structures and underwater armoring. Overall, impacts to individual birds and/or their habitat from the Proposed Action would be **minor** adverse and **minor beneficial** because impacts	*Alternative C-1*: The conclusions for impacts of Alternative C-1 are the same as described under the Proposed Action. BOEM anticipates adverse impacts resulting from Alternative C-1 would be **minor** adverse with additional **minor beneficial** impacts to some species (diving seabirds) from the presence of structures and underwater armoring.	*Alternative C-2*: The conclusions for impacts of Alternative C-2 are the same as described under the Proposed Action. BOEM anticipates adverse impacts resulting from Alternative C-2 would be **minor** adverse with additional **minor beneficial** impacts to some species (diving seabirds) from the presence of structures and underwater armoring.	*Alternative C-3*: The conclusions for impacts of Alternative C-3 are the same as described under the Proposed Action. BOEM anticipates adverse impacts resulting from Alternative C-3 would be **minor** adverse with additional **minor beneficial** impacts to some species (diving seabirds) from the presence of structures and underwater armoring.	*Preferred Alternative (C-3b):* Although Alternative C-3b would reduce the number of WTGs and their associated IACs, which would have an associated reduction in potential collision risk, the reduction in effects from impacts would not result in different impact level determinations. BOEM expects the overall impact on birds from the Proposed Action to be **minor** adverse with additional **minor**

Resource	No Action	Proposed Action	Alternative C-1	Alternative C-2	Alternative C-3	Preferred Alternative
	Cumulative Impacts of the No Action Alternative: BOEM anticipates that the cumulative impacts under the No Action Alternative would be long-term **moderate** adverse but could potentially include **minor beneficial** impacts because of the presence of structures.	would be detectable and measurable but would not lead to long-term or population-level effects. *Cumulative Impacts of the Proposed Action:* When combined with past, present, and reasonably foreseeable environmental trends and planned non-offshore wind and offshore wind activities, the Proposed Action would result in **moderate** adverse cumulative impacts to birds because those impacts that are detectable and measurable would not lead to long-term or population-level effects. Potential **minor beneficial** cumulative impacts may result from the presence of structures.	*Cumulative Impacts of Alternative C-1*: The conclusions for cumulative impacts of Alternative C-1 are the same as described under the Proposed Action. Combined with past, present, and reasonably foreseeable environmental trends and planned non-offshore wind and offshore wind activities, the Alternative C-1 would result in **moderate** adverse and potential **minor beneficial** cumulative impacts to birds.	*Cumulative Impacts of Alternative C-2*: The conclusions for cumulative impacts of Alternative C-2 are the same as described under the Proposed Action. Combined with past, present, and reasonably foreseeable environmental trends and planned non-offshore wind and offshore wind activities, the Alternative C-2 would result in **moderate** adverse and potential **minor beneficial** cumulative impacts to birds.	*Cumulative Impacts of Alternative C-3*: The conclusions for cumulative impacts of Alternative C-3 are the same as described under the cumulative impacts of the Proposed Action. Combined with past, present, and reasonably foreseeable environmental trends and planned non-offshore wind and offshore wind activities, the Alternative C-3 would result in **moderate** adverse and potential **minor beneficial** cumulative impacts to birds.	**beneficial**, because, the resource would recover completely after decommissioning without remedial or mitigating action. *Cumulative Impacts of Alternative C-3b*: In the context of other reasonably foreseeable environmental trends and planned actions, BOEM expects that Alternative C-3b impacts would be similar to the Proposed Action (with individual IPFs leading to impacts ranging from negligible to minor adverse and minor beneficial). The overall cumulative impacts of Alternative C-3b when combined with past, present, and reasonably foreseeable activities would therefore be the same level as under the Proposed Action: **moderate** adverse and potential **minor beneficial** cumulative impacts to birds.
Coastal Habitat and Fauna	*No Action Alternative*: The impacts of ongoing activities, especially land disturbance due to development, would be potentially **moderate** adverse. *Cumulative Impacts of the No Action Alternative:* Considering the combined effects of IPFs on coastal habitats and fauna, the overall cumulative impacts associated with future offshore wind activities, combined with ongoing activities, reasonably foreseeable environmental trends, and reasonably foreseeable planned actions other than offshore wind would be **moderate** adverse.	*Proposed Action*: Overall impacts to coastal habitats and fauna from the Proposed Action would be **moderate** adverse as a result of the loss of individuals and disturbance to habitats for the duration of Project construction but no population-level impacts to fauna and no permanent loss of habitat is expected as a direct result of the Proposed Action. *Cumulative Impacts of the Proposed Action:* The overall cumulative impacts associated with the Proposed Action in combination with future offshore wind activities, ongoing activities, reasonably foreseeable environmental trends, and reasonably foreseeable planned actions other than offshore wind would be **moderate** adverse. Land disturbance is expected to continue to have the greatest impact on the condition of coastal habitats and fauna in the GAA.	*Alternative C-1*: None of the components under Alternative C-1 would alter the proposed onshore activities and facilities, O&M, or conceptual decommissioning described for the Proposed Action. Therefore, impacts to coastal habitats and fauna from the reconfigured layout under Alternative C-1 would be the same as those described for the Proposed Action, **moderate** adverse. *Cumulative Impacts of Alternative C-1*: Cumulative impacts to coastal habitats and fauna under Alternative C-1 would be the same as those described for the cumulative Proposed Action impacts, **moderate** impacts.	*Alternative C-2*: None of the components under Alternative C-2 would alter the proposed onshore activities and facilities, O&M, or conceptual decommissioning described for the Proposed Action. Therefore, impacts to coastal habitats and fauna from the reconfigured layout under Alternative C-1 would be the same as those described for the Proposed Action, **moderate** adverse. *Cumulative Impacts of Alternative C-2*: Cumulative impacts to coastal habitats and fauna under Alternative C-2 would be the same as those described for the cumulative Proposed Action impacts, **moderate** impacts.	*Alternative C-3*: None of the components under Alternative C-3 would alter the proposed onshore activities and facilities, O&M, or conceptual decommissioning described for the Proposed Action. Therefore, impacts to coastal habitats and faunafrom the reconfigured layout under Alternative C-3 would be the same as those described for the Proposed Action, **moderate** adverse. *Cumulative Impacts of Alternative C-3*: Cumulative impacts to coastal habitats and fauna under Alternative C-3 would be the same as those described for the cumulative Proposed Action, **moderate** impacts.	*Preferred Alternative (C-3b):* None of the components under Alternative C-3 would alter the proposed onshore activities and facilities, O&M, or conceptual decommissioning described for the Proposed Action. Therefore, impacts to coastal habitats and fauna from the reconfigured layout under Alternative C-3 would be the same as those described for the Proposed Action, **moderate** adverse. *Cumulative Impacts of Alternative C-3b*: Cumulative impacts to coastal habitats and fauna under Alternative C-3 would be the same as those described for the cumulative Proposed Action, **moderate** impacts.
Finfish, Invertebrates, and Essential Fish Habitat	*No Action Alternative*: Under the No Action Alternative, finfish, invertebrates, and Essential Fish Habitat (EFH) would likely continue to be affected by existing environmental trends in the region.	*Proposed Action*: BOEM anticipates construction and installation, O&M, and conceptual decommissioning of the Proposed Action would have **moderate** adverse impacts on finfish, invertebrates and EFH. The primary	*Alternative C-1*: Alternative C-1 could potentially result in reduced overall impacts on finfish, invertebrates, and EFH due to the change in layout aimed to reduce the amount of WTGs located in the	*Alternative C-2*: Alternative C-2 could potentially result in reduced overall impacts on finfish, invertebrates, and EFH due to the change in layout aimed to reduce the number of WTGs located in the	*Alternative C-3*: Alternative C-3 would result in reduced overall impacts on finfish, invertebrates, and EFH due to the change in layout that would reduce the number of WTGs. However, the	*Preferred Alternative:* Alternative C-3b would result in reduced overall impacts on finfish, invertebrates, and EFH due to the change in layout that would reduce the number of WTGs. However, the

Resource	No Action	Proposed Action	Alternative C-1	Alternative C-2	Alternative C-3	Preferred Alternative
	Ongoing activities are expected to have continuing short-term and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on finfish, invertebrates, and EFH. Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on finfish, invertebrates, and EFH. *Cumulative Impacts of the No Action Alternative:* Cumulative impacts due to reasonably foreseeable activities, such as increased vessel traffic, any new submarine cable installations or pipelines, onshore construction activities, marine survey or explorations, mineral extractions, port expansions, channel dredging activities, and the installation of any new offshore structures, buoys, or piers, are anticipated to be **moderate** adverse.	risks would be associated with cable installation, and noise from construction, most prominently associated with pile-driving activities Entrainment estimates for egg and larval species regarding the OCS-DC are anticipated to be minor as demonstrated by the calculated equivalent adult. *Cumulative Impacts of the Proposed Action:* BOEM anticipates that the cumulative impacts on finfish, invertebrates and EFH in the GAA would be **moderate** adverse. Considering all IPFs together, BOEM anticipates that the overall impacts on finfish, invertebrates, and EFH in the GAA associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would be **moderate** adverse.	presumed Atlantic cod spawning locations and complex bottom habitat areas. Overall, the potential impacts associated from the Alternative C-1 are anticipated to be **moderate** adverse. *Cumulative Impacts of Alternative C-1*: The cumulative impacts on finfish, invertebrates and EFH from Alternatives C-1 would likely be **moderate** adverse due to a reduced impact on finfish, invertebrates and EFH given that the WTGs would be removed from prioritized contiguous areas of complex habitat to be excluded from development to avoid and minimize impacts to complex fisheries habitats, while still meeting BOEM's purpose and need for the Project.	presumed Atlantic cod spawning locations and complex bottom habitat areas. Overall, the potential impacts associated from the Alternative C-2 are anticipated to be **moderate** adverse. *Cumulative Impacts of Alternative C-2*: The cumulative impacts on finfish, invertebrates and EFH from Alternative C-2 would likely be **moderate** adverse due to a reduced impact on finfish, invertebrates and EFH given that the WTGs would be removed from prioritized contiguous areas of complex habitat to be excluded from development to avoid and minimize impacts to complex fisheries habitats, while still meeting BOEM's purpose and need for the Project.	reduction would be located in Priority Area 3 and not in Priority Area 1 where Atlantic cod spawning locations and complex bottom habitat areas are located. Overall, the potential impacts associated from the Alternative C-3 are anticipated to be **moderate** adverse. *Cumulative Impacts of Alternative C-3*: The cumulative impacts on finfish, invertebrates and EFH from Alternative C-3 would likely be **moderate** adverse**.** **D**ue to the presence of Glauconite Sands in the southeastern part SRWF, more WTGs are proposed for the northwestern part of the SRWF closer to the prioritized contiguous areas of Atlantic cod spawning. Overall impact on finfish, invertebrates and EFH would be reduced as compared to the Prosed Alternative due to less WTGs being proposed under this alternative.	reduction would be located in Priority Area 3 and not in Priority Area 1 where Atlantic cod spawning locations and complex bottom habitat areas are located. Overall, the potential impacts for the Preferred Alternative would be **moderate** adverse**.** *Cumulative Impacts of Alternative C-3b*: Cumulative impacts are anticipated to be **moderate** adverse.
Marine Mammals	*No Action Alternative (without baseline):* Not approving the COP would have no additional incremental effect on marine mammals (i.e., no effect). *No Action Alternative (with baseline):* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on mysticetes (other than NARWs), and **minor** to **moderate** adverse impacts on odontocetes, and pinnipeds. The presence of structures could potentially result in **minor beneficial** impacts for pinnipeds and odontocetes. Adverse impacts on mysticetes, odontocetes, and pinnipeds would be primarily due to underwater noise, commercial and recreational fishing gear interactions, and ongoing climate change. Vessel activity (vessel	*Proposed Action (without baseline)*: The incremental impact of the Proposed Action when compared to the No Action Alternative would be **moderate** adverse for NARWs. The incremental impact of the Proposed Action when compared to the No Action Alternative would be **minor** to **moderate** adverse for other mysticetes, odontocetes, and pinnipeds. Adverse impacts are expected to result mainly from pile-driving noise and increased vessel traffic. **Minor beneficial i**mpacts on odontocetes and pinnipeds may result from increased prey availability as related to the artificial reef effect. *Proposed Action (with baseline):* BOEM expects the overall impact on marine mammals from the Proposed Action to be **major** adverse for NARWs, and **minor** to **moderate** adverse for other mysticetes, odontocetes, and pinnipeds. The overall impacts on individuals and/or their habitat could have population-level effects, but the population can sufficiently recover from	*Alternative C-1 (without baseline)*: Alternative C-1 includes changes to turbine installation locations that would not alter any of the findings for marine mammals. Therefore, the incremental impact of Alternative C-1 when compared to the No Action would be the same as described under the Proposed Action, **moderate** adverse impacts on NARWs, **minor** to **moderate** adverse impacts on other mysticetes, odontocetes, and pinnipeds**,** with **minor beneficial** impacts on odontocetes and pinnipeds from increased prey availability. *Alternative C-1 (with baseline)*: Alternative C-1 includes changes to turbine installation locations that would not alter any of the findings for marine mammals. Therefore, the conclusions for Alternative C-1 are the same as described under the Proposed Action, **major** adverse for NARWs, and **minor** to **moderate** adverse for other	*Alternative C-2 (without baseline)*: Alternative C-2 includes changes to turbine installation locations that would not alter any of the findings for marine mammals. Therefore, the incremental impacts of Alternative C-2 are the same as described under the Proposed Action, **moderate** adverse impacts on NARWs, **minor to moderate** adverse impacts on other mysticetes, odontocetes, and pinnipeds**,** with **minor beneficial** impacts on odontocetes and pinnipeds from increased prey availability. *Alternative C-2 (with baseline)*: Alternative C-2 includes changes to turbine installation locations that would not alter any of the findings for marine mammals. Therefore, the conclusions for Alternative C-2 are the same as described under the Proposed Action, **major** adverse for NARWs, and **minor** to **moderate** adverse for other mysticetes, odontocetes, and pinnipeds	*Alternative C-3 (without baseline)*: Alternative C-3 includes changes to turbine installation locations that would not alter any of the findings for mysticetes, odontocetes, or pinnipeds. Therefore, the conclusions for impacts and cumulative impacts of Alternative C-3 are the same as described under the Proposed Action, **moderate** adverse impacts on NARWs, **minor** to **moderate** adverse impacts on other mysticetes, odontocetes, and pinnipeds**,** with **minor beneficial** impacts from increased prey availability. *Alternative C-3 (with baseline)*: Alternative C-3 includes changes to turbine installation locations that would not alter any of the findings for mysticetes, odontocetes, or pinnipeds. Therefore, the conclusions for Alternative C-3 are the same as described under the Proposed Action, **major** adverse for NARWs, and **minor**	*Preferred Alternative C-3b (without baseline):* The incremental impact of Alternative C-3b, when compared to the No Action Alternative, would be similar to the Proposed Action: **moderate** adverse impacts on NARWs, **minor** to **moderate** adverse impacts on other mysticetes, odontocetes, and pinnipeds, with **minor beneficial** impacts from increased prey availability. *Preferred Alternative C-3b (with baseline):* **Alternative C-3b** would result in similar impacts on marine mammals as described under the Proposed Action, with some impacts being minimally decreased in duration and geographic extent due to the reduced number of WTGs than the maximum WTGs proposed under the PDE of the Proposed Action; **major** adverse for NARWs, and **minor** to **moderate** adverse for mysticetes (other than NARWs), odontocetes, and

Resource	No Action	Proposed Action	Alternative C-1	Alternative C-2	Alternative C-3	Preferred Alternative
	collisions) would also be a primary contributor to adverse impacts on mysticetes. For the NARW, continuation of existing environmental trends and activities under the No Action Alternative would result in **major** adverse impacts due to low population numbers and potential to compromise the viability of the species from the loss of a single individual. *Cumulative Impacts of the No Action Alternative:* Alternative A, the No Action Alternative, when combined with all other planned activities (including offshore wind) would result in **moderate** adverse impacts on mysticetes (except for NARW), odontocetes, and pinnipeds. For NARWs impacts would be **major** adverse due to low population numbers and potential to compromise the viability of the species from the loss of a single individual. Adverse impacts would be primarily due to underwater noise, vessel activity (vessel collisions), fishing entanglement, and climate change.	the impacts or enough habitat still is functional to maintain the viability of the species both locally and throughout their range. **Minor beneficial** impacts on odontocetes and pinnipeds may result from increased prey availability as related to the artificial reef effect. *Cumulative Impacts of the Proposed Action:* BOEM anticipates that the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in **moderate** adverse impacts on mysticetes, odontocetes, and pinnipeds, except for the NARW, on which impacts would be **major** adverse due to low population numbers and potential to compromise the viability of the species from the loss of a single individual. **Minor beneficial** impacts on odontocetes and pinnipeds may result from increased prey availability as related to the artificial reef effect but would be insufficient to offset negative impacts associated with baseline conditions combined with the Proposed Action.	mysticetes, odontocetes, and pinnipeds**,** with **minor beneficial** impacts from increased prey availability. *Cumulative Impacts of Alternative C-1*: Alternative C-1 includes changes to turbine installation locations that would not alter any of the findings for marine mammals. Therefore, the conclusions for cumulative impacts of Alternative C-1 are the same as described under the cumulative impacts of the Proposed Action: **major** for NARWs and **moderate** for other mysticetes, odontocetes, and pinnipeds; **minor beneficial** impacts from increased prey availability.	with **minor beneficial** impacts from increased prey availability. *Cumulative Impacts of Alternative C-2*: Alternative C-2 includes changes to turbine installation locations that would not alter any of the findings for marine mammals. Therefore, the conclusions for cumulative impacts of Alternative C-2 are the same as described under the cumulative impacts of the Proposed Action: **major** for NARWs and **moderate** for other mysticetes, odontocetes, and pinnipeds; **minor beneficial** impacts from increased prey availability.	to **moderate** adverse for other mysticetes, odontocetes, and pinnipeds with **minor beneficial** impacts from increased prey availability. *Cumulative Impacts of Alternative C-3*: Alternative C-3 includes changes to turbine installation locations that would not alter any of the findings for marine mammals. Therefore, the conclusions for cumulative impacts of Alternative C-3 are the same as described under the cumulative impacts of the Proposed Action: **major** for NARWs and **moderate** for other mysticetes, odontocetes, and pinnipeds; **minor beneficial** impacts from increased prey availability.	pinnipeds with **minor beneficial** impacts from increased prey availability. *Cumulative Impacts of Alternative C-3b*: BOEM anticipates that the cumulative impacts of Alternative C-3b when combined with ongoing and planned activities, including offshore wind, would be the same as the Proposed Action: **major** for NARWs and **moderate** for other mysticetes, odontocetes, and pinnipeds; **minor beneficial** impacts from increased prey availability.
Sea Turtles	*No Action Alternative*: BOEM anticipates that the sea turtle impacts due to current environmental trends and ongoing activities associated with the No Action Alternative would be **minor** adverse with the potential for **minor beneficial** impacts. *Cumulative Impacts of the No Action Alternative:* Under the No Action Alternative, existing environmental trends and ongoing activities, natural and human-caused IPFs would continue to affect sea turtles. BOEM anticipates that the overall cumulative impacts associated Alternative A, the No Action Alternative, when combined with all	*Proposed Action*: BOEM anticipates the impacts resulting from the Proposed Action would be **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. *Cumulative Impacts of the Proposed Action:* Considering all the IPFs together, BOEM anticipates that the overall cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in **minor** adverse impacts to sea turtles and could include potentially	*Alternative C-1*: Alternative C-1 includes changes to turbine installation locations that would not alter any of the findings for sea turtles. Therefore, the conclusions for impacts and cumulative impacts of Alternative C-1 are the same as described under the Proposed Action, **minor** adverse impacts and potentially **minor beneficial** impact. *Cumulative Impacts of Alternative C-1*: Alternative C-1 includes changes to turbine installation locations that would not alter any of the findings for sea turtles. Therefore, the conclusions for cumulative impacts of Alternative C-1 are the same as described under the cumulative impacts of the	*Alternative C-2*: Alternative C-2 includes changes to turbine installation locations that would not alter any of the findings for sea turtles. Therefore, the conclusions for impacts and cumulative impacts of Alternative C-2 are the same as described under the Proposed Action **minor** adverse impacts and potentially **minor beneficial** impact. *Cumulative Impacts of Alternative C-2*: Alternative C-2 includes changes to turbine installation locations that would not alter any of the findings for sea turtles. Therefore, the conclusions for cumulative impacts of Alternative C-2 are the same as described under the cumulative impacts of the	*Alternative C-3*: Alternative C-3 includes changes to turbine installation locations that would not alter any of the findings for sea turtles. Therefore, the conclusions for impacts and cumulative impacts of Alternative C-3 are the same as described under the Proposed Action, **minor** adverse impacts and potentially **minor beneficial** impacts. *Cumulative Impacts of Alternative C-3*: Alternative C-3 includes changes to turbine installation locations that would not alter any of the findings for sea turtles. Therefore, the conclusions for cumulative impacts of Alternative C-3 are the same as described under the cumulative impacts of the	*Preferred Alternative C-3b:* BOEM anticipates that any incremental reduction in impacts would not change the resulting effects on sea turtles to the extent necessary to alter the impact-level conclusions for any impact mechanism. The impact of Alternative C-3b, would be similar to the Proposed Action: **minor** adverse impacts with potential **minor beneficial** impacts. *Cumulative Impacts of Alternative C-3b*: The overall cumulative impacts of Alternative C-3b when combined with past, present, and reasonably foreseeable activities would therefore be the same level as under the

Resource	No Action	Proposed Action	Alternative C-1	Alternative C-2	Alternative C-3	Preferred Alternative
	other planned activities (including offshore wind) in the GAA would result in overall **minor** adverse and **minor beneficial** impacts.	**minor beneficial** impacts. The main drivers for 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.	Proposed Action, **minor** adverse impacts and potentially **minor beneficial** impact.	Proposed Action, **minor** adverse impacts and potentially **minor beneficial** impact.	Proposed Action, **minor** adverse impacts and potentially **minor beneficial** impacts.	Proposed Action: **minor** adverse with potentially **minor beneficial** impacts.
Wetlands and Waters of the United States (WOTUS)	*No Action Alternative*: BOEM anticipates that the impact on wetlands resulting from ongoing activities associated with the No Action Alternative would be **minor**. *Cumulative Impacts of the No Action Alternative:* BOEM anticipates that the overall cumulative impacts associated with Alternative A, the No Action Alternative, when combined with all other planned activities (including offshore wind) in the GAA would result in overall **moderate** impacts.	*Proposed Action*: BOEM expects the impacts resulting for the Proposed Action would likely have **minor** impact on wetlands and other WOTUS. *Cumulative Impacts of the Proposed Action:* Considering all the IPFs together, BOEM expects that the overall cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in **moderate** impacts to wetlands and other WOTUS.	*Alternative C-1*: Because changes in the WTGs arrangement would not impact onshore wetlands and other WOTUS, BOEM expects that the impacts resulting from Alternative C-1 would be the same as the Proposed Action: **minor**. *Cumulative Impacts of Alternative C-1*: Considering all the IPFs together, the overall cumulative impacts of the alternatives when combined with past, present, and reasonably foreseeable activities would be the same as the Proposed Action and result in **moderate** impacts to wetlands and other WOTUS.	*Alternative C-2*: Since changes in the WTGs arrangement would not impact onshore wetlands and other WOTUS, BOEM expects that the impacts resulting from Alternative C-2 would be the same as the Proposed Action: **minor**. *Cumulative Impacts of Alternative C-2*: Considering all the IPFs together, the overall cumulative impacts of the alternatives when combined with past, present, and reasonably foreseeable activities would be the same as the Proposed Action and result in **moderate** impacts to wetlands and other WOTUS.	*Alternative C-3*: Since changes in the WTGs arrangement would not impact onshore wetlands and other WOTUS, BOEM expects that the impacts resulting from Alternative C-3 would be the same as the Proposed Action: **minor**. *Cumulative Impacts of Alternative C-3*: In the context of ongoing and planned activities, the incremental contribution of Alternative C-3 to the impacts of individual IPFs would be similar to the Proposed Action, negligible to minor. Considering all the IPFs together, the overall cumulative impacts of the alternatives when combined with past, present, and reasonably foreseeable activities would be the same as the Proposed Action and result in **moderate** impacts to wetlands and other WOTUS.	*Preferred Alternative C-3b:* BOEM anticipates Alternative C-3b would have **minor** impacts to wetlands and other WOTUS within the GAA. *Cumulative Impacts of Alternative C-3b:* Overall cumulative impacts to wetlands from the Preferred Alternative combined with past, present, and reasonably foreseeable activities would be **moderate** due to the short-term impacts on wetlands from onshore construction activities adjacent to wetlands and other WOTUS. These resources would be expected to recover completely from these activities.
Commercial Fisheries and For-Hire Recreation Fishing	*No Action Alternative*: BOEM anticipates that the adverse impacts of ongoing activities on commercial fisheries fishing would be **minor** to **major** and **minor** to **moderate** for-hire recreational. The major impact rating for some fisheries and fishing operations is primarily driven by regulated fishing effort and climate change associated with ongoing activities. The impacts could also include long-term **minor beneficial** impacts for certain commercial fisheries and some for-hire recreational fishing operations, due to the artificial reef effect. *Cumulative Impacts of the No Action Alternative:* BOEM anticipates that the cumulative impact of the No Action Alternative would result in a **moderate** to **major**	*Proposed Action*: In the event that these specific fishing operations are unable to find suitable alternative fishing locations, they could experience long-term, major disruptions. However, it is estimated that the majority of vessels would only have to adjust somewhat to account for disruptions due to impacts. BOEM expects that the impacts resulting from the Proposed Action would be range from **minor** to **major** on commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation. In addition, the impacts of the Proposed Action could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect.	*Alternative C-1*: The impacts to commercial fishing and for-hire recreational fishing would be expected to be similar to those discussed under Alternative B; however, slightly less due to the habitat minimization layout. BOEM expects that the impacts resulting from Alternative C-1 would be range from **minor** to **major** for commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation. In addition, the impacts of Alternative C-1 could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect. *Cumulative Impacts of Alternative C-1*: In context of reasonably foreseeable environmental trends in the area, the	*Alternative C-2*: The impacts resulting from individual IPFs associated with Alterative C-2 would be similar to, but slightly less adverse than those described under Alternative C-1 (as well as Alternative B). The overall impact magnitudes under Alternative C-2 are anticipated to range from **minor** to **major** for commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation. Although impacts related to Alternative C-2 are anticipated to be slightly less adverse than Alternative B or C-1. In addition, the impacts of Alternative C-2 could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect.	*Alternative C-3*: The impacts resulting from individual IPFs associated with Alternative C-3 would be similar to, but slightly less adverse than those described under Alternative C-1, C-2 (as well as Alternative B). The overall impact magnitudes under Alternative C-3 are anticipated to range from **minor** to **major** for commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation. Although impacts related to Alternative C-3 are anticipated to be slightly less adverse than Alternatives B, C-1 and C-2, the actual difference is dependent on many variables, as discussed above, and has not been quantified. In addition, the impacts of Alternative C-3 could include long-term, **minor beneficial** impacts for some for-hire recreational	*Preferred Alternative C-3b:* It is expected that there would be a disruption to commercial fisheries and for-hire recreational fishing vessels during construction, O&M and conceptual decommissioning. The amount of disruption and impact would vary based upon several factors but could include long-term major disruptions to certain operators; however, the overall impact magnitudes under Alternative C-3 are anticipated to range from **minor** to **major** for commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation. Although impacts related to Alternative C-3 are anticipated to be slightly less adverse than Alternatives B, C-1 and C-2, the actual difference is dependent on many variables, as discussed above, and has

Resource	No Action	Proposed Action	Alternative C-1	Alternative C-2	Alternative C-3	Preferred Alternative
	adverse impact on commercial fisheries and **minor** to **moderate** adverse impacts on for-hire recreational fishing. This impact rating would primarily result from future fisheries use and management, the increased presence of offshore structures and climate change. The impacts could also include long-term **minor** to **moderate beneficial** impacts for certain commercial fisheries and some for-hire recreational fishing operations due to the artificial reef effect.	*Cumulative Impacts of the Proposed Action:* In the context of reasonably foreseeable environmental trends in the area, the contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing and planned activities would range from minor to moderate. Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action to the cumulative impacts from ongoing and planned activities would result in **major** impacts on commercial fisheries and for-hire recreational fishing because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely, even with Applicant Proposed Measures (APMs).	contribution of Alternative C-1 to the impacts of individual IPFs resulting from ongoing and planned activities would range from minor to moderate. Considering all the IPFs together, BOEM anticipates that the contribution of Alternative C-1 to the cumulative impacts from ongoing and planned activities would result in **major** impacts on commercial fisheries and for-hire recreational fishing because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely, even with APMs.	*Cumulative Impacts of Alternative C-2*: Impacts related to Alternative C-2 combined with ongoing and planned activities would result in similar, but slightly less adverse impacts than as described in the Proposed Action (and Alternative C-1), which would range from minor to moderate. Considering all the IPFs together, BOEM anticipates that the contribution of Alternative C-2 to the cumulative impacts from ongoing and planned activities would result in **major** impacts on commercial fisheries and for-hire recreational fishing because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely, even with APMs.	fishing operations due to the artificial reef effect. *Cumulative Impacts of Alternative C-3*: Considering all the IPFs together, BOEM anticipates that the contribution of Alternative C-3 to the cumulative impacts from ongoing and planned activities would result in **major** impacts on commercial fisheries and for-hire recreational fishing because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely, even with APMs.	not been quantified. In addition, the impacts of Alternative C-3 could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect. *Cumulative Impacts of Alternative C-3b*: Overall, BOEM expects that the cumulative impacts resulting from Alternative C-3b would be **major** on commercial fishing and for-hire recreational fishing but less than that of the Proposed Action (Alternative B).
Cultural Resources	*No Action Alternative*: The primary source of onshore impacts from ongoing activities would include ground-disturbing activities and the introduction of intrusive visual elements, while the primary source of offshore impacts or those activities that disturb the seafloor, such as anchoring, new cable emplacement, and installation/presence of structures. BOEM anticipates that the cultural resource impacts as a result of ongoing activities associated with the Alternative A - No Action of ongoing activities would be **major** adverse. *Cumulative Impacts of the No Action Alternative:* BOEM anticipates that the overall cumulative impacts associated with the No Action Alternative when combined with all other planned activities (including offshore wind) in the GAA would result in overall **major** adverse impacts on individual onshore and offshore cultural resources depending on the scale and extent of impacts and the unique characteristics of individual resources. The construction and operation of reasonably foreseeable offshore wind	*Proposed Action*: Based on the preceding IPF analysis, BOEM has determined that the Proposed Action would likely result in **major** adverse impacts on cultural resources. The Proposed Action would still result in adverse visual effects on above-ground historic properties and adverse physical effects to ancient, submerged landform feature historic properties which would require mitigation to resolve those adverse effects. Therefore, the overall impacts on historic properties from the Proposed Action would qualify as **major** as it would result in adverse effects on historic properties, as defined at 36 *CFR* 800.5(a)(1), that would require mitigation to resolve. *Cumulative Impacts of the Proposed Action:* Overall, BOEM anticipate the cumulative impacts from the Proposed Action and reasonably foreseeable offshore wind projects could result in **major** adverse impacts and **minor beneficial** impacts on cultural resources.	*Alternative C-1*: Alternative C-1 would result in the same **major** adverse impacts on marine and terrestrial cultural resources as the Proposed Action. *Cumulative Impacts of Alternative C-1*: Alternative C-1 would result in the same cumulative **major** adverse impacts and **minor beneficial** impacts on marine and terrestrial cultural resources as the cumulative impacts of the Proposed Action.	*Alternative C-2*: Alternative C-2 would result in the same negligible to **major** adverse impacts on marine and terrestrial cultural resources as the Proposed Action. *Cumulative Impacts of Alternative C-2*: Alternative C-2 would result in the same cumulative **major** adverse impacts and **minor beneficial** impacts on marine and terrestrial cultural resources as the cumulative impacts of the Proposed Action.	*Alternative C-3*: Alternative C-3 would result in the same **major** adverse impacts on marine and terrestrial cultural resources as the Proposed Action. *Cumulative Impacts of Alternative C-3*: Alternative C-3 would result in the same cumulative **major** adverse impacts on marine and terrestrial cultural resources as the cumulative impacts of the Proposed Action. Additionally, Alternative C-3 and present and reasonably foreseeable offshore wind projects would also result in **minor beneficial** impacts to terrestrial, marine, and above-ground resources by slowing or arresting the effects of climate change.	*Preferred Alternative C-3b*: Alternative C-3b would result in the same **major** adverse impacts on marine and terrestrial cultural resources as the Proposed Action. *Cumulative Impacts of Alternative C-3b*: Alternative C-3 would result in the same cumulative **major** adverse impacts on marine and terrestrial cultural resources as the cumulative impacts of the Proposed Action. Additionally, Alternative C-3b and present and reasonably foreseeable offshore wind projects would also result in **minor beneficial** impacts to terrestrial, marine, and above-ground resources by slowing or arresting the effects of climate change.

Resource	No Action	Proposed Action	Alternative C-1	Alternative C-2	Alternative C-3	Preferred Alternative
	projects would also **minor beneficial** impacts on individual onshore and offshore cultural resources as these projects would make incremental contributions to arresting the pace of global warming and climate change and associated impacts on cultural resources from sea level rise, increased storm severity/frequency, and increased erosion/deposition of sediments.					
Demographics, Employment, and Economics	*No Action Alternative*: BOEM anticipates that ongoing activities in the GAA (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. *Cumulative Impacts of the No Action Alternative:* BOEM anticipates that the No Action Alternative, when combined with all planned activities (including other offshore wind activities), would result in **minor adverse** and **moderate beneficial** cumulative impacts due primarily to the impacts on commercial fishing and for-hire recreational 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.	*Proposed Action*: BOEM anticipates that the Proposed Action would have **minor** adverse impacts on demographics within the analysis area. 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 impacts on commercial fishing and onshore seafood businesses would have minor impacts on demographics, employment, and economics for this component of the GAA's economy. The IPFs associated with the Proposed Action would also result in impacts on certain recreation and tourism businesses that range from negligible to minor, with an overall **minor** adverse and **minor beneficial** impact on employment and economic activity for this component of the analysis area's economy. *Cumulative Impacts of the Proposed Action:* Overall, BOEM anticipates that the Proposed Action and ongoing and planned activities would result in **minor** adverse impacts and **moderate beneficial** cumulative impacts on demographics, employment, and economics in the GAA. 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 (i.e., ports, etc.) improvements, while the **minor** adverse effects would result from aviation hazard lighting on WTGs, new cable emplacement and maintenance, the presence of	*Alternative C-1*: The impacts resulting from individual IPFs associated with Alterative C-1 would result in no change to the overall impact magnitudes to demographics, employment and economics as compared to the Proposed Action. These are anticipated to be **minor** adverse impacts and **minor beneficial** impacts on demographics, employment, and economics. *Cumulative Impacts of Alternative C-1*: Overall, Alternative C-1 combined with ongoing and planned activities would result in the same impacts as described in the Proposed Action, which include **minor** adverse impacts and **moderate beneficial** cumulative impacts on demographics, employment and economics in the GAA.	*Alternative C-2*: The impacts resulting from individual IPFs associated with Alterative C-2 would be the same as Alternative C-1. The overall impact magnitudes under Alternative C-2 are anticipated be **minor** adverse impacts and **minor beneficial** impacts on demographics, employment, and economics. *Cumulative Impacts of Alternative C-2*: Impacts related to Alternative C-2 combined with ongoing and planned activities would result in the same impacts as described in the Proposed Action (and Alternative C-1), which include **minor** adverse impacts and **moderate beneficial** cumulative impacts on demographics, employment and economics in the GAA.	*Alternative C-3*: The impacts resulting from individual IPFs associated with Alterative C-3 would be similar to, but slightly less adverse than those described under Alternatives C-1, C-2, as well as Alternative B. The overall impact magnitudes under Alternative C-3 are anticipated to be **minor** adverse impacts and **minor beneficial** impacts on demographics, employment, and economics. *Cumulative Impacts of Alternative C-3*: Impacts related to Alternative C-3 combined with ongoing and planned activities would result in similar impacts as described in the Proposed Action (and Alternatives C-1 and C-2), which include **minor** adverse impacts and **moderate beneficial** cumulative impacts on demographics, employment and economics in the GAA.	*Preferred Alternative C-3b:* The impacts resulting from individual IPFs associated with Alterative C-3b would be similar to, but slightly less adverse than those described under Alternatives C-1, C-2, as well as Alternative B. The overall impact magnitudes under Alternative C-3b are anticipated to be **minor** adverse impacts and **minor beneficial** impacts on demographics, employment, and economics. *Cumulative Impacts of Alternative C-3b:* The overall cumulative impacts related to the implementation of Alternative C-3b would be similar to, but slightly less than those described under Alternative B, which include **minor** adverse impacts and **moderate beneficial,** since less WTGs would be installed.

Resource	No Action	Proposed Action	Alternative C-1	Alternative C-2	Alternative C-3	Preferred Alternative
		structures, vessel traffic and collisions during construction, and land disturbance.				
Environmental Justice (EJ)	*No Action Alternative*: BOEM anticipates that the EJ impacts as a result of ongoing activities associated with the Alternative A - No Action of these ongoing activities would be **minor** to **moderate** adverse to **minor beneficial**. *Cumulative Impacts of the No Action Alternative:* Considering all the IPFs, BOEM anticipates that the overall cumulative impacts associated with future offshore wind activities in the GAA combined with ongoing activities and reasonably foreseeable activities other than offshore wind would result in overall **minor** to **moderate**. BOEM also anticipates that the impacts associated with future offshore wind activities in the GAA would result in **minor beneficial** effects on minority and low-income populations through economic activity and job creation.	*Proposed Action*: BOEM anticipates that the impacts of individual IPFs from the Proposed Action alone would be negligible to moderate on EJ populations within the GAA. Considering the combined impacts of all IPFs, BOEM anticipates that the Proposed Action would have overall **moderate** adverse impacts on all EJ populations. In addition, **minor beneficial** effects to EJ populations may result from reductions in air emissions if offshore wind displaces energy generation using fossil fuels, as well as beneficial effects from economic activity and job creation. *Cumulative Impacts of the Proposed Action:* The Proposed Action in combination with other offshore wind energy projects would result in a greater number of offshore structures affecting larger offshore areas, and additional onshore construction and port utilization within the GAA. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined cumulative impacts on EJ populations from ongoing and planned activities, which are anticipated to be **moderate** overall. Additionally, **minor beneficial** impacts may result from reductions in air emissions, as well as beneficial effects from economic activity and job creation.	*Alternative C-1*: The impacts resulting from individual IPFs associated with Alterative C-1 would be the same for both offshore activities and facilities and onshore activities and facilities. Therefore, the overall impact magnitudes to EJ populations would be impacted to the same degree when compared to the Proposed Action. These are anticipated to range from **moderate** adverse impacts and **minor beneficial** impacts on EJ populations. *Cumulative Impacts of Alternative C-1*: Overall, Alternative C-1 combined with ongoing and planned activities would result in the same cumulative impacts as described in the Proposed Action, which include **moderate** adverse impacts and **minor beneficial** impacts on EJ populations in the GAA.	*Alternative C-2*: The impacts resulting from individual IPFs associated with Alterative C-2 would be essentially the same the Proposed Action for both offshore activities and facilities and onshore activities and facilities. Therefore, the overall impact magnitudes to EJ populations would be impacted to the same degree when compared to the Proposed Action and Alternative C-1. These are anticipated to be **moderate** adverse impacts and **minor beneficial** impacts on EJ populations. *Cumulative Impacts of Alternative C-2*: Overall, Alternative C-2 combined with ongoing and planned activities would result in the same cumulative impacts as described in the Proposed Action and Alternative C-1, which include **moderate** adverse impacts and **minor beneficial** impacts on EJ populations in the GAA.	*Alternative C-3*: The impacts resulting from individual IPFs associated with Alterative C-3 would be essentially the same as those described under Alternatives C-1, C-2 as well as Alternative B (the Proposed Action) for both offshore activities and facilities and onshore activities and facilities. Therefore, the overall impact magnitudes to EJ populations would be impacted to the same degree when compared to the Proposed Action and Alternatives C-1 and C-2. These are anticipated to be **moderate** adverse impacts and **minor beneficial** impacts on EJ populations. *Cumulative Impacts of Alternative C-3*: Alternative C-3 combined with ongoing and planned activities would result in the same cumulative impacts as described in the Proposed Action and Alternatives C-1 and C-2, which include **moderate** adverse impacts and **minor beneficial** impacts on EJ populations in the GAA.	*Preferred Alternative C-3b:* BOEM anticipates that there would be a **moderate** impact on EJ populations within the GAA under Alternative C-3b, which would be similar to those described under Alternative B. There would also be **minor beneficial** impacts to EJ populations resulting from reductions in air emissions if offshore wind displaces energy generation using fossil fuels, as well as beneficial effects from economic activity and job creation. These beneficial effects would be similar to those described under Alternative B, but potentially a small degree less due to less overall WTGs being installed. *Cumulative Impacts of Alternative C-3b*: Alternative C-3 combined with ongoing and planned activities would result in the same cumulative impacts as described in the Proposed Action and Alternatives C-1 and C-2, which include **moderate** adverse impacts and **minor beneficial** impacts on EJ populations in the GAA.
Land Use and Coastal Infrastructure	*No Action Alternative*: The No Action Alternative would result in **minor beneficial** and **minor adverse** impacts on land use and coastal infrastructure. The identified IPFs relevant to land use and coastal infrastructure from ongoing non-offshore wind and offshore wind activities include accidental releases and discharges, lighting, land disturbance, presence of structures, noise, traffic, and port utilization.	*Proposed Action*: BOEM anticipates that impacts on land use and coastal infrastructure from the Proposed Action would be **moderate** adverse with **minor beneficial** impacts. *Cumulative Impacts of the Proposed Action:* Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action to the cumulative impacts associated with ongoing and planned activities would result in **moderate** adverse impacts and **minor beneficial** impacts on	*Alternative C-1*: BOEM expects that the impacts from Alternative C-1 to land use and coastal infrastructure would be similar to the Proposed Action, **moderate** adverse impacts to **minor beneficial** impacts. *Cumulative Impacts of Alternative C-1*: In context of reasonably foreseeable environmental trends, the contribution of Alternative C-1 to the cumulative impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as that of	*Alternative C-2*: BOEM expects that the impacts from Alternative C-2 to land use and coastal infrastructure would be similar to the Proposed Action, **moderate** adverse impacts to **minor beneficial** impacts. *Cumulative Impacts of Alternative C-2*: In context of reasonably foreseeable environmental trends, the contribution of Alternative C-2 to the cumulative impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as that of	*Alternative C-3*: BOEM expects that the impacts from Alternative C-3 to land use and coastal infrastructure would be similar to the Proposed Action, **moderate** adverse impacts to **minor beneficial** impacts. *Cumulative Impacts of Alternative C-3*: In context of reasonably foreseeable environmental trends, the contribution of Alternative C-3a, C-3b, and C-3c to the cumulative impacts resulting from individual IPFs associated with ongoing and planned activities would be the	*Preferred Alternative C-3b:* Under Alternative C-3b, impacts on land use and coastal infrastructure would be similar to the Proposed Action, **moderate** adverse with **minor beneficial** impacts for the Preferred Alternative. *Cumulative Impacts of Alternative C-3b*: In context of reasonably foreseeable environmental trends, the contribution of Alternative C-3b to the cumulative impacts resulting from individual IPFs

Resource	No Action	Proposed Action	Alternative C-1	Alternative C-2	Alternative C-3	Preferred Alternative
	Cumulative Impacts of the No Action Alternative: BOEM anticipates that the cumulative impacts of the No Action Alternative would be both **minor beneficial** and **minor** adverse in the GAA. There are potential adverse impacts from future offshore wind to land use and coastal infrastructure through accidental releases and discharges during onshore construction, land disturbance during installation of onshore cables and substations, the presence of WTGs on the viewshed, nighttime lighting on WTGs and from onshore construction, and the presence of other structures. Potential beneficial impacts to land use and coastal infrastructure would result from the expansion and productive utilization of ports and associated infrastructure that would be utilized for future offshore wind activity.	land use and coastal infrastructure in the GAA.	the Proposed Action **moderate** adverse impacts for onshore land use and coastal infrastructure and **minor beneficial** impacts.	the Proposed Action, **moderate** adverse impacts for onshore land use and infrastructure and **minor beneficial** impacts.	same as that of the Proposed Action, **moderate** adverse impacts for onshore land use and infrastructure and **minor beneficial** impacts.	associated with ongoing and planned activities would be the same as that of the Proposed Action, **moderate** adverse impacts for onshore land use and infrastructure and **minor beneficial** impacts.
Navigation and Vessel Traffic	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on navigation and vessel traffic. *Cumulative Impacts of the No Action Alternative:* Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, and reasonably foreseeable activities other than offshore wind would result in **moderate** adverse impacts because the overall effect would be notable, but vessels could adjust to account for disruptions and environmental protection measures (EPMs) would reduce impacts	*Proposed Action*: BOEM anticipates that the adverse impacts resulting from the Proposed Action would be moderate. Therefore, BOEM expects the overall impact on navigation from the Proposed Action and ongoing activities to be **moderate**, as the change in navigation and safety risk would be small. *Cumulative Impacts of the Proposed Action:* In the context of reasonably foreseeable environmental trends and planned actions, the incremental impacts under the Proposed Action resulting from individual IPFs would be **moderate**. The main IPF is the presence of structures, which could alter navigation patterns as large vessels would likely navigate around the Project.	*Alternative C-1*: BOEM anticipates that the impacts on navigation and vessel traffic from Alternative C-1 would be **moderate**, as the change in navigation and safety risk would be small. *Cumulative Impacts of Alternative C-1*: In the context of reasonably foreseeable environmental trends, the contribution of Alternative C-1 to navigation and vessel traffic impacts from ongoing and future activities would be **moderate** and the same as the Proposed Action.	*Alternative C-2*: BOEM anticipates that the impacts from Alternative C-2 would be **moderate**, as the change in navigation and safety risk would be small. *Cumulative Impacts of Alternative C-2*: In the context of reasonably foreseeable environmental trends, the contribution of Alternative C-2 to navigation and vessel traffic impacts from ongoing and future activities would be **moderate** and the same as the Proposed Action.	*Alternative C-3*: BOEM anticipates that the impacts from Alternative C-3 would be **moderate**, as the change in navigation and safety risk would be small. *Cumulative Impacts of Alternative C-3*: In the context of reasonably foreseeable environmental trends, the contribution of Alternative C-3 to navigation and vessel traffic impacts from ongoing and future activities would be **moderate** and the same as the Proposed Action.	*Preferred Alternative C-3b:* Under Alternative C-3b, impacts on navigation and vessel traffic from onshore and offshore construction, O&M, and decommissioning would be the slightly less than described for the Proposed Action. The anticipated impacts would be generated through increased vessel traffic, obstructions to navigation, delays within or approaching ports, increased navigational complexity, changes to navigation patterns, detours to offshore travel or port approaches; or increased risk of incidents such as collision, allision, and groundings. Therefore, BOEM expects the overall impact on navigation from the Alternative C-3b to be **moderate**, as the change in navigation and safety risk would be slightly less. *Cumulative Impacts of Alternative C-3b*: In the context of reasonably foreseeable environmental trends, the contribution of Alternative C-3 to navigation and vessel traffic impacts

Resource	No Action	Proposed Action	Alternative C-1	Alternative C-2	Alternative C-3	Preferred Alternative
						from ongoing and future activities would be **moderate** and the same as the Proposed Action.
Other Uses	*No Action Alternative*: BOEM Anticipates the No Action Alternative would be **negligible** for marine mineral extraction, marine and national security uses, aviation and air traffic, cables and pipelines, and radar systems. Military and national security use, aviation and air traffic, vessel traffic, commercial fishing, and scientific research and surveys are expected to continue in the GAA. Impacts of ongoing non-offshore and offshore wind activities on scientific research surveys are anticipated to be **major** due to the impacts of ongoing offshore wind activities. *Cumulative Impacts of the No Action Alternative:* BOEM anticipates that the overall cumulative impacts associated with Alternative A, the No Action Alternative, when combined with all other planned activities (including offshore wind) in the GAA would result be **negligible** for marine mineral extraction; **minor** for aviation and air traffic, cables and pipelines; **moderate** for radar systems; **minor** for military and national security; **moderate** for SAR activities; and **major** for scientific research and surveys.	*Proposed Action*: **Negligible** for marine mineral extraction, cables and pipelines; **minor** for aviation and air traffic, most military and national security uses, and radar systems; **moderate** for United States Coast Guard (USCG) Search and rescue (SAR) operations; and **major** for scientific research and surveys. *Cumulative Impacts of the Proposed Action:* Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with ongoing and planned activities would be **negligible** for marine mineral extraction, and cables and pipelines; **minor** for aviation and air traffic, and most military and national security uses; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys.	*Alternative C-1*: The overall level of impact would remain similar to the Proposed Action, **negligible** for marine mineral extraction, cables and pipelines; **minor** for aviation and air traffic, most military and national security uses, and radar systems; **moderate** for United States Coast Guard (USCG) Search and rescue (SAR) operations; and **major** for scientific research and surveys *Cumulative Impacts of Alternative C-1*: In context of reasonably foreseeable environmental trends, the contribution of Alternative C-2 to the individual IPFs resulting from ongoing and planned activities would be similar to that of the cumulative impacts of the Proposed Action. Overall cumulative adverse impacts would be **negligible** for marine mineral extraction, and cables and pipelines; **minor** for aviation and air traffic, and most military and national security uses; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys.	*Alternative C-2*: The overall level of impact would remain similar to the Proposed Action, **negligible** for marine mineral extraction, cables and pipelines; **minor** for aviation and air traffic, most military and national security uses, and radar systems; **moderate** for United States Coast Guard (USCG) Search and rescue (SAR) operations; and **major** for scientific research and surveys *Cumulative Impacts of Alternative C-2*: In context of reasonably foreseeable environmental trends, the contribution of Alternative C-2 to the individual IPFs resulting from ongoing and planned activities would be similar to that of the cumulative impacts of the Proposed Action. Overall cumulative adverse impacts would be **negligible** for marine mineral extraction, and cables and pipelines; **minor** for aviation and air traffic, and most military and national security uses; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys.	*Alternative C-3*: The overall level of impact would remain similar to the Proposed Action, **negligible** for marine mineral extraction, cables and pipelines; **minor** for aviation and air traffic, most military and national security uses, and radar systems; **moderate** for United States Coast Guard (USCG) Search and rescue (SAR) operations; and **major** for scientific research and surveys *Cumulative Impacts of Alternative C-3*: In context of reasonably foreseeable environmental trends, the contribution of Alternative C-3 to the individual IPFs resulting from ongoing and planned activities would be similar to that of the cumulative impacts for the Proposed Action. Overall cumulative adverse impacts would be **negligible** for marine mineral extraction, and cables and pipelines; **minor** for aviation and air traffic, and most military and national security uses; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys.	*Preferred Alternative C-3b:* The Preferred Alternative would result in **negligible** impacts to marine mineral extraction and cables and pipelines. However, the presence of WTGs would result in **minor** impacts to aviation and air traffic, military and national security uses, and radar systems. **Moderate** impacts to USCG SAR operations and **major** impacts to scientific research and surveys are expected due to the presence of SRWF WTGs. *Cumulative Impacts of Alternative C-3b*: In context of reasonably foreseeable environmental trends, the contribution of Alternative C-3b to the individual IPFs resulting from ongoing and planned activities would be similar to that of the cumulative impacts for the Proposed Action. The impacts would range from **negligible** to **minor** for aviation and air traffic, cables and pipelines, marine mineral extraction, and most military and national security uses; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys. These impact ratings are primarily driven by the presence of offshore structures such as WTGs in the offshore wind lease areas.
Recreation and Tourism	*No Action Alternative*: The No Action Alternative would result in **moderate** adverse and **minor beneficial** impacts. Recreation and tourism in the GAA would continue to be affected by ongoing activities, including vessel traffic, noise and trenching from periodic maintenance or installation of coastal and nearshore infrastructure, and onshore development activities. *Cumulative Impacts of the No Action Alternative:*	*Proposed Action*: BOEM anticipates the construction, operations and maintenance, and conceptual decommissioning of the Proposed Action would have **moderate** adverse and **minor beneficial** impacts to recreation and tourism. The impacts of O&M activities associated with the Proposed Alternative would range from negligible to moderate adverse and minor beneficial impacts to recreation and tourism. The overall effect of the Proposed Action on recreation and tourism would be expected to be negligible to moderate adverse and minor beneficial impacts, as	*Alternative C-1*: BOEM expects that the impacts from Alternative C-1 to recreation and tourism would be similar, but potentially less, to the Proposed Action. All other impacts are anticipated to be similar to those described under the Proposed Action and would be **moderate** adverse with **minor beneficial** impacts. *Cumulative Impacts of Alternative C-1*: In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-1	*Alternative C-2*: BOEM expects that the impacts from Alternative C-2 to recreation and tourism would be similar, but potentially less, to the Proposed Action. All other impacts are anticipated to be similar to those described under the Proposed Action and would be **moderate** adverse with **minor beneficial** impacts. *Cumulative Impacts of Alternative C-2*: In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-2	*Alternative C-3*: BOEM expects that the impacts from Alternative C-3 to recreation and tourism would be similar to the Proposed Action. All other impacts are anticipated to be similar to those described under the Proposed Action and would be **moderate** adverse with **minor beneficial** impacts. *Cumulative Impacts of Alternative C-3*: In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-3 to the cumulative impacts on	*Preferred Alternative C-3b:* Construction, O&M, and decommissioning of Alternative C-3b would have overall **moderate** adverse impacts and **minor beneficial** impacts on recreation and tourism. *Cumulative Impacts of Alternative C-3b*: In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-3b to the cumulative impacts on recreation and tourism would be marginal. BOEM anticipates that the

Resource	No Action	Proposed Action	Alternative C-1	Alternative C-2	Alternative C-3	Preferred Alternative
	BOEM anticipates that the cumulative impacts of the No Action Alternative would likely be **moderate** adverse and **minor beneficial**. The impacts associated with future offshore wind activities in the analysis area, considered with other reasonably foreseeable activities, current activities, and environmental trends, would be negligible to moderate adverse effects if no other offshore wind farms are authorized. Most of the adverse impacts could be avoided with APMs, but some impacts would only be minimized with APMs in place. If other offshore wind farms are authorized, BOEM would anticipate negligible to moderate adverse impacts to recreation and tourism with minor beneficial impacts.	recreation and tourism activities are expected to continue with most impacts being avoided with APMs in place. *Cumulative Impacts of the Proposed Action:* BOEM anticipates that the cumulative impacts on recreation and tourism in the GAA would be **moderate** adverse with **minor beneficial** impacts. In the context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action would be marginal.	to the cumulative impacts on recreation and tourism would be marginal. BOEM anticipates that the cumulative impacts of Alternative C-1 would be **moderate** adverse with **minor beneficial** impacts. This impact rating is driven by ongoing and planned activities as well as short-term and permanent disturbance associated with both onshore and offshore construction, O&M and decommissioning of the Alternative.	to the cumulative impacts on recreation and tourism would be marginal. BOEM anticipates that the cumulative impacts of Alternative C-2 would be **moderate** adverse with **minor beneficial** impacts. This impact rating is driven by ongoing and planned activities as well as short-term and permanent disturbance associated with both onshore and offshore construction, O&M and decommissioning of the Alternative.	recreation and tourism would be marginal. BOEM anticipates that the cumulative impacts of Alternative C-3 would be **moderate** adverse with **minor beneficial** impacts. This impact rating is driven by ongoing and planned activities as well as short-term and permanent disturbance associated with both onshore and offshore construction, O&M and decommissioning of the Alternative.	cumulative impacts of Alternative C-3 would be **moderate** adverse impacts with **minor beneficial** impacts. This impact rating is driven by ongoing and planned activities as well as short-term and permanent disturbance associated with both onshore and offshore construction, O&M and decommissioning of the Alternative.
Scenic and Visual Resources	*No Action Alternative*: The No Action Alternative would result in **moderate** adverse impacts on scenic and visual resources. Ongoing O&M of the Block Island project and construction of the Vineyard Wind 1 project and South Fork project would have impacts on a viewer's experience, as they change the expected environment and contrasts to the previous seascape, landscape, and open ocean environments. *Cumulative Impacts of the No Action Alternative:* The cumulative impacts of the No Action Alternative would result in **major** impacts on visual and scenic resources within the GAA due to the presence of new structures, nighttime lighting, land disturbance, and increased traffic.	*Proposed Action*: Under the Proposed Action, impacts of the Sunrise Wind Project to scenic and visual resources would be **major** adverse. The presence of offshore WTGs and OCS-DC would result in moderate to major adverse impacts to the seascape character and landscape character. Onshore structures would be located either underground or in previously developed areas, which would result in negligible impacts during O&M activities. *Cumulative Impacts of the Proposed Action:* BOEM anticipates that the cumulative impacts on scenic and visual resources in the GAA would be **major** adverse. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a detectable increment to the presence of structures, lighting, traffic, land disturbance, port utilization, and accidental releases. The Proposed Action would contribute to the cumulative impacts through changes in seascape character units, ocean character units, landscape character units, and viewer experience.	*Alternative C-1*: Under Alternative C-1, the seascape character units, ocean character unit, landscape character units, and viewer experience would have similar **major** adverse impacts to those of the Proposed Action. The negligible chances in distance of the WTGs would be unnoticeable to the casual viewer at the distance and impacts to scenic and visual resources would be similar. *Cumulative Impacts of Alternative C-1*: In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-1 to the cumulative impacts on scenic and visual resources would be detectable. However, the differences in impacts among the Proposed Action and Alternative C-1 would be negligible. BOEM anticipates that the cumulative impacts of Alternative C-1 would be **major** adverse.	*Alternative C-2*: Under Alternative C-2, the seascape character units, ocean character unit, landscape character units, and viewer experience would have similar **major** adverse impacts to those of the Proposed Action. The negligible chances in distance of the WTGs would be unnoticeable to the casual viewer at the distance and impacts to scenic and visual resources would be similar. *Cumulative Impacts of Alternative C-2*: In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-2 to the cumulative impacts on scenic and visual resources would be detectable. However, the differences in impacts among the Proposed Action and Alternative C-2 would be negligible. BOEM anticipates that the cumulative impacts of Alternative C-2 would be **major** adverse.	*Alternative C-3*: Under Alternative C-3a, C-3b, and C-3c, the seascape character units, ocean character unit, landscape character units, and viewer experience would have similar **major** adverse impacts to those of the Proposed Action. The negligible changes in distance of the WTGs relocation and reduction of total WTGs installed would be unnoticeable to the casual viewer and impacts to scenic and visual resources would be similar. *Cumulative Impacts of Alternative C-3*: In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-3a, C-3b, and C-3c to the cumulative impacts on scenic and visual resources would be detectable. However, the differences in impacts among the Proposed Action and Alternative C-3a, C-3b, and C-3c would be negligible. BOEM anticipates that the cumulative impacts of Alternative C-3a, C-3b, C-3c would be **major** adverse.	*Preferred Alternative C-3b:* The installation of WTGs and other facilities associated with the SRWF would result in changes to the existing seascape character. The seascape character units, open ocean character unit, landscape character units, and viewer experience would have **major** adverse impacts. *Cumulative Impacts of Alternative C-3b:* In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-3b to the cumulative impacts on scenic and visual resources would be detectable. However, the differences in impacts among the Proposed Action and Alternative C-3b would be negligible. BOEM anticipates that the cumulative impacts of Alternative C-3b would be **major** adverse.

Chapter 3

Affected Environment and Environmental Consequences

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter analyzes the impacts of the Proposed Action and Alternatives by establishing the existing baseline of affected resources; predicting the direct and indirect impacts; and then evaluating those impacts when added to the baseline and considered in the context of the reasonably foreseeable impacts of future planned activities. This chapter thus addresses the affected environment, also known as the existing baseline, for each resource area and the potential environmental consequences to those resources from implementation of the alternatives described in Chapter 2, *Alternatives*. In addition, this section addresses the impact of the alternatives when combined with other past, present, or reasonably foreseeable planned activities, i.e., cumulative impacts, using the methodology and assumptions outlined in Chapter 1, Introduction, and Appendix E (*Planned Activities Scenario*). Appendix E describes other ongoing and planned activities within the GAA for each resource. These actions may be occurring on the same time scale as the proposed Project or could occur later in time but are still reasonably foreseeable.

In accordance with Section 1502.21 of the CEQ regulations implementing NEPA, BOEM identified information that was incomplete or unavailable for the evaluation of reasonably foreseeable impacts analyzed in this chapter. The identification and assessment of incomplete or unavailable information is presented in Appendix F (*Analysis of Incomplete and Unavailable Information*).

Analysis Approach

The No Action Alternative is first analyzed to predict the impacts of the baseline (as described in Section 1.6.1), the status quo. A subsequent analysis is conducted to assess the cumulative impacts to baseline conditions as future planned activities occur (as described in Section 1.6.2). Separate impact conclusions are drawn based on these separate analyses. This Final EIS also conducts separate analyses to evaluate the impacts of the action alternatives when added to the baseline condition of resources (as described in Section 1.6.1) and to evaluate cumulative impacts by analyzing the incremental impacts of the action alternatives when added to both the baseline (as described in Section 1.6.1) and the impacts of future planned activities (as described in Section 1.6.2).

3.1 Impact-Producing Factors

BOEM has completed a study of impact-producing factors (IPF) on the North Atlantic OCS to consider in an offshore wind development planned activities scenario (BOEM 2019). That study is incorporated in this document by reference. The IPF study:

- Identifies cause-and-effect relationships between renewable energy projects and resources potentially affected by such projects.
- Classifies those relationships into IPFs through which renewable energy projects could affect resources.
- Identifies the types of actions and activities to be considered in a cumulative impact scenario.
- Identifies actions and activities that may affect the same physical, biological, economic, or cultural resources as renewable energy projects and states that such actions and activities may have the same IPFs as offshore wind projects.

The BOEM (2019) study identified the relationships between IPFs associated with specific past, present, and reasonably foreseeable future actions in the North Atlantic OCS. BOEM determined the relevance of each IPF to each resource analyzed in this Final EIS. If an IPF was not associated with the proposed Project, it was not included in the analysis. Table 3.1-1 provides a brief description of the primary IPFs considered in this analysis, including examples of sources and activities that result in each IPF. The IPFs cover all phases of the Project, including construction, O&M, and decommissioning. Appendix G (*Impact-Producing Factor Tables*) includes the IPF tables for each resource considered in this Final EIS.

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

Table 3.1-1. Primary Impact-Producing Factors Used in this Analysis

Impact-Producing Factor	Sources and Activities	Description
Accidental Releases	• Mobile sources (e.g., vessels) • Installation and O&M of onshore or offshore stationary sources (e.g., renewable energy structures, transmission lines, cables)	Unanticipated release or spills into receiving waters of a fluid or other substance such as fuel, hazardous materials, suspended sediment, trash, or debris. Accidental releases are distinct from routine discharges, the latter typically consisting of authorized operational effluents controlled through treatment and monitoring systems and permit limitations.
Discharges	• Vessels • Structures • Dredged material ocean disposal • Installation and O&M of submarine transmission lines, cables, and infrastructure	Generally refers to routine permitted operational effluent discharges to receiving waters. There can be numerous types of vessel and structure discharges, such as bilge water, ballast water, deck drainage, gray water, fire suppression system test water, chain locker water, exhaust gas scrubber effluent, condensate, and seawater cooling system effluent, among others. These discharges are generally restricted to uncontaminated or properly treated effluents that may have BMPs or numeric pollutant concentration limitations imposed through United States Environmental Protection Agency NPDES permits or USCG regulations.
Air Emissions	• Internal combustion engines (such as generators) aboard stationary sources or structures • Internal combustion engines within mobile sources such as vessels, vehicles, or aircraft	Release of gaseous or particulate pollutants into the atmosphere. Releases can occur on and offshore.
Anchoring	• Anchoring of vessels • Attachment of a structure to the sea bottom by use of an anchor, mooring, or gravity-based weighted structure	Anchors, anchor chain sweep, mooring, and the installation of bottom-founded structures can alter the seafloor.
Electric And Magnetic Fields	• Substations • Power transmission cables • Inter-array cables • Electricity generation	Power generation facilities and cables produce electric fields (proportional to the voltage) and magnetic fields (proportional to flow of electric current) around the power cables and generators. Three major factors determine levels of the magnetic and induced electric fields from offshore wind energy projects: (1) the amount of electrical current being generated or carried by the cable, (2) the design of the generator or cable, and (3) the distance of organisms from the generator or cable.

Impact-Producing Factor	Sources and Activities	Description
Land Disturbance	• Onshore construction • Onshore land use changes • Erosion and sedimentation • Vegetation clearance	Land disturbances for any onshore construction activities.
Lighting	• Vessels or offshore structures above or under water • Onshore infrastructure	Light presence above the water onshore and offshore as well as underwater associated with offshore wind development and activities that utilize offshore vessels.
Cable Emplacement and Maintenance	• Dredging or trenching • Cable placement • Seabed profile alterations • Sediment deposition and burial • Mattress and rock placement	Disturbances associated with installing new offshore submarine cables on the seafloor, commonly associated with offshore wind energy.
Noise	• Aircraft • Vessels • Turbines • High-resolution geophysical (HRG surveys) and geotechnical surveys (drilling) • O&M • Vibratory and impact pile driving • Dredging and trenching • UXO detonations	Noise from various sources. Commonly associated with construction activities, geophysical and geotechnical surveys, and vessel traffic. May be impulsive (e.g., pile driving) or broad spectrum and continuous (e.g., from Project-associated marine transportation vessels). May be noise generated from turbines themselves or interactions of the turbines with wind and waves.
Port Utilization	• Expansion and construction • Maintenance • Use • Revitalization	Effects associated with port activity, upgrades, or maintenance that occur only because of the Project. Includes activities related to port expansion and construction from increased economic activity and maintenance dredging or dredging to deepen channels for larger vessels.
Presence Of Structures	Onshore and offshores structures including towers and transmission cable infrastructure	Effects associated with onshore or offshore structures other than construction-related effects, including the following: • Space-use conflicts • Fish aggregation/dispersion • Bird attraction/displacement • Marine mammal attraction/displacement • Sea turtle attraction/displacement • Scour protection • Allisions • Entanglement • Gear loss/damage • Fishing effort displacement • Habitat alteration (creation and destruction) • Migration disturbances • Navigation hazard • Seabed alterations • Turbine strikes (birds, bats)

Impact-Producing Factor	Sources and Activities	Description
		• Viewshed (physical, light) • Microclimate and circulation effects Disruption or displacement of scientific surveys and impacts to radar systems (air traffic control, air space surveillance, weather, high-frequency ocean observation radar)
Traffic	• Aircraft • Vessels • Vehicles	Marine and onshore vessel and vehicle congestion, including vessel strikes of sea turtles and marine mammals, collisions, and allisions.
Energy Generation / Security	Wind energy production	Generation of electricity and its provision of reliable energy sources as compared with other energy sources (energy security). Associated with renewable energy development operations.
Climate Change	Emissions of greenhouse gases	Effects of climate change, such as warming and sea level rise, and increased storm severity or frequency. Ocean acidification refers to the effects associated with the decreasing pH of seawater from rising levels of atmospheric carbon dioxide
Gear Utilization	• Bottom trawls, bycatch/benthic disruption • Ghost fishing, entanglement • Midwater trawls, bycatch/overfishing • Dredging	Refers to entanglement and benthic disruptions that may affect biota. Primarily associated with commercial and recreational fishing activities, but also may be associated with marine minerals extraction and military uses.

Source: BOEM 2019

3.2 Mitigation Identified for Analysis in the Environmental Impact Statement

During the development of the Final EIS and in coordination with cooperating agencies, BOEM considered potential additional mitigation measures that could further avoid, minimize, or mitigate impacts on the physical, biological, socioeconomic, and cultural resources assessed in this document. These potential additional mitigation measures are described in Appendix H (*Mitigation and Monitoring*) and analyzed in the relevant resource sections in Chapter 3. BOEM may choose to incorporate one or more of these additional mitigation measures in the Preferred Alternative. In addition, other mitigation measures may be required through completion of consultations, authorizations, and permits with respect to several environmental statutes such as the MMPA, Section 7 of the ESA, or the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Mitigation imposed through consultations are included in this Final EIS. Those additional mitigation measures presented in Appendix H may not all be within BOEM's statutory and regulatory authority to require; however, other jurisdictional governmental agencies may potentially require them. BOEM may choose to incorporate one or more additional measures in the ROD and adopt those measures as conditions of COP approval. As previously discussed, all Sunrise Wind-committed measures are part of the Proposed Action (refer to Section 2.1 for details). If a mitigation measure was analyzed in the impact analysis for the selected alternative and that measure influenced the impact determination for a particular resource, that measure would be included as a term and condition.

3.3 Definition of Impact Levels

This Final EIS uses a four-level classification scheme to characterize potential beneficial and adverse impacts of alternatives, including the Proposed Action. Where directionality (e.g., adverse or beneficial) is not specifically noted, the reader should assume the impact is adverse. Tables in each resource section in Chapter 3 identify adverse and beneficial impact levels definitions for all biological, physical, and socioeconomic resources that the proposed Project and alternatives could potentially affect. In addition, impacts are defined in terms of their duration. Short-term effects are effects that may extend beyond construction, potentially lasting for several months, but not several years or longer. An example would be clearing of onshore shrubland vegetation during construction; the area would be revegetated when construction is complete and, after revegetation is successful, this effect would end. Long-term effects are effects that last for a long period of time (e.g., decades or longer). An example would be the loss of habitat where a foundation was installed. Permanent effects have no expected end. An example would be the conversion of land to support new onshore facilities or the placement of scour protection that is not removed as part of decommissioning.

3.4 Air Quality

Please see Appendix Q, Section 3.4 for the analysis of the Air Quality resource.

3.5 Water Quality

Please see Appendix Q, Section 3.5 for the analysis of the Water Quality resource.

3.6 Bats

Please see Appendix Q, Section 3.6 for the analysis of the Bats resource.

3.7 Benthic Resources

This section discusses potential impacts on benthic resources, other than fishes and commercially important benthic invertebrates, from the proposed Project, alternatives, and future offshore wind activities in the GAA (COP, Appendix D, Figure D-4; DNV GL 2021). The benthic GAA, as described in Appendix D (*Geographical Analysis Areas*), covers the offshore cable alignments including a 330-ft (100-m) buffer, the ICW-HDD area where the cables leave the mainland, and the SRWF Lease Area. For the assessment of future offshore activities, the analysis area was expanded to include an approximately 10-mi (16-km) buffer to allow broader characterization and variation of the surrounding habitat using findings from prior and ongoing studies of benthic environments in the Southern New England region More specific analysis is supported by the site-specific surveys conducted within the SRWF Lease Area. Details of sampling methods and results are provided in COP Appendices M1-M3 (Inspire 2022a, Inspire 2022b, Inspire 2022c). Benthic resources include the sediments, substrate, and living resources on the bottom of a water body, in this instance, the Atlantic Ocean and waters within the Southern New England Region of the Mid-Atlantic Bight. Benthic communities vary depending on the physical habitat characteristics including water depth, substrate properties and composition, level of disturbance, and light availability. Benthic communities may shift in response to biological interactions such as predation, competition, and seasonal species migrations.

3.7.1 Description of the Affected Environment and Future Baseline Conditions

3.7.1.1 SRWEC-OCS

After crossing into federal waters, the SRWEC alignment proceeds approximately 40 mi (64 km) east, then turns to the northeast and continues for another 45 mi (72 km) to the Lease Area boundary (see Figure 1.1-1 in the COP, Sunrise Wind 2023a). This portion of the SRWEC disturbance corridor would cover approximately 1,260 ac (170 km by 30 m); however, benthic surveys covered a much broader buffer (1,082 ft [330 m]) on either side of the proposed corridor to thoroughly characterize the environment.

The affected environment for the proposed cable alignment crosses a transitional zone separating waters off the barrier islands and Long Island Sound from the OCS (BOEM 2013) and is within the Mid-Atlantic oceanic ecoregion, or the Southern New England Region. These waters support a diverse and abundant assemblage of fishes and invertebrates, including many commercially and recreationally important species which are discussed in Section 3.14, Commercial Fisheries and For-Hire Recreational Fishing.

The 2020 surveys identified two distinct regions of the SRWEC-OCS based on sediment composition and benthic community: (1) the western stations extending from the three-mile NYS waters boundary to where the planned cable corridor turns northeastward, and (2) the eastern portion including the remaining stations along the SRWEC-OCS extending to the SRWF (COP, Appendix M1; Inspire 2022a). Sediments transition from medium sand and fine sand (CMECS Substrate Subgroups) with ripples in the western portion to very fine sand with limited small-scale bedforms along the eastern portion of the SRWEC-OCS. The biological components of the benthic environment along the SRWEC-OCS follow a similar pattern. Generally, the western portion of the SRWEC-OCS had high densities of sand dollars while the eastern portion of the SRWEC-OCS was inhabited by burrowing anemones (*cerianthids*) and sea stars. This corroborates previous reports that observed high occurrences of sand dollars and sand ripples in this general area (e.g., NYSERDA 2017). Gravel was uncommon in sediments along the SRWEC-OCS, and no boulder fields were observed at any of the stations along the SRWEC-OCS. In soft-bottom habitats, one cluster of scattered boulders was mapped east of the corridor bend and dispersed scattered boulders were observed along the entire corridor east of the bend; west of the corridor bend, scattered boulders were rarely observed. At the two stations that did have gravel present, the macrohabitat types were identified as sand with pebbles/granules, the maximum gravel size was pebble/granule, and there was no observed attached epifaunal growth. Water depths ranged from 15 to 88 ft (5 to 27 m) with shallower areas nearer to shore.

3.7.1.2 Regional Setting

The Lease Area is located offshore of the Northwestern Atlantic OCS within the Southern New England Region; a portion is within the southern part of the Rhode Island and Massachusetts WEAs and the remainder is located within the western portion of the Massachusetts WEA. Surveys have determined that Cox Ledge, an area noted for its benthic habitat complexity, is approximately 3.1 to 6.2 mi (5 to 10 km) north of Priority Area 1, which is the area closest to the ledge terminus (Figure 2.1-5). The SRWEC is planned to extend westward from the southern part of the Lease Area through the New York Bight (NYB) to Fire Island, New York (see Figure 1.1-1 of the COP; Sunrise Wind 2023a). In 1968, the United States obtained an easement from New York for the "use and occupation by the United States of America for the purposes of Fire Island National Seashore of lands now or formerly under the waters of the Atlantic Ocean in the Towns of Islip and Brookhaven.” The NPS administers these lands extending 1,000 ft (304.8 m) southerly into the Atlantic Ocean as part of Fire Island National Seashore. The SRWEC would then cross the ICW to connect with the onshore facilities.

The SRWF and the SRWEC would cross waters that transition from the continental slope and coastal areas near Long Island extending out onto the OCS. The benthic assessments confirmed the presence of this region’s characteristic mobile sandy substrate and associated benthic communities that are adapted to survive in dynamic ocean conditions (COP, Appendices M1 [Inspire 2022a], M2 [Inspire 2022b], and M3 [Inspire 2022c]). Although there are likely shifts in benthic community assemblages and particular taxa abundances from year to year and seasonally, the benthic habitat and ecological functioning of the benthic community is generally stable in the marine portions of the Project Area. Specific sensitive taxa in the region, including soft corals, are generally long-lived and sessile. As such, their distributions and presence are not strongly influenced by seasonality (Sunrise Wind 2023a).

Benthic communities provide important ecosystem functions related to trophic (food web) processes as well as contributing to habitat complexity in the generally homogeneous sandy/soft substrate typical of the region. The species that inhabit the benthic habitats of the OCS include infaunal species, those living in the sediments (e.g., polychaetes, amphipods, mollusks), and epifaunal species, those living on the seafloor surface (mobile; e.g., sea stars, sand dollars, sand shrimp) or attached to substrates (sessile; e.g., barnacles, anemones, tunicates). In addition to trophic links and biogenic structure, benthic species can also serve important roles in facilitating nutrient and carbon cycling in the sediments through functions such as water filtration, biodeposition, bioirrigation, and bioturbation. A summary of these species, likelihood of presence, and the potential time of year that they could be present in the region is included in Table 5.2-3 of the COP, Appendix M-1 (Inspire 2022a).

Site-specific benthic habitat assessments were conducted in the spring (SRWF and SRWEC-OCS) and summer 2020 (SRWEC-NYS) (COP, Appendix M1 [Inspire 2022a] and M2 [Inspire 2022b]), using a combined SPI/PV system. The data generated from these SPI/PV surveys met BOEM Benthic Habitat Survey Guidelines (BOEM 2019) to characterize surface sediments; delineate and characterize hard bottom areas; identify and confirm benthic flora and fauna, including sessile and slow-moving invertebrates; identify sensitive habitats; establish pre-construction baseline benthic conditions against which post-construction habitats can be compared; and determine the suitability of sampled reference areas to serve as controls for future monitoring and assessment. Backscatter data were derived from multibeam echo sounding and processed to a resolution of 25 cm. These data are based on the strength of the acoustic return to the instrument so that softer, fine-grained sediments absorb more of the acoustic signal and a weaker signal is returned to the device, providing information on seafloor sediment composition and texture. A combination of backscatter over hill-shaded bathymetry and side-scan sonar data were used to detect large- and small-scale bedforms, such as megaripples and ripples, mapped for SRWF in Figure 3.7-1 and for SRWEC-OCS and SRWEC-NYS waters in Figure 3.7-2. Boulders present in the Lease Area and along the SRWEC corridor are depicted in Figure 3.7-3.

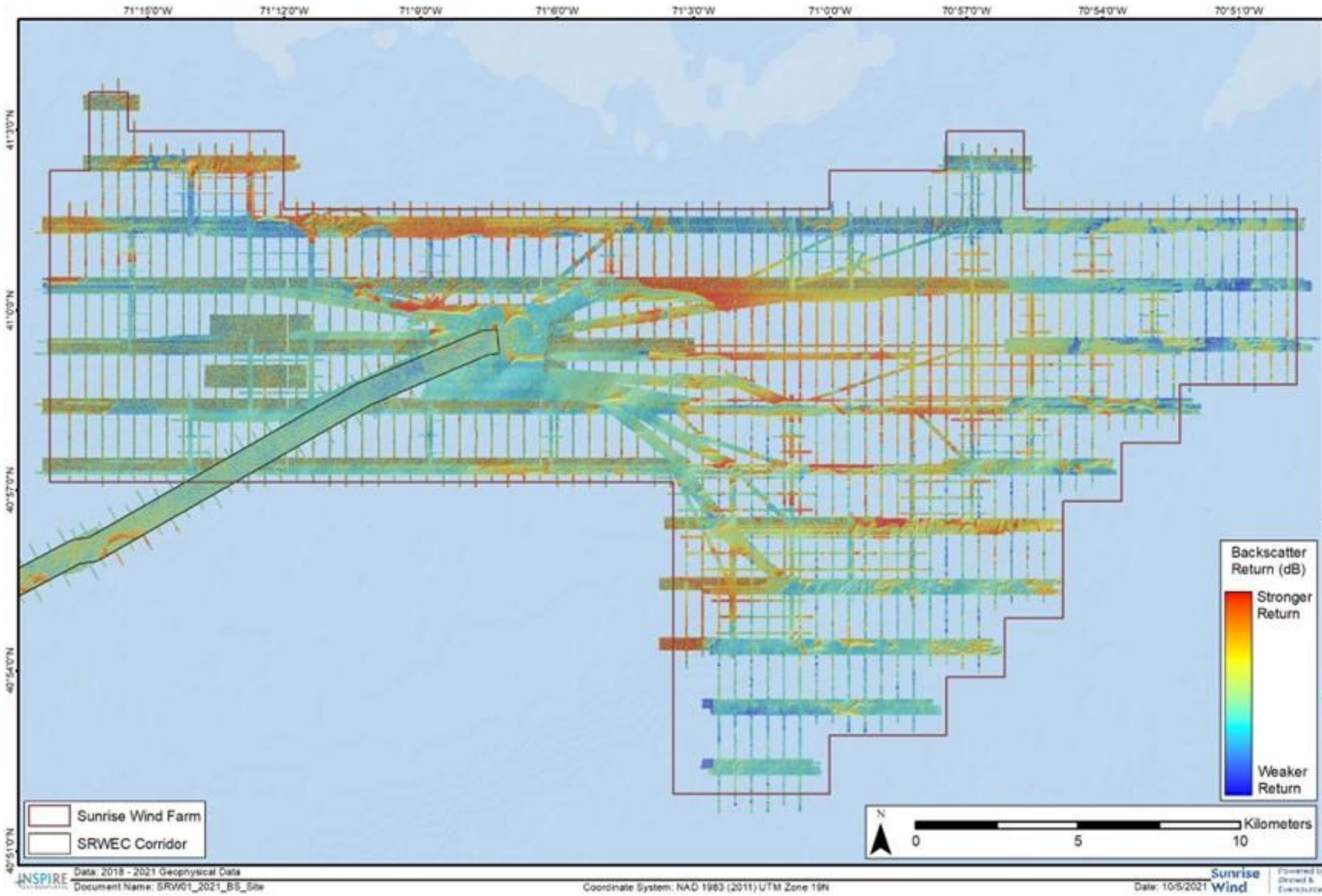

Figure 3.7-1. **Backscatter Data Over Hill-shaded Bathymetry at the SRWF and SRWEC-OCS**

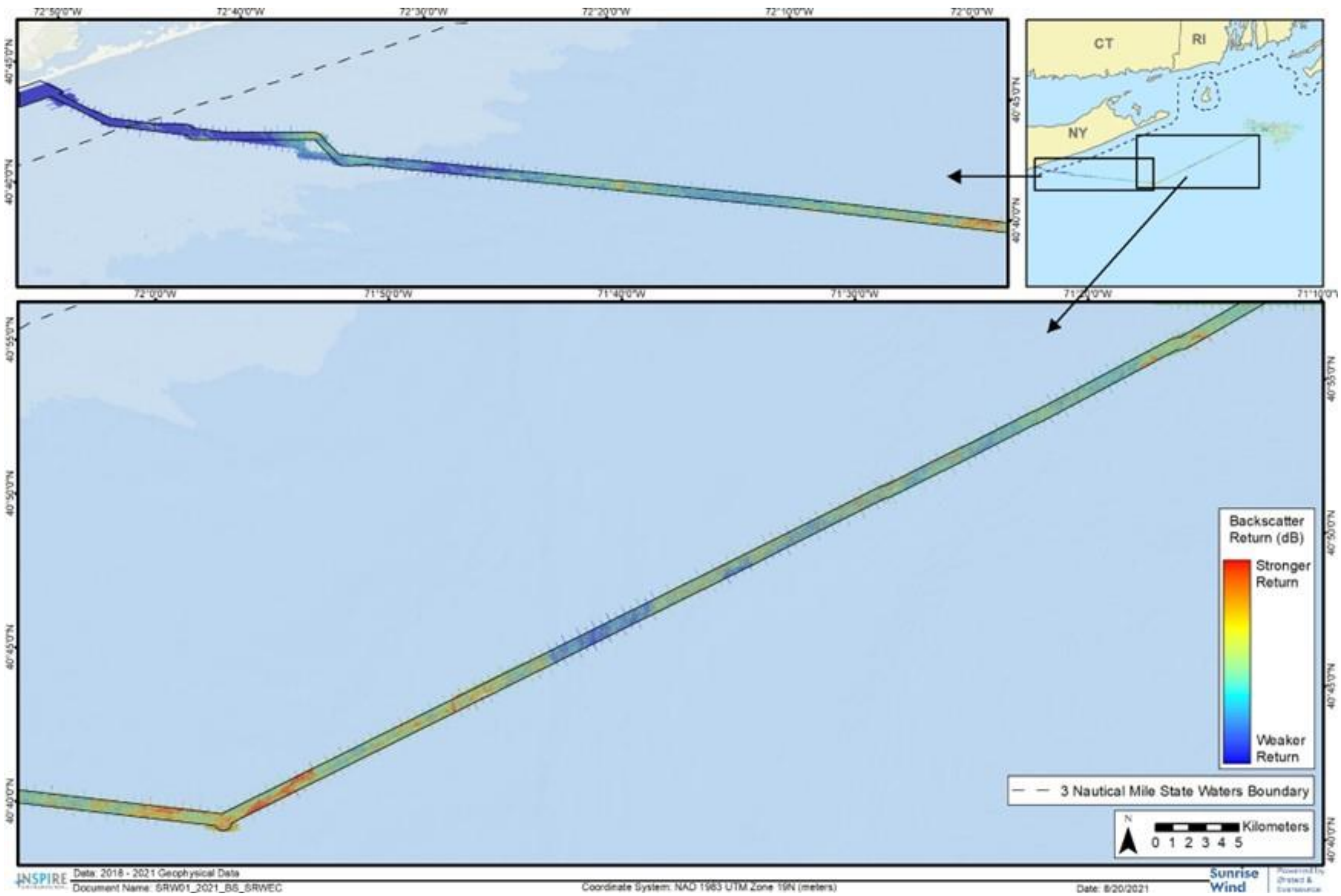

Figure 3.7-2. Backscatter Data Over Hill-shaded Bathymetry at the SRWEC-OCS and SRWEC-NYS

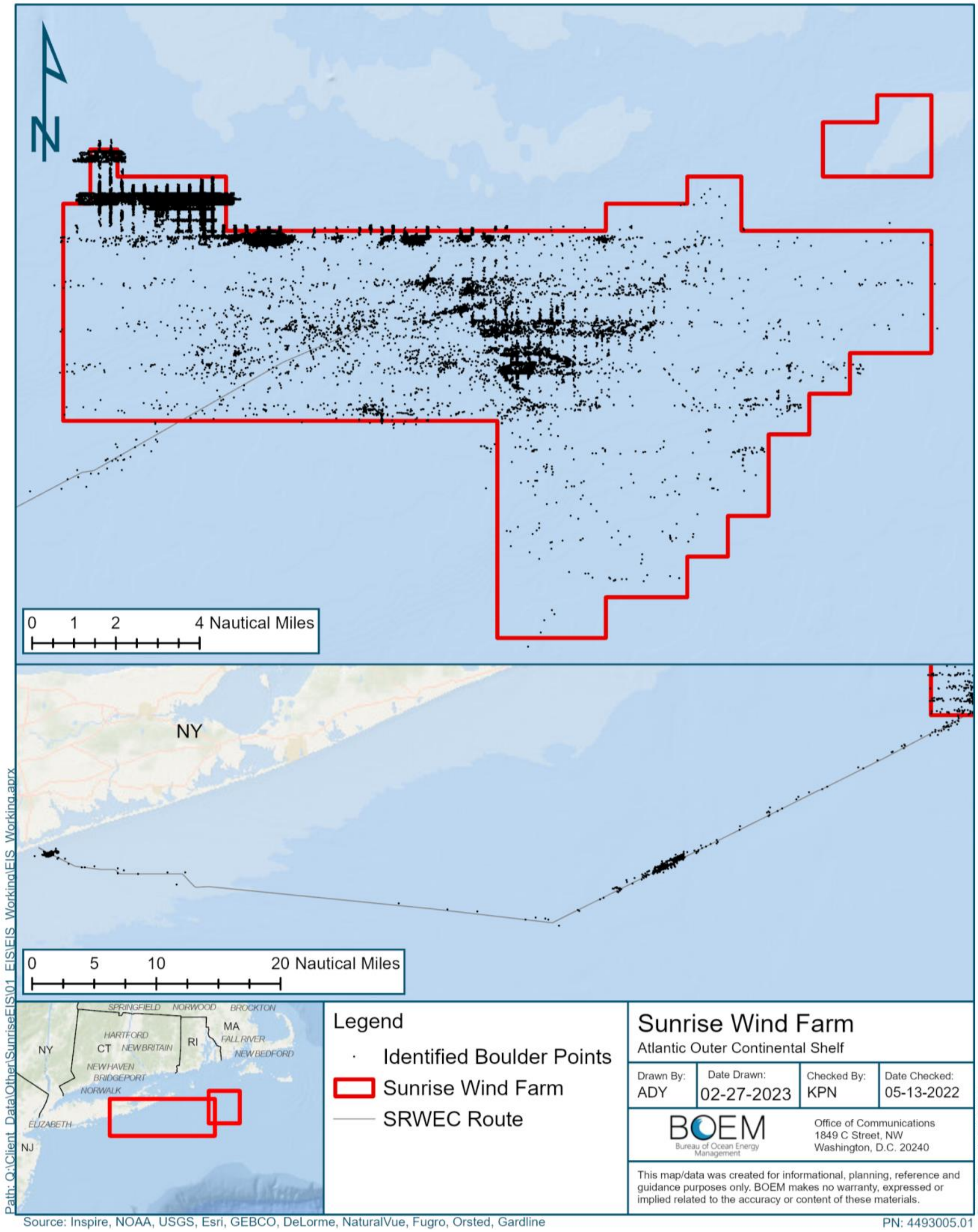

Figure 3.7-3. Boulders Present in the SRWF Lease Area and SRWEC Corridor

There are five benthic resource assessment areas for the Sunrise Wind Project: (1) the SRWEC alignment within NYS waters (SRWEC-NYS); (2) the SRWEC alignment on the OCS; (3) the ICW-HDD area; (4) the ICW temporary equipment area; and (5) the SRWF. The Benthic Habitat Study Area is inclusive of the areas Sunrise Wind surveyed for siting the SRWF in the Lease Area, a 330 ft (100 m buffer on either side of the SRWEC–OCS and the SRWEC–NYS, and the area encompassed by the ICW HDD. The SRWEC–OCS and SRWEC–NYS Study Areas are corridors that were surveyed to support siting of the export cable bundle (COP, Appendix M-3; Inspire 2022c). Benthic resources vary among these five areas and will be discussed separately. Sediment grain size distribution is an important factor of benthic habitats and influences benthic community distributions and can be used to infer benthic taxa that are likely present in a particular environment. Linking the physical substrate characteristics with the biological functional and taxonomic composition is accomplished using the Coastal and Marine Ecological Classification Standard (CMECS) (FGDC 2012), as recommended by BOEM (BOEM 2019). CMECS provides a standard means to categorize the physical (substrate) and biological (biotic) components of environments.

A total of 408 stations were surveyed, which included 252 stations at the SRWF, 107 stations along the OCS section of the export cable (SRWEC– OCS), 35 stations in the NYS section of the export cable (SRWEC-NYS), and eights stations along the path of the ICW-HDD. Additionally, 20 stations were surveyed across four reference areas to serve as a comparison. Samples were collected at intervals of 1,000 ft (304.8 m). Four reference areas were sampled and characterized to provide a baseline for post-construction monitoring (COP, Appendix M1; Inspire 2022a). In general, the physical and biological features characterizing the four reference areas were similar to the nearby stations at the SRWF and SRWEC-OCS. This indicates that these potential reference areas are likely suitable for comparison after cable installation and wind farm construction.

3.7.1.3 Surficial Sediments and Geomorphology

Spatial trends in sediment composition were found in the SRWF area. The northwest region had a higher frequency of gravels; the southeast and west-central regions were characterized by finer substrata and limited small-scale sediment mobility; and the northeast region was generally composed of fine to coarse sand with sand ripples common. Boulders were infrequently observed at the SRWF but did occur in the northwest region, with the exception of an area located along the southern border at approximate longitude of 71.1 degrees west.

Surficial sediments were mapped for a portion of SRWF and along the route of the SRWEC in the OCS and New York state waters based on both acoustic and SPI/PV ground-truthing surveys (COP, Appendices M1 [Inspire 2022a], M2 [Inspire 2022b], and M3 [Inspire 2022c]). The sea bottom sediments in the SRWF and the SWREC generally consist of a mix of sand and muddy sand coastal plain sediments, with coarser, glacially deposited sands and gravels in the northwestern portion of the SRWF and locally elsewhere. The northwest portion of the SRWF was the only area where gravel was observed consistently across stations. Gravel in this area ranged in size from “washed” pebbles and granules to patchy cobbles and boulders on sand, which were encrusted by epifauna (e.g., bryozoa and hydroids). Patches of mixed sediments also occur, as well as occasional lenses of muddy sediments.

Within the ICW-HDD, surficial sediments generally consist of Holocene gravels and fine sands, muddy sands, and sandy muds. Surficial sediments on the inner Continental Shelf within the SRWEC-NYS alignment primarily consist of Holocene-era fine to medium quartz beach, dune sands, and finer-grained sediments (Williams 1976). These sediments are generally 6 to 16 ft (2 to 5 m) thick but can be up to 33 ft (10 m) thick in the vicinity of ebb-tide shoals or large, linear, obliquely shore-attached sand ridges (Bokuniewicz et al. 2011; Schwab et al. 2000). Also present in some areas of the SRWEC-NYS alignment, and more commonly in the nearshore areas within the Fire Island National Seashore boundary, are coarse sand and gravel glacial outwash deposits of Pleistocene age (Williams 1976)(Figure 3-19, COP, Appendix M3; Inspire 2022c). Medium-density boulder fields identified in the nearshore area of SRWEC-NYS as part of benthic mapping are likely associated with Pleistocene-era glacial outwash or moraine deposits (COP, Appendix M3; Inspire 2022c). The majority of the SRWEC-NYS both within the Fire Island boundary and extending along the alignment was composed of sand and muddy sand.

Surficial sediments on the outer shelf within the SRWEC-OCS alignment generally consist of Holocene or Pleistocene fine to medium quartz marine sands, interbedded with lenses of silt and clay (Williams 1976). These sediments are typically 33 to 98 ft (10 to 30 m) thick, and possibly as thick as 295 to 328 ft (90 to 100 m) where deposits have filled an intricate paleochannel system cut into the Upper Pleistocene surface formed during the last marine transgression (Bokuniewicz et al. 2011; Schwab et al. 2000; Williams 1976).

Within the SRWF, surficial sediments include both Holocene or Pleistocene fine to medium quartz marine sands and muddy sands, interbedded with lenses of silt and clay, and coarser glacially deposited sands and gravels. The SRWF is in adjacent to the terminal moraine associated with the maximum extent of the Laurentide continental ice sheet (Fugro 2021) where it lies atop the open Continental Shelf. The SRWF and the SRWEC-OCS are located immediately south of submerged end moraines, in what was an extensive glacial outwash plain. Glacial moraine habitats were not observed within the Study Area (COP, Appendix M3; Inspire 2022c). The sediments associated with the glacial influenced areas in the northern and western parts of the SRWF include Pleistocene sand and gravel fluvioglacial outwash deposits and reworked sand, gravel, and silt sediments from glacial processes. Boulder deposits present in the SRWF are part of moraine deposits, glacial outwash, or glacial erratics transported by glacial ice rafts. Benthic sediment mapping classified areas as stratified and sorted glacial drift based on morphological interpretation of an irregular seafloor (COP, Appendix M3; Inspire 2022c).

Seabed slopes are generally very low, with an average gradient of less than 0.1 degrees (0.15 percent). Within glacially deposited boulder fields, rugosity can be high, with seabed gradients locally exceeding 5 degrees. Sediment bedforms develop in finer-grained sediments as a response to hydrodynamic conditions induced by currents and wave action. Sediment bedforms identified in inner and outer shelf sandy sediments include ripples (less than 1.6 ft [0.5 m] in height), mega ripples (1.6 to 5 ft [0.5 to 1.5 m] in height), and occasionally sand waves (more than 5 ft [1.5 m] in height). In some areas, sandy sediments are without notable bedforms, indicating lower-energy sand deposition areas. Generally, softer silt/clay sediments within the SRWF and the SWREC lack surficial bedforms, indicating low energy depositional environments.

3.7.1.4 General Area Characteristics

Seven benthic macrohabitat types were documented during the site-specific SPI/PV survey as characterized from the comprehensive SPI/PV analyses of selected physical and biological attributes: (1) sand and mud, (2) sand, (3) sand and mud with ripples, (4) sand with ripples, (5) sand with mobile gravel, (6) patchy cobbles and boulders on sand, and (7) cobbles and boulders on sand. The dominant CMECS substrate group across all areas surveyed was sand or finer, and small, dispersed areas of gravels were also encountered. Dominant substrate subgroups present in order of prevalence included very fine sand, fine sand, medium sand. There were some dispersed areas of gravels and a few cobbles and very infrequent boulders, although some area surveys encountered no boulders (e.g., SWREC-OCS). The CMECS biotic setting for all areas surveyed was benthic/attached biota and the biotic class was faunal bed. Although the biotic subclass is not directly based on sediment grain size distributions, it reflects them at the scale of relevance to the dominant fauna present, thus serving as an integrator of physical and biological characteristics of the seafloor. CMECS expressly states that "substrate type is such a defining aspect of the faunal bed class that CMECS Faunal Bed subclasses are assigned as physical-biological associations involving both biota and substrate" (FGDC 2012). Biotic subclass varied somewhat among the benthic resource assessment areas, but soft sediment fauna generally dominated the stations surveyed with occurrences of attached fauna (where hard substate components were present) and inferred fauna. Specific fauna and spatial trends observed are described below for each assessment area.

Table 3.7-1 summarizes results relevant to the discussion of the benthic habitat surveys conducted by INSPIRE Environmental in 2020 at the four assessment areas.

3.7.1.5 ICW-HDD

A portion of the onshore transmission cable would cross the Long Island ICW where it opens into Bellport Bay near the William Floyd Parkway Bridge (Figure 3.3.3-3 in the COP, Sunrise Wind 2023a). An HDD would be used to place the cable to avoid impacts to coastal resources. This assessment area is in a narrow section of the ICW connecting Narrow Bay with Bellport Bay. The ICW is maintained for vessel traffic and dredging to maintain the 6 ft (2 m) depth and dredge material redistribution does occur on a regular basis. In 2012, dredged materials were used to repair a barrier island breach caused by Hurricane Sandy near Smith Point County Park, the proposed landfall site for the SRWEC (USACE 2022).

The eight stations along the alignment were classified by the CMECS Biotic Subclass as either soft sediment fauna or attached fauna. The north side of the channel had a thick carpet of polychaete tubes across the sediment–water interface. The two stations on the south side of the channel were characterized by sand ripples with some biotic tracks. The two central station had small gravels encrusted with bryozoa (moss animals) over muddy sand. Tufts of floating macroalgae were noted in multiple PV replicates collected from the ICW HDD. SAV beds including some eel grass (*Zostera marina)* were found off the south shore of the channel.

3.7.1.6 SRWEC-NYS Alignment

The first 6.2 mi (10 km)-long segment of the SRWEC alignment would be developed in NYS waters off the coast of Long Island, New York. The alignment begins at Smith Point County Park and proceeds east to the boundary of NYS waters approximately 3 nm (3.45 mi; 5.56 km) offshore. This portion of the SRWEC disturbance corridor would cover approximately 74.1 ac (0.3 square kilometers [km^2]); however, benthic survey stations covered a much broader buffer (1,083 ft [330 m]) on either side of the proposed corridor to thoroughly characterize the environment.

All 35 stations surveyed along the SWEC-NYS alignment, including the two stations nearest, but outside of, the Fire Island National Seashore easement, consisted of soft sediments ranging from very fine sand to medium sand with visual evidence of generally low organic matter content, although there was evidence of the presence of benthic microalgae at many of the stations (COP, Appendix M2; Inspire 2022b). The sediment grab samples were all primarily sand with minor fractions of silt/clay and gravel. The macrohabitat characteristics indicated greater bedload transport nearer to shore with more distinct ripples in the sand as well as greater suspended material which contributed to higher turbidity. This trend indicates decreasing wave action effects proceeding from shallower waters out into deeper areas. Water depths ranged from 15 to 88 ft (5 to 27 m) with shallower areas nearer to shore. Approximately 80 percent of the habitats mapped in SRWEC–NYS were categorized as soft bottom and the remaining 20 percent were categorized as complex (COP, Appendix M2; Inspire 2022b). Most of the habitats crosswalked to complex (see Section 3.7.5.2.1), as well as boulder fields and scattered boulders, were mapped in one discrete area interspersed with soft bottom habitats approximately 1.24 mi (2.0 km) offshore where the SRWEC–NYS Study Area widens nearshore, but beyond the Fire Island National Seashore boundary (COP, Appendix M3; Inspire 2022c).

Hermit crabs (*Coenobitidae*), sand dollars (*Echinarachnius parma*), burrowing anemones (*cerianthids*) and tube-building polychaetes (*Diopatra* sp.) were commonly observed in the SPI and PV images across SRWES-NYS stations. Sediment grab analysis revealed the infaunal community was generally dominated by two polychaetes (*Polygordius* sp. and *Mediomastus* sp.), with high occurrences of the amphipod, *Protohaustorius wigleyi*, at the nearshore stations.

Table 3.7-1. Select Physical and Biotic Characteristics of Benthic Habitats Summarized by Proposed Project Component Areas

Area	No. of Samples	Water Depth ft (m)			Dominant Substrate[1]		Biotic Subclass[1]	Common Taxa Observed (n = # Stations)
		Minimum	Maximum	Average	Group	Subgroups		
ICW-HDD	8	NR	NR	NR	Sand or finer and gravel	Sandy gravel	Soft sediment fauna; attached fauna	None (n=8)
SRWEC-NYS	35	15 (4.6)	88 (26.8)	57.1 (17.4)	Sand or finer	Very fine sand, fine sand	Soft sediment fauna	Dioptera (n=7) Cerianthid (n=10) Sand Dollar (n=21)
SRWEC-OCS	107	89.9 (27.4)	224.1 (68.3)	161.7 (42.3)	Sand or finer, gravel/gravel mixes	Very fine sand, fine sand	Soft sediment fauna; attached fauna	Dioptera (n=2) Cerianthid (n=10) Sand Dollar (n=42)
SRWF	252	128 (39.0)	259.1 (79.0)	161.7 (49.3)	Sand or finer, gravel/gravel mixes	Very fine sand, fine sand	Soft sediment fauna; attached fauna	Sabelid (n=4) Cerianthid (n=10) Sand Dollar (n=11)

Sources: COP, Appendices M1 (Inspire 2022a),M2 (Inspire 2022b), and M3 (Inspire 2022c).

[1] CMECS classifications (FGDC 2012).

Notes: NR = not recorded; ICW-HDD = Intracoastal Waterway horizontal direct drilling; SRWEC-NYS = Sunrise Wind Export Cable in New York State waters; SRWEC-OCS = Sunrise Wind Export Cable in Outer Continental Shelf waters; SRWF = Sunrise Wind Farm

3.7.1.7 SRWF Lease Area

The SRWF portion of the Project would be developed on the OCS, approximately 26.5 nm (30.5 mi [48.1 km]) east of Montauk, New York. The Lease Area comprises approximately 86,769 ac (351 km^2).

Sediments were overwhelmingly from CMECS Substrate Group Sand or Finer in 252 samples taken in the SRWF. The presence or absence of bedforms in the PV images provides a snapshot in time of the small-scale sediment mobility in a given area. In the deeper regions of the SRWF, small-scale sediment mobility was generally low, as assessed through the general lack of bedforms observed; however, some spatial trends in sediment composition were observed: the northwest region had more stations with gravels; the southeast and west-central regions were characterized by finer substrata and limited small-scale sediment mobility; the northeast region was generally composed of fine to coarse sand with sand ripples common. These regions are delineated in COP, Appendix M1, Figure 3.1-1 (Inspire 2022a). Boulders were infrequently observed within the SRWF and only in the northwest region of the sample area. The presence of coarser habitat components and some hard substrates (gravels and boulders) that serve as potential attachment for epifauna places the northwest region of the Lease Area in a higher complexity habitat class (see Figures 3.1-2, 3.1-3, and 3.1-5 in the COP, Appendix M1; Inspire 2022a).

The biological attributes of the SRWF followed spatial trends corresponding with the physical features. Stations in the southeast region of the SRWF, which were predominantly very fine sand (CMECS Substrate Subgroup) and sand and mud (macrohabitat type), had high occurrences of burrowing anemones (*cerianthids*) and sabellid worms. Stations in the northeast region of the SRWF, which were predominantly medium sand or fine sand (CMECS Substrate Subgroup) and sand with ripples (macrohabitat type), had high occurrences of sand dollars. The northwest region of the SRWF, which was more heterogenous in seabed composition but included higher frequency of gravelly sand and sandy gravel (CMECS Substrate Subgroups) compared to the rest of the SRWF and was generally more complex in macrohabitat types (e.g., sand with mobile gravel, patchy cobbles and boulders on sand), was inhabited by attached epifauna (e.g., hydroids [*Tubularia* spp.], sea stars, and bryozoa).

All of the evaluated GAAs overlap Cox Ledge, an area of concern for fishery managers because it provides important habitat for several commercially and recreationally important species—notably, spawning habitat for Atlantic cod (*Gadus morhua*). A portion of Cox Ledge was designated by the New England Fishery Management Council (NEFMC) as a habitat management area to protect Essential Fish Habitat (EFH) for a number of managed fish species. NOAA acknowledged the importance of Cox Ledge but disapproved the designation because they concluded the proposed gear restrictions approved by the NEFMC would likely be ineffective at minimizing impacts on habitat function (NEFMC 2018; NOAA 2017). BOEM is currently funding a 3-year study (AT-19-08) examining movement patterns of Atlantic cod, black sea bass (*Centropristis striata*), and other species in the southern New England region, including the SRWF Lease Area. The study is being conducted by NMFS and a team comprising a state resource agency, a university, and a nonprofit organization (BOEM 2019). Given the level of concern raised about potential impacts on Cox Ledge and Atlantic cod, the discussion of potential effects presented in the following sections places emphasis on this and other species of particular concern.

3.7.1.8 Sensitive Taxa and Species of Concern

Sensitive seafloor habitats in the Mid-Atlantic ecoregion include corals, SAV beds, and valuable cobble and boulder habitat (BOEM 2019). Cobble and boulder habitat can serve as structure for hard and soft corals, nursery ground for juvenile lobster, and as preferable benthic habitat for squid to deposit their eggs. Taxa considered sensitive for this region include corals, seagrass beds, squid eggs, and American lobster (*Homarus americanus*).

In the SRWEC-NYS area, species of ecological concern and/or concern regarding possible habitat disturbance from offshore wind construction and operation activities include black sea bass (*Centropristis striata*), Atlantic cod, sea scallop (*Placopecten magellanicus*), and ocean quahog (*Arctica islandica*) (Guida et al. 2017).

The benthic surveys did not identify any sensitive taxa, species of special concern, or non-native taxa at any of the stations along the SWEC-NYS or the ICW-HDD. The estuarine environment of the ICW HDD was surveyed to determine if eelgrass was present. Eelgrass was not found during the 2020 benthic survey conducted at eight stations in the ICW or during the SAV-focused surveys conducted in Summer 2020 and Fall 2022 with towed video. SAV was mapped along the south shore of the ICW by the New York Department of State's 2018 LISS Estuary Habitat survey. The presence of seagrass beds, such as those observed along the south shore of the channel in 2018, are considered sensitive and ecologically important benthic habitat. SAV bed distribution frequently changes from year to year, particularly when large beds are not established, and water quality and clarity are highly variable. Pre-construction surveys for SAV are included in the mitigation and monitoring plan (Appendix H).

In the SRWF area, one sensitive taxon was identified. Northern star coral, *Astrangia poculata*, a nonreef-building hard coral, occurred at five stations within the SRWF (Stations 003, 085, 227, 702, and 721) (COP, Appendix M1, Inspire 2022a). Two species of special concern, a sea scallop, *Placopecten magellanicus*, and bivalve siphons indicative of ocean quahog were documented in the SRWF area. The sea scallops observed were isolated individuals at seven of the 252 stations, no scallop beds or high-density areas were observed. The bivalve siphons were observed at one station (Station 130).

3.7.2 Impact Level Definitions for Benthic Resources

This Final EIS uses a four-level classification scheme to analyze potential impact levels on benthic resources from the alternatives, including the Proposed Action. Table 3.7-2 lists the definitions for both the potential adverse impact levels and potential beneficial impact levels for benthic resources. Table G-6 in Appendix G (*Impact-Producing Factor Tables*) identifies potential IPFs, issues, and indicators to assess impacts to benthic resources. Impacts are categorized as beneficial or adverse and may be short-term or long-term in duration. Short-term impacts may occur over a period of a year or less. Long-term impacts may occur throughout the duration of a Project or persist after decommissioning. The concept of recoverable impacts evaluates the intensity and duration of a potential effect in the context of the response (of an individual or a habitat) to experiencing an impact. A recoverable impact is one where an injury or displacement may occur, but the individual or habitat is likely to recover without lingering adverse effects. A non-recoverable impact may injure an individual to the extent where the individual retains long-term impairment or mortality results. However, recoverable impacts may reduce individual fitness and/ or expose the individual to increased risk of predation (Popper et al. 2014).

Table 3.7-2. Definition of Potential Adverse and Beneficial Impact Levels for Benthic Resources

Impact Level	Definition of Potential Adverse Impact Levels	Definition of Potential Beneficial Impact Levels
Negligible	Impacts on benthic resources (species or habitat) would be adverse but so small as to be undetectable or barely measurable, with no consequences to individuals or populations.	Impacts on species or habitat would be beneficial, but so small as to be unmeasurable.
Minor	Most adverse impacts on species would be avoided. Adverse impacts on sensitive habitats would be avoided; adverse impacts that do occur would be temporary or short term in nature.	If beneficial impacts occur, they may result in a benefit to some individuals and would be temporary to short term in nature.
Moderate	Adverse impacts on species would be unavoidable but would not result in population-level effects. Adverse impacts on habitat may be short term, long term, or permanent and may include impacts on sensitive habitats but would not result in population-level effects on species that rely on them.	Beneficial impacts on species would not result in population-level effects. Beneficial impacts on habitat may be short term, long term, or permanent but would not result in population-level benefits to species that rely on them.
Major	Adverse impacts would affect the viability of the population and would not be fully recoverable. Adverse impacts on habitats would result in population-level impacts on species that rely on them.	Beneficial impacts would promote the viability of the affected population or increase population resiliency. Beneficial impacts on habitats would result in population-level benefits to species that rely on them.

3.7.3 Impacts of Alternative A - No Action on Benthic Resources

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

3.7.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for benthic resources described in Section 3.7, Affected Environment 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 GAA that contribute to impacts on benthic resources are generally associated with inshore dredging, coastal development, offshore construction including bottom disturbance and habitat conversion, and climate change. Impacts associated with climate change have the potential to alter species distributions and increase individual mortality and disease occurrence. Ongoing offshore wind activities within the GAA (a 330-ft [100-m] buffer along the cable routes and a 10-mi [16-km] radius centered on the SRWF Lease Area) that contribute to impacts on benthic resources include:

- Ongoing construction of the South Fork project (12 WTGs and 1 OSS) in OCS-A

The South Fork project would affect benthic resources through the primary IPFs of noise, presence of structures, electromagnetic fields (EMFs), and seafloor disturbance. Ongoing offshore wind activities would have the same type of impacts from noise, presence of structures, EMF, and seafloor disturbance that are described in detail in the following section for planned and ongoing offshore wind activities, but the impacts would be of lower intensity.

3.7.3.2 Cumulative Impacts of the No Action Alternative

At the time of this Final EIS, there are several offshore wind projects in various stages of permitting and development. As such, the following is a general description of potential impacts due to offshore wind and other ongoing actions in the analysis area; however, it is impossible to predict with certainty which projects would be in process, under construction, or operating in the near future. Therefore, this impact analysis makes assumptions about the magnitude and extent of potential impacts based on currently licensed offshore wind projects and those under consideration as well as other ongoing activities in the impacts assessment area.

Seafloor disturbance: Based on projects currently under evaluation or development, up to 1,284 ac (519 ha) could be affected by anchoring or mooring activities during offshore wind energy development within the benthic resources GAA. This offshore energy facility construction would involve direct disturbance of the seabed, leading to direct impacts on benthic, finfish, and invertebrate resources or degradation of sensitive habitats, including EFH. In general, however, these effects would be localized to the disturbance footprint and vicinity. The severity of these effects would vary depending on the species and life stage sensitivity to specific stressors that extend into the area, resulting in minor to moderate adverse impacts on benthic resources. Such impacts are expected to be localized and short-term but could be long-term if they occur in eelgrass beds or hard-bottom habitats.

Future activities would disturb more than 3,037 ac (1229 ha) of seabed from IAC installation within the benthic GAA, resulting in the long-term alteration of benthic habitat. The specific type and extent of habitat conversion and the resulting effects on benthic habitats, EFH, invertebrates, and finfish would vary depending on the Project design and site-specific conditions. The widespread development of offshore renewable energy facilities would, however, create a distributed network of artificial reefs on the Mid-Atlantic OCS. These reefs form biological hotspots that could support species range shifts and expansions, non-native species, and changes in biological community structure (Degraer et al. 2019;

Methratta and Dardick 2019; Raoux et al. 2017). Those changes could influence fish and invertebrate community structure in the future, but the likelihood, nature, and significance of these potential changes are difficult to predict and a topic of ongoing research.

Presence of structures: The future addition of new WTG and OCS-DC foundations in the EFH, finfish, and invertebrate GAA, as well as foundations within the benthic GAA could result in artificial reef effects that influence benthic habitat and fish and invertebrate community structure within and in proximity to the Project footprints. This could in turn influence the abundance and distribution of EFH species. While reef effects would largely be limited to the areas within and or close to wind farm footprints, the development of individual or contiguous wind energy facilities in nearby areas could produce cumulative effects that would be permanent and minorly beneficial for some species from habitat conversion and have minor adverse effects due to permanent habitat loss for soft-bottom specialized benthic species. New structures, and the associated attached benthic communities that would develop, would attract structure-oriented fishes as long as the structures remain. Abundance of certain fishes may increase with short-term to permanent moderate impacts. Studies from The Block Island wind farm reported an increase of mussel beds, tunicates, and the indigenous corals. This was followed by an increase of multiple abundant predators associated with the mussel communities included moon snails, crabs, and sea stars (Hutchison et al. 2020a). The Block Island Wind Farm is relatively near SRWF so similar changes and patterns are expected.

Hydrodynamic disturbance resulting from the broadscale development of large offshore wind farms is a topic of emerging concern because of potential effects on the Mid-Atlantic Bight cold pool. The cold pool is a mass of relatively cool water that forms in the spring and is maintained through the summer by stratification. The cold pool supports a diversity of fish and other marine species that are usually found farther north but thrive in the cooler waters it provides (Chen et al. 2018; Lentz 2017). Changes in the size and seasonal duration of the cold pool over the past five decades are associated with shifts in the fish community composition of the Mid-Atlantic Bight (Chen et al. 2018; Kohut and Brodie 2019). Several lease areas within the Rhode Island/Massachusetts WEAs are located on the approximate northern boundary of the cold pool. The potential effects of extensive wind farm development on features like the cold pool is a topic of emerging interest and ongoing research (Chen et al. 2016). The placement of monopiles and WTGs in the benthic resource GAA has the potential to influence hydrodynamic conditions at both local and broader regional scales. These effects fall into two categories, changes in wind field down current of the wind farm, affecting surface currents and wave formation, and turbulent mixing caused by the presence of the structures in the water column. The extent of these effects and resulting significance on biological processes are likely to vary considerably between different oceanographic environments (van Berkel et al. 2020). The presence of WTGs is likely to create localized hydrodynamic effects that could have localized impacts on food web productivity and pelagic eggs and larvae. Addition of vertical structure that spans the water column could alter vertical and horizontal water velocity and circulation.

Van Berkel et al. (2020) and Schultze et al. (2020) note that environments characterized by strong seasonal stratification are likely to be less sensitive to wind field and turbulent mixing effects on oceanographic processes. The SRWF and surroundings are characterized by strong seasonal stratification in summer and fall, within increased mixing and deterioration of stratification driven by storms and changes in upwelling in late fall into winter (Chen et al. 2018; Lentz 2017). On the Mid-Atlantic Bight, increased mixing could influence the strength and persistence of the cold pool, a band of cold, near-bottom water that exists at depth from the spring to fall. However, the turbulence introduced by monopile foundations is not expected to significantly affect the cold pool due to the strength of the stratification (temperature differences between the surface and the cold pool reach 50°F [10°C] [Lentz 2017]). Temperature anomalies created by mixing at each monopile would likely resolve quickly due to strong forcing towards stabilization (Schultze et al. 2020). Benthic habitats located at the base of the turbine structures would not be directly affected by changes in shallower water temperatures, but the indirect effect of these changes on temperature patterns along the bottom would potentially alter conditions.

BOEM has conducted a modeling study to predict how planned offshore wind development in the area could affect hydrodynamic conditions in the northern Mid-Atlantic Bight. Johnson et al. (2021) considered a range of development scenarios, including full buildout of both WEAs with a total of 1,063 WTG and OSS foundations. They determined that all scenarios would lead to small but measurable changes in current speed, wave height, and sediment transport in the northern Mid-Atlantic Bight. The resulting changes in current speed and wave height could influence larval transport and settlement and reduce bed shear stress thereby affecting sediment transport. Particle tracking, which integrates the overall effect of objects subjected to the effects of currents, showed variations on the order of ± 10 percent between the baseline condition (no offshore wind farms) and the 12 MW full build-out scenario (1,063 WTG and OSS foundations). This is in line with the observed order of magnitude change in the depth averaged currents (Johnson et al. 2021). In addition, small changes in stratification could occur, leading to prolonged retention of cold water near the seabed within the area during spring and summer.

Johnson et al. (2021) used an agent-based model to evaluate how these environmental changes could affect planktonic larval dispersal and settlement for three EFH species, summer flounder, silver hake, and Atlantic sea scallop. The effects on sea scallop would be the most applicable to assessing impacts to benthic organisms. They determined that offshore wind development could affect larval dispersal patterns, leading to increases in larval settlement density in some areas and decreases in others, but would be unlikely to negatively impact population productivity for these species. Johnson et al. (2021) concluded that changes in larval distribution patterns on the order of miles or tens of miles are therefore unlikely to result in biologically significant effects on larval survival and recruitment. For example, in the case of sea scallops, larval dispersal to waters southwest of Block Island is predicted to increase while dispersal to waters south of Martha’s Vineyard would decrease under all modeled scenarios (Johnson et al. 2021). These localized effects are unlikely to have a measurable population-level effect on this species because sea scallop larvae originate in both local and distant spawning areas and are dispersed regionally over a southwesterly gradient (Johnson et al. 2021). In this context, localized shifts in larval transport and settlement density on the scale of miles to tens of miles are unlikely to lead to the development of significant population sinks. Even where they occur, localized changes in larval recruitment may not necessarily translate to negative effects on adult biomass. For example, Atlantic sea scallops are prone to overcrowding and reduced growth rates in areas with high larval recruitment (Bethoney and Stokesbury 2019), therefore changes in dispersal that reduce overcrowding could lead to increased growth and abundance in specific areas.

While findings for these species are instructive, they are not necessarily representative of potential effects on all benthic species that rely on planktonic dispersal of gametes and larvae. The BOEM modeling results determined that small but measurable changes in current speed, wave height, and sediment transport would occur across the northern Mid-Atlantic Bight. As stated, hydrodynamic effects could change how the planktonic gametes and larvae of many marine species are dispersed across the region. Changing larval dispersal pathways can disrupt connectivity between populations and the processes of larval settlement and recruitment (Pinsky et al. 2020). Unfavorable changes can create a condition where population may be negatively affected by a prolonged reduction in larval survival (Pinsky et al. 2020). This could result in negative impacts on predator species like Atlantic cod that return to the same spawning habitats year after year and rely on relatively consistent oceanographic conditions to disperse planktonic eggs to areas favorable for larval and juvenile survival (Dean et al. 2022). As such, hydrodynamic effects on these species could be more significant, but the available information does not suggest that such effects are likely. While hydrodynamic effects on these species could potentially be more significant, the available information does not suggest that such effects are likely.

Installation of multiple wind farms and their constellations of WTGs would likely create individual localized hydrodynamic effects that could have localized effects on food web productivity and pelagic gametes and larvae. Given their planktonic nature, altered circulation patterns could transport pelagic gametes and larvae out of suitable habitat, altering their survivability. These effects would apply to benthic species that produce or prey upon pelagic gametes, eggs, and larvae. These localized hydrodynamic effects would persist throughout the life of the projects until monopiles are decommissioned and removed.

Mobile or attached benthic species utilizing water column habitat could experience localized hydrodynamic effects down current of each SRWF monopile. These effects may be limited to decreased current speeds but could also include minor changes to seasonal stratification regimes. Mobile adults and juveniles would be expected to elicit an avoidance behavioral response away from potential unsuitable habitat due to hydrodynamic effects from monopiles. Sessile and attached species may experience changes in recruitment or survival depending on how the currents affect thermal patterns. Johnson et al. (2021) review of the 12 MW full build-out versus the baseline hydrodynamic model temperature stratification results showed a relative deepening in the thermocline of approximately 1 to 2 m and a retention of colder water inside the offshore wind farm area through the summer months compared to the situation where OSW structures were not present. These localized effects would persist throughout the life of the project.

While hydrodynamic impacts on invertebrates are likely to vary between species, the modeled findings for sea scallops are likely representative of the magnitude of potential effects on any invertebrate species having widely dispersed planktonic larvae. Localized changes in larval settlement patterns in the absence of population-level effects would constitute a minor adverse impact on this resource. This impact would be effectively permanent.

Sediment suspension and deposition: Under the No Action Alternative, several thousand miles of cable would be added in the EFH, finfish, and invertebrate GAA, as well as within the benthic GAA. Cable placement and other related construction activities would disturb the seabed, creating plumes of fine sediment that would disperse and resettle in the vicinity. The resulting effects on benthic habitats, EFH, finfish, and invertebrates would be similar in nature to those observed during construction of the Block Island Wind Farm (BIWF) (Elliot 2017) but would vary in extent and severity depending on the type and extent of disturbance and the nature of the substrates. These effects would be short-term in duration, effectively ending once the sediments have resettled. Similarly, suspended sediment concentrations close to the disturbance could exceed levels associated with behavioral and physiological effects on fish and invertebrates but would dissipate with distance, generally returning to baseline conditions within a few hours. In theory, bed-disturbing activities occurring nearby (i.e., within 300 ft [100 m]) could elevate suspended sediment levels, resulting in short-term, minor adverse effects on benthic habitat, EFH, finfish, and invertebrates.

Noise: Numerous proposed offshore wind construction projects could be developed on the Mid-Atlantic OCS between 2022 to 2030 (see Appendix E). This would result in noise-generating activities—specifically, impact pile driving, HRG surveys, construction and O&M vessel use, and WTG operation. BOEM believes it is reasonable to conclude that impact pile driving, construction vessel, and HRG survey noise from future projects could adversely affect EFH, invertebrates, and finfish. In addition, construction noise impacts from future actions elsewhere in the Mid-Atlantic OCS could adversely affect demersal and pelagic fish and invertebrates that migrate to or use the GAA during part of their life cycle. Noise transmitted through water and through the seabed can cause injury to or mortality of benthic resources in a limited area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. The extent would depend on pile size, hammer energy, and local acoustic conditions. The affected areas would likely be recolonized in the short term. In the planned activities scenario, noise from pile-driving for WTG placement at potentially concurrent projects would be dispersed broadly and would only be detectable by invertebrates in the immediate area of the activity; therefore impacts are expected to range from minor to moderate adverse because they could affect individuals, but would not rise to population-level effects. Due to the unknowns associated with projects, the timing, extent, and severity of these effects on habitat and aquatic community structure cannot currently be quantified.

Tougaard et al. (2020) summarized available monitoring data on wind farm operational noise, including both older generation geared turbine designs and quieter modern direct drive systems like those proposed for the SRWF. In their review, they evaluated approximately 40 wind projects with turbines ranging from 0.2 to 6.15 MW. They determined that operating turbines produce underwater sound pressure level (SPL) on the order of 105-128, in the 25-Hz to 1-kHz range as measured at 50 m; however, the turbines evaluated were smaller capacity, and the total number of turbines in the projects evaluated was less than what is proposed at SRWF. Tourgaard's levels were consistent with the noise levels observed at the BIWF (110 to 125 dB SPL; Elliot 2019) More recently, Stöber and Thomsen (2021) used monitoring data and modeling to estimate operational noise from larger (10 MW) current generation direct drive WTGs and concluded that these designs could generate higher operational noise levels than those reported in earlier research; however, these studies and models have demonstrated that noise generated by wind turbines attenuates rapidly with distance from the turbines (falling below normal ocean ambient noise within ~1 km from the source), and the combined noise levels from multiple turbines is lower or comparable to that generated by a small cargo ship and unlikely to be detectable to fish and invertebrates outside the respective wind farm footprints. The available information suggests the effects of operational underwater noise from future activities would occur for the life of the proposed Project but are not anticipated to have population-level effects and effects to benthic invertebrates would be negligible.

Vibration from impact pile driving can be transmitted through sediments. Benthic habitat is composed of various types of sediment, structural features that are formed by that sediment (e.g., interstitial spaces between boulders, sand waves), and organisms that reside in and on the sediment. Substrates and associated structural features are poor transmission media for and are relatively unaffected by underwater noise. Past research has shown that invertebrates are sensitive only to the particle motion component of noise. Detectable particle motion effects on invertebrates are typically limited to within 7 ft (2 m) of the source or less (Carroll et al. 2016; Edmonds et al. 2016; Hawkins and Popper 2014; Payne et al. 2007); however, recent research (Jones et al. 2020; Jones et al. 2021) indicate that longfin squid, an EFH invertebrate species, can sense and respond to vibrations from impact pile driving at a greater distance based on sound exposure experiments. This suggests that infaunal organisms, such as clams, worms, and amphipods may exhibit a behavioral response to vibration effects over a larger area. For example, noise has been shown to affect bivalves based on reactions where bivalves close their valves and burrow deeper when subjected to noise and vibration stimuli (Roberts and Elliott 2017). Prolonged closure could reduce respiration and growth, prevent expulsion of wastes, and lead to mortality, though the duration of pile-driving actions within the small radius of potential effects for infaunal organisms is expected to be on the order of hours. With impulse impacts, such as those from pile driving, physiological sound thresholds may be exceeded for some species, resulting in injury or mortality, especially for affected species in the immediate vicinity (less than tens of meters), but additional research is needed.

Noise transmitted through water and/or through the seabed can cause injury and/or mortality to benthic resources in a limited area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. Although construction within the WEA is expected to last from 2023 to 2030, the pile-driving activity at any given site would be on the order of days. Since the WTGs are spaced up to 1 nm apart, impacts from pile driving at other WTGs would not be detectable beyond the area immediately surrounding a WTG. Actual placement of the piles could result in mortality of infaunal and sessile organisms in the immediate area, but affected areas would likely be recolonized in the short term, and the overall adverse impact on benthic resources would be minor. Given the limited area where vibration is detectable by infaunal organisms and the distance between proposed and operating offshore developments vibration would not be detectable by invertebrates outside of each project and adverse impacts to benthic resources due to vibration would be highly proximal and expected to be minor for organisms in the immediate area of disturbance but negligible in the context of the GAA.

EMF: At least seven submarine power and communications cables cross the Rhode Island/Massachusetts WEAs. These cables would presumably continue to operate and generate EMF effects under the No Action Alternative. While the type and capacity of those cables is not specified, the associated baseline EMF effects can be inferred from available literature. Electrical telecommunications cables are likely to induce a weak EMF on the order of 1 to 6.3 microvolts per meter within 3.3 ft (1 m) of the cable path (Gill et al. 2005). Fiber optic communications cables with optical repeaters would not produce EMF effects.

Under the No Action Alternative, several thousand miles of cable would be added in the EFH, finfish, and invertebrate GAA, as well as within the benthic GAA, producing EMFs in the immediate vicinity of each cable during operations. BOEM anticipates that the proposed offshore energy projects would use HVAC transmission, but high voltage direct current (HVDC) designs are possible and could occur. BOEM would require these future submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation. EMF effects from these future projects on benthic habitats, EFH, invertebrates, and finfish would vary in extent and significance depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or HVDC, transmission voltage). While EMFs are measurable within tens of feet of cable corridors, bottom-dwelling invertebrates (e.g., lobster) are impacted by the field as they temporarily pass over the cable location. HVAC transmission appears to be less likely to result in measurable physiological or behavioral effects (Hutchison et al. 2020b). Accordingly, EMF effects from future activities using HVAC transmission would range from negligible to minor adverse for invertebrates that dwell in or immediately on the seafloor. Studies (Hutchison 2018; Hutchison 2020b) have observed behavioral responses in lobster that were exposed to an EMF from an HVDC cable in a controlled environment, meaning that higher level long-term (e.g., minor or moderate) adverse effects could result should future projects use HVDC transmission. A more recent lab-based study found that European lobster (*Homarus gammarus*) eggs exposed to 2.8 mT (28,000 mG) via a static DC current exhibited reduced stage-specific egg volume and overall smaller body size and larval deformities (Harsanyi et al. 2022). These adverse effects on larval development would likely reduce survival, dispersal, and fitness (Harsanyi et al. 2022). The effect of EMF on benthic organisms is an area where more research is needed to assess the potential impacts of large cable networks on benthic fauna.

Accidental releases and discharges including trash and debris: Offshore wind energy development could result in the accidental release of water quality contaminants, trash, or other debris, which could theoretically lead to an increase in debris and pollution in the GAAs (see Section 3.5 for characterization of existing marine pollution conditions). In general, the types of accidental hazardous materials releases associated with marine construction projects consist of fuels, lubricating oils, and other petroleum products. BOEM prohibits the discharge or disposal of solid debris into offshore waters during any activity associated with the construction and operation of offshore energy facilities (30 *CFR* 250.300). The USCG similarly prohibits the dumping of trash or debris capable of posing entanglement or ingestion risk (MARPOL, Annex V, Public Law 100−220 [101 Stat. 1458]). Compliance with these requirements would effectively minimize releases of trash and debris.

Increased vessel traffic associated with offshore renewable energy construction presents the potential for the inadvertent introduction of invasive species during discharge of ballast and bilge water. BOEM would require all Project construction vessels to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 *CFR* 151.2025) and USEPA NPDES Vessel General Permit standards, effectively avoiding the likelihood of non-native species invasions through ballast water discharge. Considering these requirements and the dispersed distribution of planned offshore energy facilities, existing water quality trends are likely to continue.

The impacts from ongoing activities and future non-offshore wind activities stem from the increased potential for releases over the next 30 years due to increasing vessel traffic and ongoing, chronic releases. Future offshore wind activities would contribute to an increased risk of releases and impacts on benthic resources. The contribution from future offshore wind activities would represent a low percentage of the overall risk from ongoing activities. In context of reasonably foreseeable environmental trends, including climate change, the combined adverse impacts on benthic resources (mortality, decreased fitness, disease) from accidental releases and discharges are expected to be negligible, localized, and short-term due to the likely limited extent and duration of a release.

3.7.3.3 Impacts of Alternative A on ESA-Listed Species

There are no ESA-listed threatened or endangered invertebrate or coral species, nor are there any benthic species currently proposed for listing in the New England/Mid-Atlantic Region as reported by NMFS (NOAA 2021). Therefore, there would be no potential for impacts to ESA-listed species under the No Action Alternative.

3.7.3.4 Conclusions

Impacts of the No Action Alternative

Under the No Action Alternative, BOEM would not approve the COP; Project construction and installation, O&M, and conceptual decommissioning would not occur; and potential impacts on benthic habitat, EFH, invertebrates, and finfish species associated with the proposed Project would not occur; however, ongoing activities would have continued, short- to long-term impacts on benthic habitat, EFH, invertebrates, and finfish species. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with ongoing activities, including permitted offshore wind projects, and environmental trends in the GAA would result in **moderate** adverse impacts and could potentially include **minor beneficial** impacts on benthic resources due to the artificial reef effect (habitat conversion). Future offshore wind activities are expected to contribute considerably to several IPFs, primarily new cable emplacement and the presence of structures namely, foundations and scour/cable protection. BOEM has concluded that the onshore components of offshore wind energy development are unlikely to measurably affect the marine environment and would therefore have no effect on marine invertebrates.

Cumulative Impacts of the No Action Alternative

While the proposed Project would not be built as proposed under the No Action Alternative, BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing short- to long-term impacts (disturbance, displacement, injury, mortality, reduced reproductive success, habitat degradation, habitat conversion) on benthic resources, finfish, invertebrates, and EFH, primarily through resource exploitation/regulated fishing effort, dredging, bottom trawling, bycatch, pile-driving noise, new cable emplacement, the presence of structures, and climate change.

Based on the analysis presented under the above IPFs, BOEM anticipates that the impacts of ongoing activities, especially seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear, would be moderately adverse for benthic resources. Reasonably foreseeable activities other than offshore wind include increasing vessel traffic; increasing construction, marine surveys, marine minerals extraction, port expansion, and channel-deepening activities; and the installation of new towers, buoys, and piers would result in moderate adverse impacts for benthic resources. BOEM expects the combination of ongoing activities and reasonably foreseeable activities other than offshore wind to result in **moderate** adverse impacts on benthic resources, primarily driven by ongoing dredging and fishing activities.

The combined significance criteria in Table 3.7-2 are used to characterize the combined effects of all IPFs likely to occur under the No Action Alternative. BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have short-term to permanent adverse impacts (e.g., disturbance, injury, mortality, habitat degradation, habitat conversion) on benthic resources, primarily through pile-driving noise, anchoring, new cable emplacement, the presence of structures during operations of future offshore facilities (i.e., foundations, cable, and scour protection), climate change, and ongoing seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, including climate change, and reasonably foreseeable activities other than offshore wind would result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts on benthic resources due to the artificial reef effect (habitat conversion). Future offshore wind activities are expected to contribute considerably to several IPFs, primarily new cable emplacement and the presence of structures—namely, foundations and scour/cable protection.

The No Action Alternative would forgo the benthic monitoring that Sunrise Wind has voluntarily committed to perform, the results of which could provide an understanding of the effects of offshore wind development; benefit future management of finfish, invertebrates, and EFH; and inform planning of other offshore developments; however, other ongoing and future surveys could still provide similar data to support similar goals.

3.7.4 Relevant Design Parameters & Potential Variances in Impacts

This Final EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than described in the sections below (Sunrise Wind 2023a). The following proposed PDE parameters (Appendix C) would influence the magnitude of the impacts to benthic resources:

- The total amount of scour protection for the foundations, inter-array cables, and offshore export cable corridors that results in long-term habitat alteration;
- The installation method of the export cable in the offshore export cable corridors and for inter-array and interlink cables in the SRWF and the resulting amount of habitat temporarily altered;
- The number and type of foundations used for the WTGs and OSS: Sunrise Wind would construct a maximum of 94 11-MW WTGs within 102 possible positions and 1 OSS;
- The methods used for cable laying and landfalls, as well as the types of vessels used and the amount of anchoring;
- The amount of pre-cable laying dredging or preparation, if any, and its location; and
- The time of year when foundation and cable installations occur.

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

- The number, size, location, and amount of scour protection for WTG and OCS-DC foundations: the level of impact related to foundations is proportional to the number of foundations installed; fewer foundations would present less risk to benthic organisms.
- Location of WTGs with respect to benthic habitat types. WTGs sited in or near more complex habitat types (coarse substrates and boulders) would have greater potential for impacts on benthic resources. Sites that require relocation of boulders would have additional adverse impacts to the benthic communities.
- Offshore export cable routes and OCS-DC footprints: the route chosen (including variants within the general route) and OCS-DC footprints would determine the amount of habitat affected.
- Season of construction: spring and summer are the primary spawning seasons for many benthic invertebrates as well as fish that lay demersal eggs. Project activities during these seasons would likely have greater impacts due to localized disruption of these processes and impacts on reproductive processes and sensitive early life stages.
- The conclusion section within each alternative analysis discussion includes rationale for the overall effect determination. The Proposed Action (Alternative B) and all other action alternatives would result in moderate adverse and minor to moderate beneficial impacts on benthic resources and invertebrates in the GAA because a notable and measurable impact is anticipated, but the resource would likely recover completely when the impacting agents disappear and remedial or mitigating action have been implemented.

3.7.5 Impacts of Alternative B – Proposed Action on Benthic Resources

The sections below summarize the potential impacts of the Proposed Action on benthic resources during the various phases of the Proposed Action. Routine activities would include construction, O&M, and decommissioning of the Project, as described in Chapter 2, Section 2.1.2 *Alternative B – Proposed Action.* Table 2.1-2 summarizes the Project components for the Proposed Action and (Sunrise Wind 2023a) a detailed map showing the location of all proposed WTGs, inter-array cables, and the OCS-DC is provided in Figure 2.1-1 (Sunrise Wind 2023a).

Table 3.7-3 summarizes the estimates for short- and long-term benthic habitat disturbances by offshore Project components and is based on surveys conducted in 2020 (COP, Appendices M1 [Inspire 2022a], M2 [Inspire 2022b], and M3 [Inspire 2022c]) and summarized in Section 3.7.1, *Benthic Resources*. The Lease Area comprises approximately 86,769 ac (35,114 ha) and the SRWEC disturbance corridor would cover approximately 1,259 ac (170 km by 30 m). Although some areas of the benthic habitat would be permanently altered by the project even after decommissioning, it is not possible to estimate the acres that would not return to their current state.

Table 3.7-3. Short-term and Long-term Benthic Habitat Disturbance by Project Component for the Proposed Action

Project Component	Component Acres	Short-term Disturbance		Long-term Disturbance	
		Acres	%	Acres	%
SRWEC (NYS and OCS)	1,320.83	1,270.20	96%	468.90	36%
SRWF Total	5,743.80	5,743.80	100%	892.46	16%
Lease Area	86,769	7,014.00	8.1%	1,361.36	1.6%

Sources: COP, Appendices M1 (Inspire 2022a), M2 (Inspire 2022b), and M3 (Inspire 2022c).

Construction, O&M, and decommissioning activities associated with the SRWF and SRWEC have the potential to cause both direct and indirect impacts on the benthic habitat and living resources of the affected environment discussed above. Impacts would vary by habitat, species, and life stage, with some species/life stages being more vulnerable than others. IPFs associated with the construction and O&M phases of the Project are identified in Table G-7 in Appendix G (*Impact-Producing Factor Tables*) and described separately, by phase, for the SRWF and SRWEC in the following sections. In general, onshore activities including construction, O&M, and decommissioning of the Project have minimal potential to affect benthic resources. Potential impacts would be discussed for the ICW-HDD, but no other onshore Project components have potential for direct or indirect impacts to benthic resources.

3.7.5.1 Construction and Installation

Sunrise Wind estimates that the construction and installation of the components with the potential to affect benthic resources would include the SWREC, which would take approximately 8 months, that the SRWF WTG foundations and associated structures would take approximately 5 months, and that the IAC would take approximately 7 months. Some of these activities would occur concurrently, while others must be completed in sequence or would progress along an alignment. The COP, Figure 3.2.2-1 (Sunrise Wind 2023a), provides a Project construction timeline of approximately 15 months to complete all of these components. No single area is likely to experience disturbance or impacts from construction activities for the entire 15-month period, and the analyses presented used estimated durations of 7 to 12 months since activities may affect multiple areas concurrently or intermittently over longer periods. The entire project is anticipated to span approximately 2 years; therefore, there would be some periods of inactivity interspersed among the 15-months where seafloor disturbances are likely to occur.

3.7.5.1.1 Onshore and Nearshore Activities and Facilities

Onshore facilities would not have direct or indirect impacts on benthic resources with the exception of the ICW HDD alignment where it crosses Bellport Bay. Nearshore facilities would include the temporary landing structure located at Smith Point County Park and the HDD exit pit.

Seafloor disturbance: The COP (Sunrise Wind 2023a) states that an HDD exit pit, which may be located offshore (approximately 2,225 ft [678 m] seaward from the MHWL) beyond the Fire Island National Seashore boundary, would disturb up to 61.8 ac (25 ha) of soft-bottom benthic habitat. A small area of temporary disturbance (up to 4,800 sq ft (446 m^2)) would occur within the 1,000 ft (304.8 m) easement owned by the United States and administered by the NPS for the temporary landing structure (discussed below under temporary structures). These areas would be reclaimed after cable installation is completed. Because the cable under the ICW would be placed at a target depth of 5 to 75 ft (1.5 to 25 m) beneath the ground surface or channel bottom using an HDD, it is unlikely that the benthos in the channel would be disturbed to the extent that infaunal organisms, the macroalgae beds on the north side, or the narrow seagrass areas along the south shore would be affected. No trenching or channel substrate disturbance is planned as part of the ICW-HDD. Given the small area and short duration of the disturbance, the adverse impacts to benthic habitat and fauna are likely to be **minor**. Since the ICW is dredged periodically to facilitate vessel traffic, the level of disturbance from the HDD, which is being employed to eliminate disturbance of the channel substrate, would be negligible in comparison (USACE 2022). The Dredging Activities Work Plan includes species protective seasonal restrictions that would require any seafloor disturbing activities, including dredging to be completed beginning December 1 and ending on, but inclusive of, April 30 to avoid impacts to Atlantic sturgeon, a species protected by the ESA. This restriction would also avoid the horseshoe crab spawning season in the area, which runs from May through July each year.

Sediment suspension and deposition: The shoreline disturbing activities would result in short-term increases in sediment suspension and deposition near the HDD exit pit onshore and offshore; however, sediment control structures onshore are part of the proposed environmental protection measures (see COP, Section 4.4.3.1, Sunrise Wind 2023a) for construction and would minimize sediment delivery to the channel. When compared to the background level of sediment suspension due to maintenance dredging and vessel traffic in the ICW, the potential for impacts to benthic resources due to the HDD would be negligible.

Noise and vibration: There would be short-term impacts to the benthic fauna due to vibration and noise generated by drilling and construction equipment during the HDD process. The extent and duration of these impacts would be minimal and would be negligible to the benthic communities near the HDD alignment when viewed in the context of background levels of noise and vibration due to vessel traffic in the channel and on the highway bridge adjacent to the alignment. These mechanisms for these impacts would be similar to those described below under the offshore activities and facilities.

EMF: Because EMFs are generated by power production when WTGs are operating, there would be no potential for impacts from EMFs on the benthic environment during construction beyond background levels.

Discharges and releases: Sunrise Wind would develop an Inadvertent Return Plan prior to construction that would describe the measures that would be implemented to prevent and identify inadvertent releases of drilling fluid.

Trash and debris: The construction phase has the greatest potential for generating solid waste and construction debris at onshore facilities, including the ICW-HDD. Sunrise Wind would comply with applicable federal, state, and local laws, comprehensive measures prior to and during construction to avoid, minimize, and mitigate impacts related to trash and debris disposal. Good housekeeping practices would be implemented to minimize trash and debris in work areas, including orderly storage of tools, equipment, and materials, as well as proper waste collection, storage, and disposal to keep work areas clean and minimize potential environmental impacts. Collected trash and debris would be disposed of in a landfill and/or recycling center as appropriate. Based on these factors, accidental releases of trash and debris from onshore federally approved activities are not expected to appreciably contribute to adverse benthic habitat impacts, and therefore the effects of the Proposed Action would be negligible.

Temporary structures: The temporary landing structure that may be deployed to aid in the transport of equipment and materials for the landfall HDD and ICW HDD may impact the benthic and shellfish resources in its direct vicinity. The sessile and slow-moving benthic organisms inhabiting the sediments below where the temporary landing structure, ramps, and piles (4,800 sq ft [446 m^2) may be installed within the Fire Island National Seashore boundary near Smith Point County Park may be crushed by the spuds from the barge. The pier may be temporarily grounded at low tides, which may lead to injury or mortality. The temporary landing structure may crush SAV if it exists directly below the structure when it becomes grounded. Sparse or trace benthic macroalgae habitats and no SAV areas were mapped in these areas based on the 2020 video survey (see Table 3.2-2; Figure 2.3-2 of COP Appendix M2, Inspire 2022b), although historical data from 2018 and 2002 indicate presence of 0.8 ac (3,237.5 m^2) and 0.3 ac (1,214.1 m^2) of SAV in the areas east and west of ICW crossing, respectively. The temporary landing structure may also shade the sediments in its vicinity, reducing the photosynthetic capacity of SAV. A pre-construction SAV survey would be conducted in the ICW, and the proposed temporary landing structure would be positioned to avoid and minimize impacts to this sensitive habitat to the extent practicable. The pier may remain in place year-round but is likely to be used from fall to spring which would reduce potential impacts to SAV by avoiding the peak growing season.

3.7.5.1.2 Offshore Activities and Facilities

Table 3.7-4 summarizes the acres of seafloor and benthic habitat types affected by the construction and decommission stages (short-term) and the acres that would remain disturbed for the life of the Project (long-term) based on data presented in the COP and COP, Appendix M3 (Inspire 2022c).The table is broken out by project areas including the SRWEC and landfall HDD, the SRWF WTGs and OCS foundations, and inter-array cables. These estimates rely on assumptions regarding the distribution of seafloor structure that would require leveling (ripples) or relocation (boulders) based on the Project-specific benthic assessments as well as a review of other benthic surveys in the WEA.

NOAA recently provided updated habitat mapping recommendations (March 2021), which request that the maximum potential acres that may be impacted by the Project be inventoried in terms of the NOAA Habitat Complexity Categories outlined in these recommendations. These habitat complexity categories were defined by NOAA for the purposes of EFH consultation, but apply to the benthic habitat assessment. The NOAA Habitat Complexity Categories include soft bottom, complex, heterogeneous complex, and large-grained complex (large boulders). For purposes of the EFH consultation, NOAA defined complex habitats as SAV and sediments with >5 percent cover of gravel of any size (CMECS substrate class rock, CMECS substrate groups of gravelly, gravel mixes, and gravels, as well as shell substrate CMECS classifications). Heterogenous complex is used for habitats with a combination of soft bottom and complex features. Soft bottom includes silt, sand, and mud habitats. To provide an impact assessment of the study area in terms of NOAA Habitat Complexity Categories, the benthic habitats delineated by Sunrise Wind and detailed here have been crosswalked to the NOAA Habitat Complexity Categories. This crosswalk was used to calculate acres of each habitat category that may be impacted by Project activities.

Table 3.7-4. Maximum Potential Impacts to Benthic Habitats by NOAA Habitat Complexity Category from Proposed Project Design and Associated Assumptions and Information from the COP Related to Areas of Anticipated Impact [1]

Project Component	Units	Proportional Disturbance by Habitat Type				Total Area of Impacts to the Seafloor
		Large Grained Complex	Complex	Soft Bottom	Total	
SRWEC and Landfall HDD						
Cable Protection						
Long-term (Permanent)	acres	0	28.85	436.81	465.66	38.5
	percent	0%	6%	94%	100%	8.30%
Cable Installation and Preparation						
Short-term (Temporary)	acres	0	72.56	1,091.7	1,164.26	<1,164.26
	percent	0%	6%	94%	100%	
HDD Exit Pit and Support Area						
Short-term (Temporary)	acres	0	0	61.8	61.8	<61.8
	percent	0%	0%	100%	100%	
HDD of SRWEC under ICW						
Short-term (Temporary)	acres	0	15.5	17.2	32.7	0
	percent	0%	47%	53%	100%	0%
Temporary Landing Structure (for Construction)						
Short-term (Temporary)	acres	0	0.3	1.4	1.7	0.11
	percent	0%	18%	82%	100%	6.50%
WTGs and OCS Foundations						
Long-term (Permanent)	acres	0	1.52	1.96	3.49	3.27
	percent	0	44%	56%	100%	~94%
Scour and Cable Protection for WTGs and OCS						
Long-term (Permanent)	acres	0.09	38.48	64.88	103.44	98.05
	percent	0.10%	37%	63%	100%	95%
Totals for WTG and OCS Foundations						
Long-term (Permanent)	acres	0.09	40	66.84	106.93	101.32
	percent	0.10%	36%	61%	100%	
Short-term (Temporary)	acres	22.86	1,545.06	2,195.13	3,763.04	127
	percent	1%	41%	58%	100%	3.4 to 3.7%
Inter-array Cables						
Cable Protection						
Long-term (Permanent)	acres	0	297.68	436.07	760.75	up to 139.36
	percent	0%	39%	61%	100%	up to 18%
Cable Installation and Preparation						
Short-term (Temporary)	acres	0	627.83	993.11	1,620.94	<1,620.94
	percent	0%	39%	61%	100%	<100%

Notes:

[1] Table adapted from Table 4-1 in COP, Appendix M3 (Inspire 2022c). The current indicative geographic information system (GIS) layout was used to determine the distribution of benthic habitat types crosswalked to NOAA Habitat Complexity Categories within the total maximum footprint of each Project element. This may result in different total numbers from those presented in the COP (Sunrise Wind 2023a); for example, the current indicative IAC network is 164.2 mi (264.2 km) in GIS, whereas the Project Design Envelope (PDE) presented in the COP allows for a 10% increase on this value for a total of 180.2 mi (290 km), allowing for some changes to the length of the IAC as Sunrise Wind further refines its design and construction plans. In addition, because 102 potential positions are in consideration for 94 WTG foundations, acres of habitat that may be impacted were calculated for the 102 positions and reported on the “Total” column; however, the actual total acreage that is as anticipated to be impacted is related to the total area that may be impacted by 94 WTG foundations and is reported in the "Total Area of Anticipated Impacts to the Seafloor" column. This column is also used to report the maximum total area that

may be disturbed by activities that would only be conducted along certain portions of the cables (cable protection, boulder clearance); for these values the total length provided in the PDE, rather than the indicative GIS data, were used to calculate a conservative value.

2 These areas assume disturbance of the entire SRWEC corridor and include the preparation for up to three HDD pits, the support area, a survey area, and the construction of a temporary landing structure to assist during the HDD construction. The temporary landing structure construction impact area would fall within the Fire Island National Seashore boundary.

3 Up to 5% of the entire up to 100-mi-long (160-km-long) SRWEC-OCS, 5 mi (8 km), and up to 5% of the entire up to 6.2-mi-long (10-km-long) SRWEC-NYS, 0.3 mi (0.5 km), may require cable protection. Cable protection would measure up to 39 ft (12 m) wide. Therefore, a total area of up to 25.2 ac (10.2 ha; 23.7 ac [9.6 ha] for the SRWEC-OCS; 1.5 ac [0.6 ha] for the SRWEC-NYS) may require cable protection. Up to nine crossings of SRWEC-OCS are anticipated that would require protection (1.48 ac [0.6 ha] per crossing). A total of up to 13.3 ac [5.4 ha] of additional cable protection may be needed for these crossings.

It is assumed up to 1,640 ft (500 m) of cable protection would be required per crossing. These acreages would make up approximately 8.3% of the entire SWEC.

4 Acres are based on 39-ft (12-m) diameter monopile WTG foundations, with an area of 0.03 ac (121.4 m^2) for each WTG foundation and 0.64 ac [2,590 m^2] for the four legged piled jacket OCS-DC foundation (inclusive of rock for surface leveling and scour protection covering the entire 167.3 by 167.3 ft [51 by 51 m] area), resulting in totals of 2.63 ac [1.1 ha] for all 94 WTGs (2.85 ac [1.2 ha] across the 102 potential positions) and 3.27 ac [1.3 ha] total inclusive of all 94 WTGs and the OCS-DC, which is ~94% of the total calculated across all 103 potential positions (3.49 ac [1.4 ha]) from the indicative GIS layout. This area may be disturbed by temporary installation activities before being permanently impacted by the physical structure of the foundations.

5 The area of the full IAC corridor of seafloor disturbance represents a conservative assumption for maximum short-term seafloor disturbance; it is anticipated that less than the full area would be temporarily disturbed by seafloor preparation and cable installation activities.

6 Up to 15% of the entire up to 180-mi-long (290-km-long) IAC network, 27.0 mi (43.5 km), may require cable protection. Cable protection would measure up to 39.0 ft (12.0 m) wide.

Therefore, an area of up to 129.0 ac (52.2 ha) plus up to 10.36 ac (4.2 ha) additional cable protection at seven of the IAC network crossings may require cable protection. If cable protection were needed across the entire up to 180-mi-long (290-km-long) IAC network a total of 859.9 ac (348.0 ha) would be needed.

Seafloor disturbance: Seafloor-disturbing activities would include seafloor preparation, impact and/or vibratory pile driving/foundation installation, IAC installation, and vessel anchoring (including spuds from jack-up vessels). These activities could cause injury or mortality to benthic species and negatively affect their habitats. The impacts associated with these activities would be local and would cease after the construction is complete in a given area. Seafloor disturbance and habitat alteration would encompass a small portion of similar available benthic habitat in the area.

As detailed in Appendix H, the Project includes several mitigation measures to limit impact to benthic resources. APMs include performing pre-siting surveys and pre-construction, construction, and post-construction surveys, minimizing seabed disturbance, avoiding sensitive habitats and areas that would require extensive seabed alterations, avoiding anchoring in sensitive habitats (e.g., hard-bottom habitats, seagrass beds, nearshore areas), and minimizing the amount of cable and scour protection installed. Pre-siting and pre-construction surveys would be used to guide final placement of WTGs and cable alignment to avoid sensitive habitats.

The total width of the disturbance corridor for installation of the SRWEC would be up to 98 ft (30 m), inclusive of any required sand wave leveling and boulder clearance. The benthos is generally concentrated in the uppermost layers of the sediments on the seafloor, and any sessile organisms in the area of disturbance (where trenches are cut) are likely to be crushed or buried. Sessile and slow-moving benthic species, including infaunal species, eggs, and larvae, that cannot avoid seafloor preparation or cable installation equipment, may be subject to mortality and injury if they are present within the impact area during construction. Horseshoe crabs (*Limulus polyphemus*) are present in the Project Area and may be impacted by nearshore construction activities including export cable installation and construction and dredging activities, especially near the Fire Island National Seashore. Dredge disposal/placement may result in the loss of horseshoe crabs and their eggs and larvae, and their habitat, resulting in a reduction in prey species and subsequent indirect adverse effects on species that consume horseshoe crab. As noted in the Sunrise EFH assessment, horseshoe crabs are known to occur near where the SRWEC would intersect with the Fire Island National Seashore.

Seafloor preparation and cable installation would flatten sandwaves and eliminate or alter depressions in soft-bottom habitats. Typical soft-bottom habitats would be expected to recover within 18 to 24 months as the seafloor is reshaped by natural sediment transport processes (Dalyander et al. 2013) and seafloor-dwelling organisms recover following disturbance (Bastien et al. 2018). The level of impact from seabed profile alterations, whether through leveling or additional deposition, could depend on the width and depth of the areas cleared as well as the time of year that they occur, especially if these alterations overlap with times and places of high benthic organism abundance or reproductive activity.

Boulder clearance associated with seafloor preparation is expected to have direct adverse impacts on benthic and shellfish resources in the limited areas it may be required along the IAC corridor and around individual foundations. Sunrise Wind intends to relocate boulders as subsequent pre-construction surveys at the site provide information on the relevant area for installation and operation. The COP includes an assumption that up to 5 percent of the SRWEC-OCS, up to 30 percent of the SRWEC-NYS, and up to 10 percent of the IAC may require boulder clearance within a 98-ft (30-m)-wide corridor, and that boulders would be removed from a 722 ft (220 m) radius area around each WTG and OCS-DC foundation. Sunrise Wind plans to relocate boulders that are within the designated boulder relocation area to the nearest point outside of the boulder relocation area to minimize the distance and disturbance to attached fauna. Boulders up to approximately 7.9 ft (2.4 m) in diameter would be moved using a boulder grab. A towed plow was proposed for installation of the cable and IAC within the SRWEC, but is no longer under consideration (Sunrise Wind 2023b). The goal would be to move boulders as little as possible, and there is currently no plan to create boulder aggregations. (January 2023 Boulder Relocation Plan, Sunrise Wind 2023b). Loss of attached fauna is expected during boulder relocation. Relocated boulders may be recolonized, but microhabitats on the boulder would be shifted and attached fauna may not survive relocation or be able to adapt to a different positioning. Relocating boulders would be a permanent change in the original and new site for each boulder moved. The original site would become less complex habitat and the new site would gain potential complex habitat, and the biotic communities would shift accordingly at each location. Relocated boulders are expected to return to their pre-Project habitat function with relatively rapid (less than 1 year) recolonization expected (Guarinello et al. 2017). However, recovery from boulder relocation may take several years as the initial colonization would not represent an established epifaunal community and stages of community succession would be expected. Additionally, boulder relocation may result in new arrangements of boulders, creating new features that may serve as high-value habitat. For example, this increased complex structured habitat may benefit juvenile lobsters and fish by providing an opportunity for refuge compared to surrounding patchy habitat. Boulders would not be moved to their original locations as part of decommissioning since that would result in further disturbance; therefore, these changes in benthic habitat would be permanent.

If necessary, CFE or suction hopper dredging may be used for sand wave leveling during installation of the IAC. This method utilizes thrust to direct waterflow into sediment, creating liquefaction and subsequent dispersal. The CFE tool draws in seawater from the sides and then jets this water out from a vertical down pipe at a specified pressure and volume. The water withdrawal volumes are expected to be approximately 250 to 650 million gallons (946 to 2,460 million liters) for the jet plow and approximately 191 to 516 million gallons (724 to 1,953 million liters) for CFE equipment. The down pipe is positioned over the cable alignment, enabling the stream of water to fluidize the sands around the cable, which allows the cable to settle into the trench under its own weight. During the process, the fluidized sand gets deposited within the local sand wave field. Local impact caused by entrainment of zooplankton and ichthyoplankton during hydraulic plowing or dredging can lead to mortality. These losses are expected to be very low based on a previous assessment conducted for the SRWF, which found that the total estimated losses of zooplankton and ichthyoplankton from jet plow entrainment were less than 0.001 percent of the total zooplankton and ichthyoplankton abundance present in the study area, which encompassed a linearly buffered region of 9 mi (15 km) around the export cable and 16 mi (25 km) around the wind farm (Inspire 2019). The impacts to eggs and larvae from CFE are expected to be similar to those observed from jet plow trenching and are not expected to result in population-level impacts.

Other seafloor preparation activities, IAC installation, and installation of cable protection would occur along the IAC corridor and around individual foundations and would be expected to have similar direct short-term impacts on benthic and shellfish resources as boulder clearance and relocation in these areas.

The installation of the WTG and OCS-DC foundations and associated scour protection could crush and/or displace benthic species (Broad et al. 2020), particularly sessile species and eggs and larvae within the impact area of the foundations and scour protection. Because of the slow speed of the seafloor preparation and cable installation equipment and limited size of the impact areas, it is expected that most mobile benthic species would be able to avoid these activities and would not be subject to mortality or injury but may still experience some direct adverse impact. Vessel anchoring (including spuds from jack-up vessels) could cause mortality or injury to slow-moving or sessile benthic species within the impact areas of the spuds, anchors, and anchor chain sweep. The extent of vessel anchoring impacts would vary, depending on the vessel type, number of vessels, and duration onsite, but would be smaller in spatial extent than other seafloor-disturbing construction activities.

All seafloor disturbances would have greater impacts if they occur during sensitive life stages of the benthic organisms such as reproduction and spawning periods and larval dispersal seasons. The Project schedule (Table 2.1-3) shows that SRWEC, IAC, and WTG foundation construction is expected to occur spanning the full year with activities. The SRWEC construction would occur from Q3 through Q4 of 2024 and Q1 through Q2 of 2025, IAC construction would occur from Q2 through Q3 of 2024; Q2 through Q4 of 2025, and WTG construction would occur from Q2 through Q4 of 2025. The spring and summer seasons are likely to encompass the breeding seasons for several benthic organisms and fish species with demersal eggs or that are dependent on benthic organisms for food. However, given the diversity of habitats, depths, fish, epifauna, and benthic invertebrates in the vicinity of the Project components, one or more species may be spawning or in a reproductive phase during each season. It is difficult to estimate the level of impact on specific organisms given that construction activities would progress along the linear features (SWREC and IAC) and would similarly progress across the grid of WTG locations for 9 or more months. However, it is reasonable to assume that the intensity of impacts would vary depending on the organism and the respective life stages affected during disturbance.

In areas of seafloor disturbance, benthic habitat recovery and mobile and sessile benthic infaunal and epifaunal species abundances may take 1 to 3 years to recover to preimpact levels, based on the results of a number of studies on benthic recovery (e.g., Hutchison et al. 2020a, Carey et al. 2020; Guarinello and Carey 2020; AKRF et al. 2012; Germano et al. 1994; Hirsch et al. 1978; Kenny and Rees 1994). Based on a review of impacts of sand mining in the U.S. Atlantic and Gulf of Mexico, soft-bottom communities within the cable corridors would recover within 3 months to 2.5 years (Kraus and Carter 2018; Brooks et al. 2006; BOEM 2015; Normandeau Associates 2014). A separate review of case studies from cable installations in Atlantic and Pacific temperate zones concludes that recovery of benthic communities on the OCS (less than 262 ft [80 m] depth) occurs within a few weeks to 2 years after plowing, depending on the available supply of sediment (Brooks et al. 2006). Recovery time varies somewhat with the method of installation, with more rapid recovery after plowing than jetting (Kraus and Carter 2018).

Benthic habitat recolonization rates depend on the benthic communities in the area surrounding the affected region. Sand sheet and mobile sand with gravel habitats as found within and near the SRWF are often more dynamic in nature; therefore, they are quicker to recover than more stable environments, such as fine-grained (e.g., silt) habitats and rocky reefs (Dernie et al. 2003). Species inhabiting these dynamic habitats are adapted to deal with physical disturbances, for example, frequent sedimentation associated with strong bottom currents and ground swell. As such, these communities are expected to recolonize more quickly after a disturbance than communities not well adapted to frequent disturbance (e.g., cobble and boulder habitats). Mobile species may be indirectly affected by the short-term reduction of benthic forage species; however, given the prevalence of similar habitat in the area, this is likely to be a minor adverse impact. In summary, the entire area of the disturbance corridor for the SRWEC is likely to experience moderate impacts due to the level of disturbance required for trenching (see Table G-6 in Appendix G). In contrast the area required to construct the SRWF and IAC is a small (8 percent) portion of the Lease Area. Therefore, in the context of habitat available within the Lease Area, the impacts to benthic resources due to the short-term seafloor disturbance associated with construction activities would be adverse and moderate.

Prescence of structures: Although structures would be placed during construction, the effects of their presence are evaluated under the Operations and Maintenance sections since the key impacts during construction would be due to the seafloor disturbance required to place them, discussed in the section above.

Sediment suspension and deposition: Seafloor-disturbing activities would result in short-term increases in sediment suspension and deposition. Sediment transport modeling was performed using the particle tracking model (PTM) in the Surface-Water Modeling System, which is a two-dimensional Lagrangian PTM developed by the Coastal Inlets Research Program and the Dredging Operations and Environmental Research Program at the USACE Research and Development Center. Details on the PTM, data input into the model, and output from the model simulation runs are summarized in the COP, Appendix H and Table 4.4.2-2 in the COP (Woods Hole Group 2022; Sunrise Wind 2023a).

For the IAC, two representative segments of installation by jet plow were simulated and the modeling results indicate that sediment plumes with total suspended sediment (TSS) concentrations exceeding the ambient conditions by 100 mg/L could extend up to 3,346 ft (1,020 m) from the cable corridor centerline. The model estimated that the elevated TSS concentrations would be of short duration and are expected to return to ambient conditions within 0.5 hour following the cessation of cable burial activities. The modeling results indicate that sedimentation from IAC burial is expected to exceed 0.4 in (10 mm) of deposition a maximum of 220 ft (67 m) from the cable centerline covering an area of 7.4 ac (3.0 ha) of the seafloor, and the TSS plume is predicted to be primarily contained within the lower portion of the water column, approximately 12.8 ft (3.9 m) above the seafloor.

Suspension of sediments into the water column and the redistribution of sediments that fall out of suspension could result in mortality of benthic organisms through smothering and irritation to respiratory structures, particularly sessile species and species with limited mobility. Mobile organisms are expected to temporarily vacate the area and move out of the way of incoming sediments (MMS 2007). Most marine species have some degree of tolerance to higher concentrations of suspended sediment because storms, currents, and other natural processes regularly result in increases in turbidity (MMS 2009); however, eggs and larval organisms are especially susceptible to smothering through sedimentation. Also, smaller organisms are likely more affected than larger organisms, as larger organisms may be able to extend feeding tubes and respiratory structures above the sediment (United Kingdom Department for Business Enterprise and Regulatory Reform 2008).

Maurer et al. (1986) found that several species of marine benthic infauna (e.g., the clam Mercenaria, the amphipod *Parahaustorius longimerus*, and the polychaetes *Scoloplos fragilis* and *Nereis succinea*) exhibited little to no mortality when buried under up to 3 in (8 cm) of various types of sediment (from predominantly silt-clay to pure sand). The modeling results indicate that sedimentation from IAC construction can be expected to exceed 0.4 in (10 mm) of deposition out to 220 ft (67 m) from the jet plow activity, with a total of 7.4 ac (3.0 ha) of seafloor that may experience more than 0.4 in (more than 10.2 mm) of sediment deposition during construction. The modeled depth of sedimentation is unlikely to adversely affect the marine benthic infauna.

As discussed above, following a seabed disturbance, benthic habitat recovery may take up to 1 to 3 years and for benthic organism abundances to return to preimpact numbers (e.g., (AKRF et al. 2012; Brooks et al. 2006; Germano et al. 1994; Hirsch et al. 1978; Kenny and Rees 1994; Kraus and Carter 2018; BOEM 2015; Normandeau Associates 2014). Recovery time varies somewhat with the method of installation, with more rapid recovery after plowing than jetting (Kraus and Carter 2018).

As noted previously, benthic habitats within and near the SRWF, including sand sheet and mobile sand with gravel, are dynamic in nature and as such, the benthic organisms are generally adapted to disturbances associated with natural sediment resuspension and deposition events (e.g., storms, tidal currents, circulation). Therefore, the benthic communities in these more frequently disturbed, soft bottom habitats recover more quickly than communities inhabiting more stable environments such as fine-grained (e.g., silt) habitats and rocky reefs (Dernie et al. 2003). In areas with cobble and boulder habitat, the benthic organisms are not well adapted to frequent sedimentation and, therefore, may take longer to recolonize after the disturbance.

In summary, the entire area of the disturbance corridor for the SRWEC is likely to experience moderate adverse impacts due to the localized suspended sediment and deposition produced by trenching (see Table G-6 in Appendix G). In contrast the area affected by construction activities for the SRWF and IAC is a small (8 percent) portion of the Lease Area; however, mortality due to disturbance and burial of benthic species would be likely. Therefore, in the context of habitat available within the Lease Area, the adverse impacts to benthic resources due to the short-term increase in TSS and sediment deposition associated with construction activities would be moderate.

Noise and vibration: Underwater sounds are composed of both pressure and particle motion components and are perceived by aquatic organisms in different ways. An underwater sound originates from a vibrating source, which causes the particles of the surrounding medium (water) to oscillate, which causes adjacent particles to move and transmit the sound wave. Particle motion can be measured in terms of displacement (m), velocity ($m\ s^{-1}$), or acceleration ($m\ s^{-2}$). Sound pressure is the variation in hydrostatic pressure caused by the compression and rarefaction of the particles caused by the sound and is measured in terms of decibels (dB) relative to 1 microPascal (μPa).

Benthic habitat is composed of various types of sediment, structural features that are formed by that sediment (e.g., interstitial spaces between boulders, sand waves), and organisms that reside in and on the sediment. Substrates and associated structural features are poor transmission media for and are relatively unaffected by underwater noise. Noise thresholds for adult invertebrates have not been developed because of a lack of data. Detectable particle motion effects on invertebrates are typically limited to within 7 ft (2 m) of the source or less (Carroll et al. 2016; Edmonds et al. 2016; Hawkins and Popper 2014; Payne et al. 2007).

Very little is known about the sensitivity of aquatic animals to the energy that is generated within and close to the substrate (Hawkins et al. 2021). Roberts et al. (2015) observed behavioral changes to blue mussels (*Mytilus edulis*) in response to experimental seabed vibration stimulus. The responses show that a vibration is likely to impact the overall fitness of both individuals and beds of blue mussels. It is not known how energetically costly the behaviors exhibited in their experimental work were, or to what extent they would affect the long-term fitness of the animals (Roberts et al. 2015), however it is unlikely that they would result in population-level impacts. Sound-detection organs vary widely among fishes and invertebrate species, and it is likely that detection capabilities and sensitivities may differ substantially between species (Hawkins et al. 2021).

Vibration from impact pile driving can be transmitted through sediments. Recent research (Jones et al. 2020; Jones et al. 2021) indicate that longfin squid, an EFH invertebrate species, can sense and respond to vibrations from impact pile driving at a greater distance based on sound exposure experiments. This in turn suggests that infaunal organisms, such as clams, worms, and amphipods, may exhibit a behavioral response to vibration effects over a larger area, but additional research is needed. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to benthic resources in a limited area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. Bivalve mollusks also have statocysts, cells that sense changes in particle motion to alert them to possible predators and prey in their vicinity, suggesting that this species group could be susceptible to similar impacts. Certain bivalves exhibited behavioral responses to impulsive noise in controlled research. For example, Jézéquel et al. (2022) observed that substrate vibration from impact pile driving caused behavioral responses in Atlantic sea (giant) scallop, specifically rapid closing of shells in response to each pile strike, up to 26 ft (8 m) from the source. No visible responses were observed at 164 ft (50 m) from the source, indicating that these behavioral effects are generally localized to the vicinity of the disturbance. Although the duration of the construction phase is expected to cover 5 months or more, the pile-driving activity at any given site would be on the order of days. Since the WTGs are spaced up to 1 nm apart, impacts from pile driving at other WTGs would not be detectable beyond the area immediately surrounding a WTG. Actual placement of the piles could result in mortality of infaunal and sessile organisms in the immediate area, but affected areas would likely be recolonized in the short term, and the overall impact on benthic resources would be minor.

EMF: No EMF are anticipated to be generated by construction activities; therefore, there is no potential for impacts due to this IPF for this phase.

Discharges and releases: Project-related marine vessels operating during construction would be required to comply with regulatory requirements for management of onboard fluids and fuels, including prevention and control of discharges. Trained, licensed vessel operators would adhere to navigational rules and regulations, and vessels would be equipped with spill containment and cleanup materials. Additionally, Sunrise Wind would comply with applicable International Maritime Organization (IMO) International Convention for the Prevention of Pollution from Ships (MARPOL), federal (USCG), and state (NY) regulations and standards for reporting treatment and disposal of solid and liquid wastes generated during all phases of the Project. Sunrise Wind would file an Emergency Response Plan/Oil Spill Response Plan that would cover accidental discharges and oil spills. Some liquid wastes would be permitted as discharge into marine waters (i.e., domestic water, deck drainage, treated sump drainage, uncontaminated ballast water, and uncontaminated bilge water); these are not expected to pose an adverse impact to marine resources as they would quickly disperse, dilute, and biodegrade (BOEM 2013).

All vessels would similarly comply with USCG standards regarding ballast and bilge water management. Liquid wastes from vessels (including sewage, chemicals, solvents, and oils and greases from equipment) would be properly stored, and disposal would occur at a licensed receiving facility. As required by 30 *CFR* 585.626, chemicals to be utilized during the Project are provided in Appendix E-1 and in Tables 3.3.1-2 and 3.3.6-2 of the COP (Sunrise Wind 2023a). Any unanticipated discharges or releases are expected to result in minimal, short-term impacts; activities are heavily regulated and unpermitted discharges are considered accidental events that are unlikely to occur. In the unlikely event that a reportable spill was to occur, the National Response Center would be notified, followed by the USEPA, BOEM, and USCG, as outlined in Appendix E-1 of the COP (Sunrise Wind 2023a). Because of the restrictions and mitigation measures designed to prevent spills and discharges, and the implementation of spill response plans, the risk to benthic resources from discharges and releases is negligible.

Trash and debris: Any active vessel operating within a marine environment has the potential to create trash and debris; however, the discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by BOEM (30 *CFR* 250.300) and the USCG (MARPOL, Annex V, Pub. L. 100-220 [101 Stat. 1458]). In accordance with applicable federal, state, and local laws, Sunrise Wind would implement comprehensive measures prior to and during Project construction activities to avoid, minimize, and mitigate impacts related to trash and debris disposal. All trash and debris would be properly stored on vessels for later disposal of on land at an appropriate facility per 30 *CFR* 585.626(b)(9). Trash and debris would be contained on vessels and offloaded at port or construction staging areas. Food waste that has been ground and can pass through a 1-in (25-mm) mesh screen may be disposed of according to 33 *CFR* 151.51-77. All other trash and debris returned to shore would be disposed of or recycled at licensed waste management and/or recycling facilities. Disposal of any other form of solid waste or debris in the water is prohibited, and good housekeeping practices would be implemented to minimize trash and debris in vessel work areas including orderly storage of tools, equipment, and materials, as well as proper waste collection, storage, and disposal to keep work areas clean and minimize potential environmental impacts. With proper waste management procedures, the potential for trash or debris to be introduced into the marine environment and cause impacts to the benthic habitat is expected to be negligible.

3.7.5.2 Operations and Maintenance

3.7.5.2.1 Onshore and Nearshore Activities and Facilities

As noted under the construction impacts analyses, there is little to no potential for onshore activities and facilities to affect benthic resources. Once the ICW-HDD is completed, there would be no further activity at the onshore construction site. Therefore, no direct or indirect impacts to benthic resources from any of the IPFs are anticipated due to the O&M of onshore facilities.

EMF: The onshore transmission cable, SRWEC–Transition, SRWEC at the TJB, and the onshore interconnection cable would not be a direct source of any electric field above ground due to the cable construction, duct bank, and burial underground (COP Appendix J2, Exponent Engineering 2022).

3.7.5.2.2 Offshore Activities and Facilities

Seafloor disturbance: Once constructed, the SRWF would result in localized changes to seafloor topography and hydrodynamics due to the presence of foundations, scour protection, and cable protection. The seafloor overlaying the majority of buried IAC (where cable protection would not exist) is expected to return to pre-construction conditions over time and no long-term changes to sediment mobility and depositional patterns are expected. Minimal impacts on benthic species are expected from O&M of the IAC, as they would be buried beneath the seabed; however, seafloor disturbance during O&M of the SRWF may occur during maintenance of bottom-founded infrastructure (e.g., foundations, scour protection, cable protection), anchoring by maintenance vessels for routine maintenance of WTGs or OCS-DC, and non-routine maintenance of the IAC and SRWEC. During O&M, anchoring would be limited to vessels required to be onsite for an extended duration.

Removing soft-bottom habitat may result in both negative and beneficial direct long-term impacts on benthic species. Species that have life stages associated with soft-bottom habitats, such as ocean quahog (*Arctica islandica*), waved and chestnut Astarte clam (*Astarte undata* and *A. castanea*), Atlantic surf clam (*Spisula solidissima*), sand shrimp (*Crangon septemspinosa*), amphipods, channeled whelk (*Busycon carica*), and horseshoe crab (*Limulus polyphemus*), may experience long-term effects as their available habitat would be slightly reduced; however, the completed SWREC alignment and the WTG foundations and OCS-DC within the SRWF would create new benthic habitat structure within the Lease Area. The IAC would likely require targeted surface protection in areas of consolidated glacial drift that are already hard bottom, which would not result in long-term habitat conversion. The COP (Sunrise Wind 2023a) estimates that 101.32 ac (41.00 ha) of hard surface foundation and associated scour protection and 139.36 ac (56.40 ha) of cable associated structures and protections would remain on the seafloor for the life of the Project. When added together, the total acreage that would be converted from soft bottom to hard bottom represents a negligible fraction of the total soft bottom on the southern New England Continental Shelf, but the dispersed nature of the areas may have less predictable effects.

Presence of structures: The installation of up to 94 offshore monopile foundations with associated scour protection would result in the direct disturbance and conversion of benthic habitats. The duration of these impacts would vary depending on the type of benthic habitat impacted. Disturbance of soft-bottom benthic habitat would flatten sand ripples, pits, and depressions and kill or displace habitat-forming invertebrates living on and in the seafloor within the impact footprint. Disturbance of complex benthic habitat during seafloor preparation could change benthic habitat composition by relocating boulders and cobbles and exposing soft substrates. Each WTG would be spaced approximately 1.15 mi (1 nm) from the adjacent WTGs in the array, so these hard bottom analogous habitat areas would create a regular, patchy, higher complexity habitat where epifaunal organisms could attach. The riprap materials surrounding the foundations for scour protection would provide shelter and hiding areas for more mobile organisms such as crabs, squid, and fish. These new hardbottom areas would be analogous, but not identical to, native habitat materials and would therefore not constitute equal quality sites. Differences in surface roughness, size of scour protection materials, and arrangements on the seafloor would affect species colonizing the sites. Colonization of the new seafloor features would take approximately the same time as is estimated for recovery of disturbed habitat, or from several months up to 3 years. The first 4 years of monitoring of the Block Island Wind Farm found that epifaunal communities became well-established on the submerged structures in 3 to 4 years, attached communities were dominated by blue mussels (*Mytilus* edulis), some vertical zonation was observed in the attached communities, and effects spread out from the base structures (Hutchison et al 2020a). The BIWF monitoring observed some succession and hypothesized that additional changes are likely as the benthic community develops. Differences among the rates and species composition of colonization and community changes was attributed to differences in hydrodynamics at the 3 WTGs monitored (Hutchison et al. 2020a). Invasive species were present (e.g., a tunicate, *Didemnum vexillum*), but were not disproportionally present in the surveyed areas as compared to pre-project conditions (Hutchison et al. 2020a).

The Sunrise Wind Project is expected to operate for 25 years or more, so habitat changes would be a long-term feature. The spacing of the SRWF WTGs is close enough to allow for dispersal of gametes and larval forms of attached organisms which may facilitate the progressive colonization of the structures farther offshore.

Once colonized, these complex habitat patches would likely attract other species as a food source, spawning area, or shelter site. As these foundations extend from below the seafloor to above the surface of the water, the development of attached benthic fauna and flora zonation with depth is expected (De Mesel et al. 2015; De Backer and Hostens 2017). Macroalgal zonation may occur ranging from deeper growing red foliose algae and calcareous algae to kelps and other species more common in shallow environments. Other species that may benefit from the increased hard substrate, which would exhibit zonation with depth, include sea anemones and other anthozoans, bivalves such as horse mussel (*Modiolus modiolus*) and blue mussel (*Mytilus edulis*), green sea urchin (*Strongylocentrotus droebachiensis*), barnacles, hydrozoans, sponges, and other fouling organisms (Degraer et al. 2020). Similar effects have been seen at offshore oil rigs where ocean communities develop and resemble those found at natural and artificial reef structures (Chen et al. 2023; Hutchison et al. 2020a). Hutchison et al. (2020a) found that attached fauna including mussels colonized the five turbine foundations and jacket structures at the BIWF within 3 years of construction to the extent that the structures became areas of high biotic diversity and began to proceed through habitat and community successional stages. Although the SRWF is farther offshore and would use a monopole structure different from the BIWF, it is reasonable to expect that similar habitat and community development would occur once construction is completed. Chen et al. (2023) examined samples of sediment infauna and hard substrate epifauna from seven European wind farms ranging in ages from three to 11 years and measured biodiversity at the foundations and scour protection using species richness and abundance. They found that at these sites, all in the North Sea at depths less than 50 m, that species richness increased where hard substrates replace soft bottom areas (on new turbine foundations) and showed an increase over time since installation (Chen et al. 2023). They compared their monitoring results and model predictions to oil and gas platforms used as a reference and found that the that the species richness and abundance values in their “immediate-hard” category were within the range of those oil and gas platforms (Chen et al 2023). The spacing of the SRWF WTGs is close enough to allow for dispersal of gametes and larval forms of attached organisms which may facilitate the progressive colonization of the structures farther offshore. However, the artificial habitat network of the structures provide does not discriminate between native and invasive species in terms of its facilitation of dispersal and range extensions.

The increase in habitat heterogeneity and hard substrate may promote not only the growth of native epibenthic species, as discussed above, but may potentially promote colonization by nonindigenous species and/or range-expanding species. The potential effects of the colonization of non-native and invasive species on the community assemblage and ecosystem function varies by species and abundance. Chen et al. (2023) noted that the ecological effects of shifting the benthic community require monitoring and research to assess whether these effects would be adverse, beneficial, or locally variable. Additionally, epibenthic species from southern regions, such as the Mid-Atlantic, may utilize this novel habitat as their populations move northward as suitable environmental conditions shift northward in response to climatic drivers (i.e., range-expansion species).

Installation of up to 94 of WTGs would likely create individual localized hydrodynamic effects that could have localized effects on food web productivity and pelagic gametes and larvae. Given their planktonic nature, altered circulation patterns could transport pelagic gametes and larvae out of suitable habitat, altering their survivability. These effects would apply to benthic species that produce or prey upon pelagic gametes, eggs, and larvae. These localized hydrodynamic effects would persist throughout the life of the projects until monopiles are decommissioned and removed.

Mobile or attached benthic species utilizing water column habitat could experience localized hydrodynamic effects down current of each SRWF monopile. These effects may be limited to decreased current speeds but could also include minor changes to seasonal stratification regimes. Mobile adults and juveniles would be expected to elicit an avoidance behavioral response away from potential unsuitable habitat due to hydrodynamic effects from monopiles. Sessile and attached species may experience changes in recruitment or survival depending on how the currents affect thermal patterns. Johnson et al. (2021) review of the 12 MW full build-out versus the baseline hydrodynamic model temperature stratification results showed a relative deepening in the thermocline of approximately 1 to 2 m and a retention of colder water inside the offshore wind farm area through the summer months compared to the situation where OSW structures were not present. These localized effects would persist throughout the life of the Project.

Long-term disturbance of the areas required for the SRWEC and SRWF constitute a relatively small percentage of the available habitat in the Lease Area and the OCS, and these impacts would be locally focused and dispersed (Table G-6 in Appendix G). However, the presence of a network of hard surfaces and their subsequent colonization would likely alter the benthic communities for the life of the project. Therefore, the potential for effects to the benthic resources communities due to seafloor disturbance, including the presence of new structures, during Project O&M would include minor to moderate adverse and minor to moderate beneficial impacts.

Sediment suspension and deposition: Increases in sediment suspension and deposition during O&M would result from vessel anchoring and non-routine maintenance activities that require exposing the IAC. Impacts on benthic resources and shellfish resulting from sediment suspension and deposition during these activities are expected to be similar to those discussed for the construction phase but on a more limited spatial scale. Additional organic matter deposition due to the colonization of the new hard bottom habitats and monopiles is likely and may be another factor in the habitat succession in and around these structures.

The reduced level of activities that would contribute to sediment suspension and deposition coupled with the dispersed and intermittent nature of these disturbances suggest that the potential for adverse effects to the benthic resources during O&M of the Project would be negligible.

Noise and vibration: Impacts on benthic and shellfish resources from vessel noise during O&M are expected to be similar to those discussed for construction, though lesser in extent. The noise generated by vessel would be similar to the range of noise from existing vessel traffic in the region and is not expected to substantially affect the existing underwater noise environment. The WTGs would produce low-level continuous underwater noise during operation. Low-frequency sounds are produced when the blades spin, and Elliott et al. (2019) found that direct drive WTGs produced noise levels lower than the older turbines (Kikuchi 2010, Betke et al. 2004). There are no conclusive studies on the impacts of WTG operational noise on benthic species; however, the rapid colonization of underwater structures at operational wind farms suggests that benthic and invertebrate communities would be unlikely to be adversely affected. Noise levels from WTGs operation are not expected to result in injury or mortality of benthic or shellfish species; therefore, impacts due to noise are expected to be negligible.

EMF: Once energized, the Project IAC would produce a magnetic field and an induced electric field that would decrease in strength rapidly with distance. The IAC would be shielded to block the electric field produced by the voltage impressed on the conductors and, where feasible, segments not meeting the target burial depth (2 to 7 ft [0.6 to 2 m]) beneath the seafloor would be protected by additional cover. Submarine transmission cables are sources of magnetic fields as well as induced electrical fields (Snyder et al. 2019). Exposure of marine species to EMF could be short- or long-term, depending on the mobility and behavior of the species/life stage (Woodruff et al. 2012; Love et al. 2015; Love et al. 2016; United Kingdom Department for Business Enterprise and Regulatory Reform 2008).

As detailed in the COP, Appendix J1 (Exponent Engineering 2022), the AC magnetic fields and induced electric fields from operational IAC would decrease quickly with increasing distance. At a height of 3.3 ft (1 m) directly over the cables at peak loading, AC magnetic and induced electric field levels were calculated to be 4.6 mG (0.00046 mT) and 0.09 millivolts per meter (mV/m), decreasing to 0.1 mG (0.00001 mT) and less than 0.01 mV/m or less at a horizontal distance of ±10 ft (3 m) from the cables. Where the SRWEC cables are buried together to a depth of 3.3 ft (1 m), the change in DC magnetic field from that of Earth’s geomagnetic field would be +104 mG (0.0104 mT) with induced electric fields (in an ocean current of 2 ft/sec [0.6 m/s]) of 0.37 mV/m. Based on these modeling results and recent research, the EMF associated with the operation of the IAC, SRWF, and SRWEC would be below the detection capability of most invertebrate species and are unlikely to result in measurable impacts on benthic invertebrate species or populations.

While certain fish and crustacean species are known to detect EMF at static and low AC frequencies (Taormina et al. 2018; Gill et al. 2014), the ability of soft-bodied benthic invertebrates to detect EMF is not as well understood. The levels of EMF from AC subsea cables at the Virginia Offshore Wind Technology Advancement Project site were found to not adversely affect benthic habitats (BOEM 2015). Similarly, the EMFs from subsea cables associated with the BIWF were determined to have no effect on sturgeon or their prey (NMFS 2015). The finding that neither sturgeon nor their prey would be affected by EMF can be extrapolated to the dominant benthic species in the marine portions of the Project Area; the Atlantic sturgeon is a bottom feeder reported to prefer polychaetes and arthropods (Johnson et al. 1997). Based on field data from operational wind projects in Europe and the United States Atlantic coast, and modeling results of potential effects of EMF on managed species, the IAC would have minimal direct long-term impact on benthic and shellfish resources.

Field surveys on the behavior of large crab species and lobster at AC and DC submarine cable sites (Love et al. 2017; Hutchison et al. 2018) suggest that the Project's calculated magnetic field levels (COP Appendix J-1, Exponent Engineering 2022) are not likely to impact the distribution and movement of large epibenthic crustaceans. Ancillary data and observations from these field studies suggest that cephalopod behavior is similarly unaffected by the presence of 60-Hz AC cables. Hutchison (2018; 2020b) assessed the responses of American lobster to a DC cable under field conditions and concluded that EMF resulted in small-scale changes in lobster distribution within the cages, although the cable was not observed to present a barrier to movement. In contrast, two marine crab species on the Pacific coast (Dungeness crab [*Metacarcinus magister*] and *Cancer productus*) were reported to be insensitive to EMF from energized subsea cables (Love et al. 2017). A synthesis paper on the current understanding of potential impacts of EMF on invertebrates concludes that while some studies have shown changes in individuals during laboratory studies, not enough information is available to determine how those changes may extend to the population or community level or ecological processes (Albert et al. 2020). More recent studies including Jakubowska-Lehrmann et al. (2022) reviewed research on bivalves including blue mussels, a species known to occur in the SRWF area, and exposed a cockle (*Cerastoderma glaucum*) to EMF to assess potential effects on this species. The research Jakubowska-Lehrmann et al. (2022) reviewed on blue mussels documented negative effects of EMF expressed as cellular stress responses in blue mussels at EMF levels of 0.3–0.6 mT (3,000 – 6,000 mG). However, the experimental EMF levels are several orders of magnitude higher than what would be experienced by benthic macroinvertebrates living near the IAC (See description from the COP, above). Albert et al. (2022) exposed adult blue mussels to a DC field of 300 µT (3,000 mG) magnetic field treatment using a similar laboratory set up (Helmholtz coils) as Jakubowska-Lehrmann, and found that the mussels did not exhibit observable differences in valve activity and filtration rate, thus suggesting that, at such an intensity, artificial EMFs do not significantly impair their feeding behavior. Both researchers note that additional research is needed, particularly in situ trials, to understand better how EMF may affect different species and life stages of organisms potentially exposed to EMF near wind farms.

A review of noise and EMF effects on crustaceans highlights the lack of consensus on how these stressors affect species and notes the need for monitoring and research to better understand the potential for cumulative and interactive effects to crustaceans and other benthic organisms (Scott et al. 2020). Horseshoe crabs, which are not a true crab, are a unique benthic species that occupies the nearshore areas where the SRWEC would make landfall. Horseshoe crabs are one of the species selected for acoustic telemetry monitoring which may provide information on how this species behaves in relation to the presence of the SRWEC (see Sunrise Wind EFH Assessment, BOEM 2023).

Based on the modeling results and existing evidence, the EMF associated with the vast majority of the cable routes (i.e., where cables are installed together) would be below the detection capability of most invertebrate species and are unlikely to result in measurable impacts on benthic invertebrate species. In a small area (approximately 1 percent at the total length of Project DC cables) at landfall, DC EMFs would be higher than along the HVDC cable route. In this area, fields may be detectable by some species; however, as this represents a small proportion of the total site and available coastal habitat, population-level effects on key invertebrate species are not expected and adverse impacts are expected to remain minor.

Discharges and releases: Impacts from accidental discharges and releases during O&M are expected to be similar to, but of lesser likelihood than during construction, as there would be fewer Project-related marine vessels during this phase, and regulatory requirements and preventative measures would still apply. Unpermitted discharges or releases are considered accidental events, and in their unlikely occurrence, these are expected to result in minimal, short-term impacts. Permitted discharges are not expected to pose an adverse impact to marine resources as they would quickly disperse, dilute, and biodegrade (BOEM 2013).

Operation of the OCS-DC would require the continuous withdrawal and discharge of non-contact cooling water. The daily DIF for the OCS-DC would be 8.1 mgd, and the daily average intake flow would range from 4.0 to 5.3 mgd. The maximum daily average discharge temperature would be 90°F, and the daily average discharge temperature would be 86°F (TRC 2021). The vertical discharge pipe would be oriented downward in the water column, and the thermal effluent would be discharged at a depth of 40 ft (12 m) below local MSL. Hydrothermal modeling determined that this represented the optimal depth for discharge of the heated effluent because rapid and complete mixing would occur and would prevent the thermal plume from migrating to the surface or benthos (TRC 2021). The thermal plume would be contained within 87 ft (26.5 m) of the discharge point and occupy a maximum area of 731 ft^2 (68 m^2) under a worst-case scenario. Further, modeling demonstrated that discharge at this depth would not impact water quality beyond the regulatory mixing zone of 330 ft (100 m) from the point of discharge.

The CWIS would contain an electrochlorination system that would produce chlorinated seawater to prevent biofouling within the system (TRC 2021). The chlorinated seawater would be taken up with raw seawater and directed through the Heat Exchange System and the Dump Caisson. The chlorine concentration that would be added would range from 0.5 ppm up to 2 ppm during infrequent shock dosing. The amount of chlorine added to the seawater would be automatically adjusted so that the chlorine would be completely consumed by potential biofouling organisms within the system to minimize or eliminate the release of hypochlorite through the Dump Caisson. Thus, the release of hypochlorite to the seawater is unlikely to occur.

Sunrise Wind submitted an NPDES permit application to the USEPA in December 2021 for the discharge of water from the OCS-DC (TRC 2021). Section 316(b) of the Clean Water Act requires that NPDES permits for facilities with CWIS ensure that the location, design, capacity, and construction use the best technology available to minimize effects on the environment. Water quality monitoring during operation would occur as specified in the NPDES permit. Because of the restrictions and mitigation measures designed to dissipate the thermal impacts from the cooling water, prevent spills and discharges, and the implementation of spill response plans, the risk to benthic resources from discharges and releases is negligible.

Trash and debris: Impacts from marine disposal of trash and debris during O&M are expected to be similar to, but of lesser likelihood than during construction, as there would be fewer Project-related marine vessels during this phase, and regulatory requirements and preventative measures would still apply. The unanticipated marine disposal of trash and debris is considered an unpermitted, accidental event, and containment and good housekeeping practices would be implemented similar to those described under the construction activities previously. With proper waste management procedures, the potential for trash or debris to be introduced into the marine environment and cause impacts to the benthic resources is expected to be negligible.

3.7.5.3 Conceptual Decommissioning

WTGs and foundations (along with their associated transition pieces) now have an expected operating life of at least 25 years, and substantially longer with prudent inspection and maintenance practices. This timeframe is applicable to offshore wind facilities worldwide, including the SRWF. At the end of the Project's operational life, it would be decommissioned in accordance with a detailed Project decommissioning plan developed in compliance with applicable laws, regulations, and BMPs at that time. The Project is planned with the intent that all components would be removed, and disturbances would be reclaimed at decommissioning. Sunrise Wind would develop a final decommissioning and removal plan for the facility that complies with all relevant permitting requirements that account for changing circumstances, evolving science, and any relevant legislation.

Removing offshore facilities including the SWREC, WTG foundations, and the IAC, would incur impacts similar in extent and magnitude to those described for their construction. Some removal processes may create less adverse impacts than construction; therefore, impacts from decommissioning are not addressed separately in this section, with one exception. The Project's introduction of complex habitat in the offshore environment is expected to result in beneficial impacts, which would be reversed at the time of decommissioning. This reversal of beneficial effects is discussed briefly below for each IPF.

3.7.5.3.1 Onshore Activities and Facilities

As noted under the construction impacts analyses, there is little to no potential for onshore activities and facilities to affect benthic resources. Once the ICW-HDD is completed, there would be no further activity at the onshore construction site. Therefore, no direct or indirect impacts to benthic resources from any of the IPFs are anticipated due to the decommissioning of onshore facilities.

3.7.5.3.2 Offshore Activities and Facilities

Seafloor disturbance: At the end of the Project's operational life, Project structures would be decommissioned in accordance with a detailed Project decommissioning plan that would be developed in compliance with applicable laws, regulations, and BMPs at that time. All facilities would be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 *CFR* 585.910(a)). This plan would account for changing circumstances during the operational phase of the Project and would reflect new discoveries particularly in the areas of marine environment, technological change, and any relevant amended legislation. Absent permission from BOEM, Sunrise Wind would complete decommissioning within 2 years of termination of the lease.

If the human-made structures are to be removed at the end of the Project's operational life, as currently prescribed, this would reverse the expected beneficial impacts on benthic and shellfish resources through the introduction of complex habitat. Over time, the disturbed area is expected to revert to pre-construction conditions, which would result in a beneficial impact for species and life stages that inhabit soft-bottom habitats which as previously noted often recover within 1 to 3 years of disturbance. Overall, habitat alteration from decommissioning is expected to cause minimal impacts because similar soft and hard bottom habitats are already present in and around the SRWF and SRWEC (COP, Appendices M-1 [Inspire 2022a], M-2 [Inspire 2022b], and M-3 [Inspire 2022c]); however, monitoring of the ocean communities in and around the hard bottom habitat, cable protection areas, and monopoles should be used to determine if the array of these habitats has ecological effects across the Lease Area that exceed those expected form the conversion of a relatively small area of the OCS habitat.

A recent review on the impacts of decommissioning engineered structures provides the case for considering alternatives to a mandated complete removal of all engineered structures. The paper emphasizes the potential importance of man-made submerged structures as complex habitats potentially supporting a rich localized food web (Fortune and Paterson 2020). Benthic habitat monitoring at the foundations and the surrounding seabed would document the direct realized effects of these novel hard surfaces on benthic and shellfish resources. Benthic monitoring survey methodologies are outlined in the Fisheries and Benthic Research Monitoring Plan (Appendix AA1 of the Sunrise Wind COP).

Documenting the established epifaunal community that would inhabit the foundations and the infaunal community at the base of these structures would provide information on the habitat value, including its value as refuge and food source for other marine species. The data gathered from these post-construction benthic surveys would be used to inform decommissioning strategies in the future.

Sediment suspension and deposition: Sediment deposition and increases in suspended sediment during decommissioning are expected to be similar in extent, but lower in magnitude and duration for decommissioning phase; however, removal requires excavation to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 *CFR* 585.910[a]), which may disturb some areas more than was required in construction. Recontouring of the seafloor may be required to complete reclamation of areas where structures displaced sediments. Even with these potential increases to sediment disturbance in some aspects of decommissioning, the time for suspended materials to resettle and the time for the benthic areas to recover would be expected to be similar to the 2.5 years estimated for post-construction.

Noise and vibration: Impacts from noise and vibration including excavation and removal of structures during decommissioning are expected to be similar to, but of shorter duration and lesser magnitude than during construction.

EMF: No EMFs are anticipated to be generated by decommissioning activities; therefore, there is no potential for impacts due to this IPF for this phase.

Discharges and releases including trash and debris: Impacts from accidental releases or discharges including marine disposal of trash and debris during decommissioning are expected to be similar to, but of lesser likelihood than during construction, as there would be fewer Project-related marine vessels during this phase, and regulatory requirements and preventative measures would apply. The Project's permits would require a spill response plan, updated to comply with prevailing regulations at this phase of the Project. The unanticipated marine disposal of trash and debris is considered an unpermitted, accidental event, and containment and good housekeeping practices would be implemented similar to those described under the construction activities above. With proper waste management procedures, the potential for trash or debris to be introduced into the marine environment and cause impacts to the benthic habitat is expected to be negligible.

Climate change: Globally, climate change is altering ocean water temperatures, circulation patterns, and oceanic chemistry at local, regional, and continental scales. These changes could indirectly affect benthic habitat and community composition through a variety of mechanisms. As an example, changes in species distributions, migration timings, and general northward shifts in pelagic species evidenced by changes in larval dispersal and adult populations have been documented across many ocean species (Pinsky et al. 2020). These trends would be expected to continue under the Proposed Action alternative. The severity of impacts on benthic habitat resulting from climate change are uncertain but are anticipated to range from minor to moderate adverse and would be effectively permanent. The Proposed Action could also contribute to a long-term net decrease in GHG emissions. This difference may not be easily measurable but would be expected to help reduce climate change impacts.

3.7.5.4 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities. 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 benthic resources through the primary IPFs of seafloor disturbance, presence of structures, and changes to noise and EMF. The proliferation of offshore wind farms and their associated offshore infrastructure have the potential to change attributes of the seafloor environment within the multiple lease areas.

3.7.5.5 Impacts of Alternative B on ESA-Listed Species

There are no ESA-listed threatened or endangered invertebrate or coral species nor are there any benthic species currently proposed for listing in the New England/Mid-Atlantic Region as reported by NMFS (NOAA 2021).

3.7.5.6 Conclusions

Impacts of the Proposed Action

The construction and installation, O&M, and decommissioning of the Proposed Action would impact benthic habitat through several mechanisms, including short-term and long-term habitat disturbance, permanent habitat conversion, and changes in substrate composition and nutrient cycling from reef effects caused by colonization of structures by habitat-forming invertebrates. These effects would alter the structure and function of benthic habitats within the maximum work area, including where cable protection is used, and create new habitat structure that would benefit some fish and invertebrate species. During Project construction, seafloor disturbance and sediment suspension/deposition are expected to affect sessile species and organisms with limited mobility, including early life stages (e.g., larvae and eggs) more than mobile species; however, these impacts, as well as impacts associated with construction noise, are expected to be short-term and cease when construction activity stops. During O&M of the Project, impacts associated with seafloor disturbance, sediment suspension/deposition, and noise are expected to be similar but lesser in extent compared to construction.

Seafloor disturbance activities that result in the conversion of soft sediment habitats to hard bottom habitat associated with foundations, scour protection, and cable protection (e.g., concrete mattresses or rock berms) along portions of the SWREC and IAC routes, are expected to have long-term, minor to moderate adverse and minor to moderate beneficial impacts on benthic organisms, with the beneficial impacts focused on species that rely on complex, hard bottom habitats. Benthic habitat recovery and the recolonization by benthic infaunal and epifaunal species may take up to 1 to 3 years (e.g., Hutchison 2020a; AKRF 2012; Germano 1994; Carey 2020; Hirsch 1978; Kenny 1994). The change in character of the more uniform, low complexity habitat within the Lease Area and the SWREC alignments to patchy, higher complexity habitat would have localized effects on the distribution and number of benthic species and the higher trophic levels such as fish and larger, mobile invertebrates. Because the SRWEC, WTGs, and the IAC would be present for 25 years or longer, these effects may alter the ocean community within the Project boundaries. When placed in soft-bottom habitat, these structures would effectively change the habitat type. When placed in large-grained complex or complex habitat, these structures would either alter the habitat type or modify benthic habitat structure through burial and damage to habitat-forming invertebrates. That habitat structure would recover and would evolve over time into functional benthic habitat as reef effects mature. In all cases, the presence of structures would constitute a long-term to permanent impact to benthic habitat. Decommissioning would remove these hard structures and the organisms that would have attached to them. The removal of these dispersed, higher complexity areas en masse would be a substantial disturbance to the localized benthic communities and there would not be alternative sites of similar character available for recolonization; however, in the context of the OCS and the Mid-Atlantic Bight, these changes would affect a negligible portion of the available habitat.

Inadvertent discharges/releases, trash and debris, and EMF are expected to have negligible adverse impacts on benthic and shellfish resources during construction, O&M, and decommissioning of the Sunrise Wind Project.

None of the IPFs are expected to result in population-level effects on benthic species, due to the scale and intensity of the Project activities, and the availability of similar habitat in the surrounding area. The impacts discussed in this section would vary slightly by habitat composition within the Project Area, but the intensity and duration of the impacts are not expected to exceed the significance criteria for minor effects.

BOEM anticipates the adverse impacts resulting from the Proposed Action alone would range from negligible to moderate. Therefore, BOEM expects the overall adverse impact on benthic resources from the Proposed Action and ongoing activities to be **moderate**, as some of these impacts could persist after the Project is decommissioned, but they would not prevent full recovery of ecosystem function. Additionally, **minor beneficial** impacts may result due to the artificial reef effect (habitat conversion to hard bottom).

Cumulative Impacts of the Proposed Action

In the context of other reasonably foreseeable environmental trends and planned actions, the incremental adverse impacts under the Proposed Action resulting from individual IPFs would range from negligible to moderate, depending on the species and habitat component. Considering all the IPFs together, BOEM anticipates that the Proposed Action and future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, including climate change, and reasonably foreseeable activities would result in **moderate** adverse cumulative impacts on benthic habitat composition and could potentially include **moderate beneficial** cumulative impacts on benthic resources due to the artificial reef effect (habitat conversion). Some of these impacts could persist after the Project is decommissioned, but they would not prevent full recovery of ecosystem function.

The Proposed Action is limited in scale compared to some of the offshore renewable energy projects planned in the GAA. BOEM estimates the Proposed Action and other planned future projects would result in the development of 1,056 WTG and OCS-DC foundations in the RI/MA analysis area as well as up to 108 foundations within the benthic GAA. Some of these projects are larger in scale than the

Proposed Action, and many projects could be developed in adjacent lease areas. Depending on how they are located and distributed, the development of multiple large-scale projects could have broader scale cumulative effects on biological communities than the Proposed Action considered in isolation. More research and project monitoring are needed to determine the likelihood and potential significance of broader cumulative effects on invertebrates and benthic habitats.

3.7.6 Alternative C-1 - Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions

Alternative C-1 would have the same number of turbine locations (94 WTGs) as the Proposed Action that may be approved by BOEM; however, 8 WTG positions from Priority Area 1 would be excluded from consideration for development (Figure 2.1-2). This alternative was determined to be infeasible following additional geotechnical and geophysical surveys that were undertaken by SRW in 2022 on the eastern portion of the lease area. Following the publication of the Draft EIS and analysis of Alternative C-1, the additional geotechnical and geophysical survey data was analyzed and published, which informed the infeasibility of Alternative C-1 due to glauconite sands (see COP Appendix G-3 Foundation Feasibility Assessment dated June 30, 2023, Public Facing Version; Ørsted Offshore North America 2023). Under Alternative C-1, 94 WTGs were proposed for installation in 102 positions, excluding 8 positions from Priority Area 1. However, due to glauconite sands, only 72 of the proposed positions are available for installation under this alternative, which would only produce 792 MW (Table 2.1-6). This renders Alternative C-1 infeasible and led to the development of Alternative C-3 (see Section 2.1.3.3).

There would be no changes to the onshore facilities, the SRWEC alignments, or the construction timeline and activities. The changes proposed in Alternative C-1 would focus on the arrangement and generating capacity of the WTGs and necessary rearrangement of the IAC to accommodate the new spatial arrangements. Therefore, the discussion of impacts in these sections would focus on the attributes that are substantively different from those under the Proposed Action. In addition, the changes in spatial arrangement are unlikely to affect the duration, intensity, or magnitude of the effects described for the following IPFs: noise and vibration, EMF, discharges and releases, or trash and debris. NEPA directs that an EIS focus on the differences among the alternatives to allow evaluation of their comparative merits. This focus does not disregard the impacts previously described, but the reader is directed to review the direct and indirect impacts to benthic resources described under the Proposed Action. A comparison of the alternatives and their potential impacts by IPF is provided in Section 3.7.7.

Under Alternative C-1, the same number of turbine locations (up to 94 WTGs) as under the Proposed Action may be approved by BOEM; however, 8 WTG potential sites from Priority Area 1 along the northern boundary of the Lease Area would be excluded from consideration for development (Figure 2.1-7). NMFS identified four Priority Areas for habitat conservation based on proximity to known Atlantic cod spawning aggregations, multi-beam backscatter data, and the presence of identified large boulders (i.e., > 0.5-1.0 m in diameter) (Figure 2.1-7). NMFS considers these areas of contiguous complex bottom habitat that should be excluded from development to avoid and/or minimize impacts to complex fisheries habitats, while still meeting BOEM’s purpose and need for the Project. The Priority Areas were identified based on recent, preliminary data suggesting limited Atlantic cod spawning activity in the area, assumed hard bottom complex substrate, and the presence of large boulders. Priority Area 1 is considered the highest priority for conservation and includes 18 WTG positions as well as the OCS-DC (Figure 2.1-7). With only eight positions to exclude for Alternative C-1, all 8 WTG positions were eliminated from Priority Area 1. To identify which eight positions to remove, BOEM relied on the locations and densities of boulders in areas of high backscatter returns. Boulders can be considered a critical element of potential sensitive habitat (Gardline 2021). Gardline (2021) identified boulders as objects that (1) returned a strong backscatter signal indicative of hard substrates; (2) were observed to have a distinct shadow or measurable height; and (3) had diameters greater than 1.6 ft (0.5 m). The density of boulders (number of boulders/155 square miles [mi^2; 250 km^2]) on the seafloor surrounding each WTG position was calculated using the ESRI ArcGIS Pro Spatial Analyst Density function (Figure 3.7-4 and Tables B-13 and B-14 in Appendix B [*Supplemental Information and Additional Figures and Tables*]). Although the software calculates the density over a larger area (155 mi^2 [250 km^2]), the project would only clear an area with a radius of 721 ft (0.06 mi^2) (220 m [0.15 km^2]) around each WTG position. Then, boulder densities within NMFS's Priority Area 1 were ranked and the eight contiguous WTG positions with the highest boulder densities within Priority Area 1 were identified for exclusion in Alternative C (Figure 3.7-4).

Boulder densities were highest in WTG position Nos. 87 to 94, with the exception of WTG No. 91, and were identified for exclusion from development (Figure 3.7-4). WTG No. 91 has a slightly lower boulder density (15.6/155 mi^2 [250 km^2]) when compared to WTG No. 96 (16.0/155 mi^2 [250 km^2]); however, WTG No. 91 was chosen for exclusion to provide contiguous fisheries habitat without disturbance. While low densities of boulders occur within Priority Areas 2 and 4, Priority Area 1 was deemed the higher priority due to adjacent proximity to Cox Ledge. The positions identified for exclusion within Alternative C-1 were determined to be most optimal for minimizing fisheries habitat impacts.

This alternative would require a change of the outlay of IAC, which could result in an increase or decrease of the total miles of IAC; however, since the actual locations and arrangement for the IAC have not been defined, the potential change in disturbance acreage cannot be quantified definitively at this time. Table 3.7-5 presents estimates of the different impact areas for Alternative C-1 based on the acres of impact per monopole foundation and miles of IAC per WTG provided in the COP (Sunrise Wind 2023a).

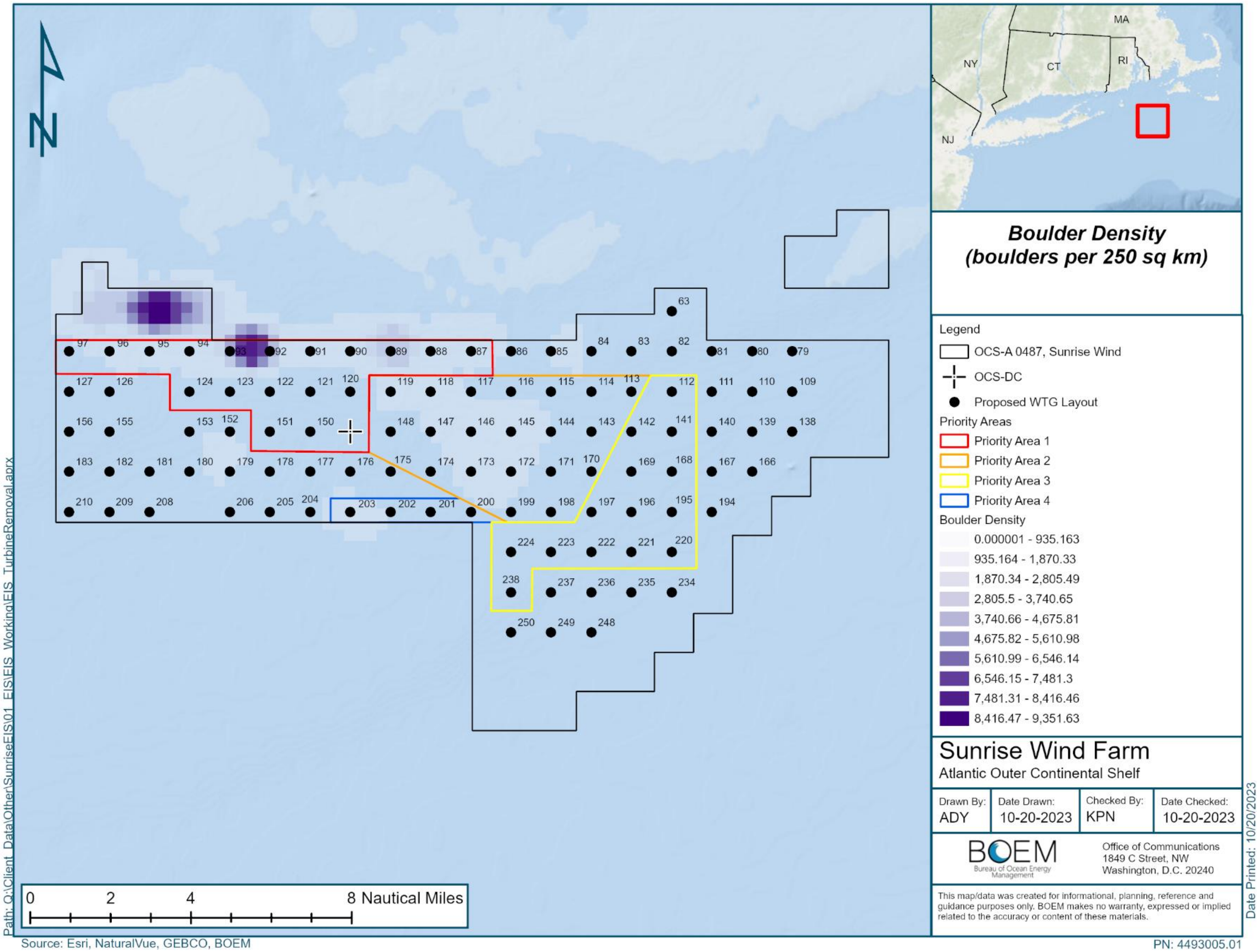

Figure 3.7-4. Boulder Densities within the Sunrise Wind Farm Lease Area

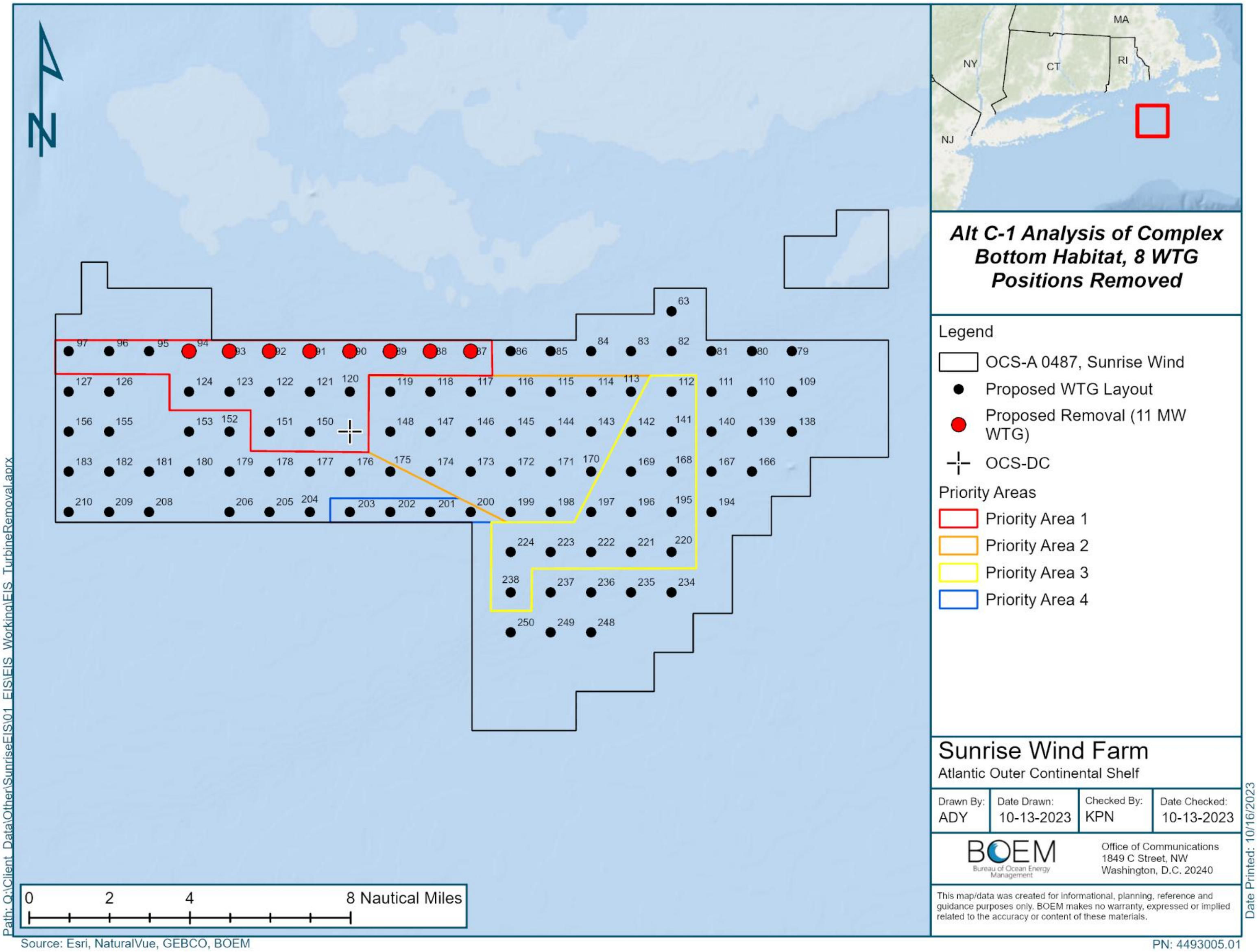

Figure 3.7-5. WTG Positions Identified for Removal under Alternative C-1

3.7.6.1 Construction and Installation

3.7.6.1.1 Onshore Activities and Facilities

No aspect of Alternative C-1 would alter the construction of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to benthic resources due to the construction of the onshore activities or facilities other than what is described under the Proposed Action.

3.7.6.1.2 Offshore Activities and Facilities

As noted above, Alternative C-1 would not change any aspect of the SRWEC alignments described under the Proposed Action; therefore, the discussion of impacts for Alternative C-1 would focus on the SRWF and the Lease Area. Table 3.7-5 summarizes the estimated seafloor disturbance areas under Alternative C-1. These estimates are based on assumptions for disturbance areas for Project components presented in Table 4-1 of the COP, Appendix M3 (Inspire 2022c).

Table 3.7-5. Maximum Potential Impacts to Benthic Habitats by NOAA Habitat Complexity Category from Proposed Alternatives, C-1, C-2, and C-3 Project Design and Associated Assumptions and Information from the COP Related to Areas of Anticipated Impact [1]

Impact Duration	Maximum Construction Disturbance Acres	Proportional Disturbance by Habitat Type		
		Large Grain Complex Acres (%)	Complex Acres (%)	Soft Bottom Acres (%)
Alt B: Proposed Action - Monopile Foundations (94 WTGs) and Scour Protection for WTGs and Cables				
Short-term[2]	**3,761.68**	22.83	1546.82	2192.03
		0.6%	41.1%	58.3%
Long-term[3]	108.13	0.11	40.49	67.53
		0.1%	37.4%	62.5%
Alt-B: Proposed Action - Inter-array Cable and Protections				
Short-term	**1,620.93**	0	627.82	993.11
		0.0%	38.7%	61.3%
Long-term	**760.75**	0	297.68	463.07
		0.0%	39.1%	60.9%
Alt C-1: Monopile Foundations (94 WTGs) and Scour Protection for WTGs and Cables				
Short-term[2]	**3,466.66**	**0**	**1,369.92**	**2,096.74**
		0.0%	39.5%	60.5%
Long-term[3]	**200.41**	**35.53**	**64.67**	**100.21**
		17.7%	32.3%	50.0%
Alt C-1: Inter-array Cable and Protections				
Short-term[4,]	**1,561.20**	**0**	**590.62**	**970.58**
		0.0%	37.8%	62.2%
Long-term[5]	**728.31**	**0**	**276.51**	**451.8**
		0.0%	38.0%	62.0%
Alt C-2: Monopile Foundations (94 WTGs) and Scour Protection for WTGs and Cables				
Short-term	**3,466.63**	**0**	**1,374.46**	**2,092.17**
		0.0%	39.6%	60.4%
Long-term	**99.51**	**0**	**35.09**	**64.42**
		0%	24%	76%
Alt C-2: Inter-array Cable and Protections				
Short-term	**1,671.38**	**0**	**663.06**	**1,008.32**
		0.0%	39.7%	60.3%
Long-term	**773.58**	**0**	**306.52**	**467.06**
		0.0%	39.6%	60.4%
Alt C-3a: Monopile Foundations (87 WTGs) and Scour Protection for WTGs and Cables				
Short-term	**3,206.00**	**22.77**	**1,348.19**	**1,835.04**
		0.7%	42.1%	57.2%
Long-term	**92.86**	**0.11**	**34.88**	**57.87**
		0.1%	37.6%	62.3%
Alt C-3a: Inter-array Cable and Protections				
Short-term	**1,394.56**	**0**	**616.8**	**776.76**
		0.0%	44.2%	55.7%
Long-term	**652.24**	**0**	**285.76**	**366.48**
		0.0%	43.8%	56.2%

Impact Duration	Maximum Construction Disturbance Acres	Proportional Disturbance by Habitat Type		
		Large Grain Complex Acres (%)	Complex Acres (%)	Soft Bottom Acres (%)
Alt C-3b: Monopile Foundations (84 WTGs) and Scour Protection for WTGs and Cables (924 MW)				
Short-term	**3,066.56**	20.76	1,291.01	1,754.79
		0.7%	41.7%	56.7%
Long-term	**87.24**	**0**	**32.42**	**54.82**
		0%	36.1%	61.1%
Alt C-3b: Inter-array Cable and Protections				
Short-term	**1,339.64**	**0**	**566.84**	**772.8**
		0.0%	41.3%	56.2%
Long-term	**627.93**	**0**	**263.82**	**364.11**
		0.0%	41.2%	56.8%
Alt C-3c: Monopile Foundations (80 WTGs) and Scour Protection for WTGs and Cables (880 MW)				
Short-term	**2,915.99**	**13.6**	**1,212.32**	**1,690.07**
		0.5%	41.1%	57.3%
Long-term	**82.94**	**0.0001**	**30.38**	**52.56**
		0.0%	35.5%	61.4%
Alt C-3c: Inter-array Cable and Protections				
Short-term	**1,347.62**	**0**	**581.48**	**766.14**
		0.0%	42.3%	55.8%
Long-term	**625.96**	**0**	**268.39**	**357.57**
		0.0%	42.2%	56.2%

Notes:

[1] Table updated using Table B-2, B-4, and B-6 in the 2023 Essential Fish Habitat Assessment, Appendix B- Habitat and Complexity Impact Calculations and Table 2 from the Updated Habitat Impacts Calculations, October 2023 (Inspire 2023).. The current indicative geographic information system (GIS) layout was used to determine the distribution of benthic habitat types crosswalked to NOAA Habitat Complexity Categories within the total maximum footprint of each Project element. This may result in different total numbers from those presented in the COP; for example, the current indicative IAC network is 164.2 mi (264.3 km) in GIS, whereas the Project Design Envelope (PDE) presented in the COP allows for a 10% increase on this value for a total of 180.2 mi (290 km), allowing for some changes to the length of the IAC as Sunrise Wind further refines its design and construction plans. The total allowable values presented in the COP have been used to calculate the values presented in the "Total Area of Anticipated Impacts to the Seafloor" column.

[2] Estimate uses a 722-ft (220-m) radius around each WTG foundation, which equates to 37.6 ac (15.2 ha) to include the area of seafloor preparation only that surrounds the maximum long-term footprint of the foundation, scour protection, and CPS stabilization is approximately 36.5 ac (14.8 ha) per WTG foundation and around the OCS-DC, for a total of approximately 3,759 ac (1,521 ha) inclusive of all 94 WTGs and the OCS-DC.

[3] Estimates are based on 1.06 ac (0.43 ha) per monopile foundation (foundations + scour protection + CPS stabilization), plus 2.68 ac (1.08 ha) for the OCS-DC. The maximum total area that may be permanently impacted by foundations, scour protection, and CPS stabilization totals 110.76 ac (44.82 ha).

[4] The area of the full IAC corridor of seafloor disturbance represents a conservative assumption for maximum short-term seafloor disturbance; it is anticipated that less than the full area would be temporarily disturbed by seafloor preparation and cable installation activities.

[5] Up to 15% of the entire up to 180-mi-long (290-km-long) IAC network, 27.0 mi (43.5 km), may require cable protection. Cable protection would measure up to 39 ft (12 m) wide. Therefore, an area of up to 129.0 ac (52.2 ha) plus up to 10.36 ac (4.19 ha) additional cable protection at seven of the IAC network crossings may require cable protection. If cable protection were needed across the entire up to 180-mi-long (290-km-long) IAC network, a total of 859.9 ac (348.0 ha) would be needed.

Seafloor disturbance: The intent of the WTG arrangements proposed under Alternative C-1 is to reduce seafloor disturbance in areas of higher habitat complexity and relocate those disturbances to less sensitive habitat types. All other aspects of the impacts related to construction of the SRWF would remain unchanged, and the Applicant Proposed Measures (APMs) and mitigation requirements from state and federal permits would apply as well.

Alternative C-1 would retain the same number of WTGs as the Proposed Action but would remove 8 WTG locations in Priority Area 1 from consideration. These eight sites would be relocated to the southeastern side of the Lease Area. Since the number of WTGs remains unchanged, the total area of disturbance is likely to be unchanged as well; however, the avoidance of the long-term disturbance of approximately 8.53 ac (3.43 ha) of large grain complex and complex habitats (Table 3.7-5) would reduce the overall level of adverse impacts to benthic resources during construction. Relocating the 8 WTGs would remove construction activities in these areas thereby reducing short-term disturbance in these habitats by approximately 300.8 ac (121.7 ha).

Sediment suspension and deposition: The proposed WTG arrangements under Alternative C-1 would shift some of the seafloor disturbance away from more complex habitat areas (refer to short-term area comparisons in Table 3.7-5). Other than this shift in location, there would be no substantive difference in the level or duration of impacts to benthic resources from sediment suspension or deposition as compared to that described under the Proposed Action.

Noise and vibration: Changing the number and location of the WTGs for the SRWF is not likely to appreciably affect the noise or vibration generated during the construction phase of the Project as compared to the Proposed Action. The areas of higher complexity habitat that would be avoided would experience less noise and vibration, but otherwise the mechanisms and levels of impact would be expected to be the same as the Proposed Action.

EMF: There would be no substantive difference in the potential for impacts to benthic resources from EMF under Alternative C-1 as compared to the Proposed Action.

Discharges and releases: There would be no substantive difference in the potential for impacts to benthic resources from discharges or releases under Alternative C-1 as compared to the Proposed Action.

Trash and debris: There would be no substantive difference in the potential for impacts to benthic resources from trash or debris under Alternative C-1 as compared to the Proposed Action.

3.7.6.2 Operations and Maintenance

3.7.6.2.1 Onshore Activities and Facilities

No aspect of Alternative C-1 would alter the O&M of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to benthic resources due to the O&M of the onshore activities or facilities other than what is described under the Proposed Action.

3.7.6.2.2 Offshore Activities and Facilities

Seafloor disturbance: The shift of WTGs out of the higher priority habitat areas on the northwestern portion of the Lease Area would remove impacts to those areas. Otherwise, the expected changes from introducing hard bottom habitat to areas of homogenous soft-bottom habitats would be similar to those described under the Proposed Action. In addition, Alternative C-1 would have the same number of WTGs as the Proposed Action; therefore, the extent of any beneficial impacts to benthic resources from the WTG structures would remain unchanged.

Sediment suspension and deposition: The proposed WTG arrangements under Alternative C-1 would shift some of the seafloor disturbance during O&M away from more complex habitat areas (refer to long- term area comparisons in Table 3.7-5). Other than this shift in location, there would be no substantive difference in the level or duration of impacts to benthic resources from sediment suspension or deposition as compared to that described under the Proposed Action.

Noise and vibration: Changing the location of the WTGs for the SRWF is not likely to appreciably affect the noise or vibration generated during the O&M phase of the Project as compared to the Proposed Action. The areas of higher complexity habitat that would be avoided would experience less noise and vibration, but otherwise the mechanisms and levels of impact would be expected to be that same as the Proposed Action.

EMF: There would be no substantive difference in the potential for impacts to benthic resources from EMF during O&M under Alternative C-1 as compared to the Proposed Action.

Discharges and releases: There would be no substantive difference in the potential for impacts to benthic resources from discharges or releases during O&M under Alternative C-1 as compared to the Proposed Action.

Trash and debris: There would be no substantive difference in the potential for impacts to benthic resources from trash or debris during O&M under Alternative C-1 as compared to the Proposed Action.

3.7.6.3 Conceptual Decommissioning

3.7.6.3.1 Onshore Activities and Facilities

No aspect of Alternative C-1 would alter the decommissioning processes for the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to benthic resources due to the decommissioning of the onshore activities or facilities other than what is described under the Proposed Action.

3.7.6.3.2 Offshore Activities and Facilities

Seafloor disturbance: The shift of WTGs out of the higher priority habitat areas on the northwestern portion of the Lease Area would remove impacts to those areas. Otherwise, the expected changes from removing hard bottom habitat associated with the WTG foundations and support structures and returning those areas to areas of homogenous soft-bottom habitats would be similar to those described under the Proposed Action.

Sediment suspension and deposition: The proposed WTG arrangement under Alternative C-1 would shift some of the seafloor disturbance during decommissioning away from more complex habitat areas (refer to long-term area comparisons in Table 3.7-5). Other than this shift in location, there would be no substantive difference in the level or duration of impacts to benthic resources from sediment suspension or deposition during decommissioning as compared to that described under the Proposed Action.

Noise and vibration: Changing the location of the WTGs for the SRWF is not likely to appreciably affect the noise or vibration generated during the decommissioning phase of the Project as compared to the Proposed Action. The areas of higher complexity habitat that would be avoided would experience less noise and vibration, but otherwise the mechanisms and levels of impact would be expected to be the same as the Proposed Action.

EMF: No EMFs are anticipated to be generated by decommissioning activities under any alternative; therefore, there is no potential for impacts due to this IPF for this phase.

Discharges and releases: There would be no substantive difference in the potential for impacts to benthic resources from discharges or releases during decommissioning under Alternative C-1 as compared to the Proposed Action.

Trash and debris: There would be no substantive difference in the potential for impacts to benthic resources from trash or debris during decommissioning under Alternative C-1 as compared to the Proposed Action.

3.7.6.4 Cumulative Impacts of Alternative C-1

The cumulative impacts of Alternative C-1 considered the impacts of this alternative in combination with other ongoing and planned wind 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 benthic resources through the primary IPFs of seafloor disturbance, presence of structures, and changes to noise and EMF. The proliferation of offshore wind farms and their associated offshore infrastructure have the potential to change attributes of the seafloor environment within the multiple lease areas.

Climate change: There would be no substantive difference in the potential for cumulative impacts to benthic resources from climate change under Alternative C-1 as compared to the Proposed Action.

3.7.6.5 Impacts of Alternative C-1 on ESA-Listed Species

There are no ESA-listed threatened or endangered invertebrate or coral species, nor are there any benthic species currently proposed for listing in the New England/Mid-Atlantic region as reported by NMFS (NOAA 2021).

3.7.6.6 Conclusions

Impacts of Alternative C-1

Relocating 8 WTGs from areas of higher complexity habitat to areas of soft-bottom, homogeneous habitat would reduce the overall adverse impacts of the WTG array on benthic resources. Although this shift may change the IAC array length, the total area of disturbance for WTGs and the IAC within areas of high complexity habitat would be reduced. The magnitude of this reduction would be minor, but in the context of the overall offshore wind development planned in this region, incremental decreases in impacts may have **moderate** adverse and **minor beneficial** impacts to the OCS habitat overall. BOEM expects the overall impacts to be similar to the Proposed Action.

Cumulative Impacts of Alternative C-1

Alternative C-1 does not differ substantially in size or extent from the Proposed Action, and both are limited in scale compared to some of the offshore renewable energy projects planned in the GAA. Most of the offshore wind projects under consideration or development are larger in scale than this alternative, and many projects could be developed in adjacent lease areas. Depending on how they are located and distributed, the development of multiple large-scale projects could have broader scale cumulative effects on biological communities than an individual project considered in isolation. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with Alternative C-1 and future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, including climate change, and reasonably foreseeable activities would result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts on benthic resources due to the artificial reef effect (habitat conversion).

3.7.7 Alternative C-2 - Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions and Relocation of up to 12 WTG Positions to the Eastern Side of the Lease Area

Under the Fisheries Habitat Impact Minimization Alternative C-2, the construction, O&M, and eventual decommissioning of the 11-MW WTGs and an OCS within the proposed Project Area and associated inter-array and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, to reduce impacts to complex fisheries habitats that are the most vulnerable to long-term impacts as compared to the Proposed Action, certain WTG positions would be excluded from development. Under this alternative, the same number of installed WTGs as described for the Proposed Action may be approved by BOEM.

Alternative C-2 was determined to be infeasible following additional geotechnical and geophysical surveys. Following the publication of the DEIS and analysis of Alternative C-2, the additional geotechnical and geophysical survey data was analyzed and published, which informed the infeasibility of Alternative C-2 due to glauconite sands (see COP Appendix G-3 Foundation Feasibility Assessment, June 30, 2023, Public Facing Version; Ørsted Offshore North America 2023). Under Alternative C-2, 94 WTGs were proposed for installation, with the removal of 8 and relocation of 12 WTGs (see Section 3.7.7 for Alternative C-2a-d layouts). Out of the 12 WTG positions identified for relocation, due to glauconite sands, only 3 are feasible for development. Additionally, 22 positions that were part of the original layout were determined to be infeasible for development, resulting in a total of 31 infeasible WTG positions under this alternative. Therefore, only 63 of the proposed positions are available for installation, resulting in only 693 MW, which does not meet the OREC agreement (Table 2.1-6). This renders Alternative C-2 infeasible and led to the development of Alternative C-3 (see Section 2.1.3.3).

This alternative considered and prioritized areas of complex habitat to be excluded from development to avoid and minimize impacts to complex fisheries habitats, while still meeting the purpose and need for the Project. Areas for prioritization were identified by NMFS based on recent, preliminary data suggesting limited Atlantic cod spawning activity in the vicinity of the Project Area, assumed hard bottom complex substrate, and the presence of large boulders (Figure 2.1-7). Priority Area 1 is considered the highest priority for conservation by NMFS and includes 18 WTG positions as well as the OCS-DC. In Alternative C-1, up to 8 WTG positions were identified for relocation to sites outside of this area. For Alternative C-2, this analysis was expanded upon to relocate up to 12 additional WTG positions from the Priority Areas to the eastern side of the Lease Area, in addition to removing up to 8 WTG positions identified in Alternative C-1. This alternative assumes that habitat is more suitable for development on the eastern side of the Lease Area, but surveys conducted in this area in the summer of 2022 found that the southeastern side of the Lease Area contains glauconite substrate that is unsuitable for WTG installation (see Section 2.1.3).

Alternative C-2 considers 4 WTG position configurations (C-2a, C-2b, C-2c, and C-2d) to address NMFS Priority Areas, provide continuous habitat, and avoid boulder fields. All eight positions identified in Alternative C-1 would remain excluded for development in all alternate configurations. An additional 12 WTG positions were selected for relocation based on a similar analysis for Alternative C-1. To identify which 12 positions to relocate, BOEM relied on the locations and densities of boulders in NMFS Priority Areas; boulders can be considered a critical element of potential sensitive habitat (Gardline 2021). Gardline (2021) identified boulders as objects that (1) returned a strong backscatter signal indicative of hard substrates; (2) were observed to have a distinct shadow or measurable height; and (3) had diameters greater than 1.6 ft (0.5 m). The density of boulders (number of boulders/155 mi^2 [250 km^2]) on the seafloor surrounding each WTG position was calculated using the ESRI ArcGIS Pro Spatial Analyst Density function (Table B-2.2 in Appendix B). Then, boulder densities within ranked and multiple configurations were developed to provide options of ideal WTG position configurations. NMFS Priority Areas, highest boulder densities, and maintaining contiguous habitat informed how these alternative choices were developed.

3.7.7.1 Alternative C-2a

Alternative C-2a prioritized excluding up to 8 WTG positions and relocating up to 3 WTG positions along the northern section of Priority Area 1 to maintain continuous habitat, and then excluded up to 9 WTG positions from areas with the highest boulder densities in Priority Area 2 (Figure 3.7-6). The results of this analysis provided continuous habitat but did not remove WTG positions from the lower section of Priority Area 1. Based on available data, lower Priority Area 1 has few to no boulders and non-complex habitat (Table B-2.2 in Appendix B). Habitat within the lower section of Priority Area 1 is soft-bottom habitat consisting of sand and muddy sand, with the exception of WTG positions 122, 123, and 124 which have complex habitat and coarse, mobile sediments but not boulders (Figure 3.7-4). Boulder density at the WTG positions identified for removal/relocation ranged from 0 boulders/155 mi^2 [250 km^2] (WTG No. 97) to 4,665.5 boulders/155 mi^2 [250 km^2] (WTG No. 92).

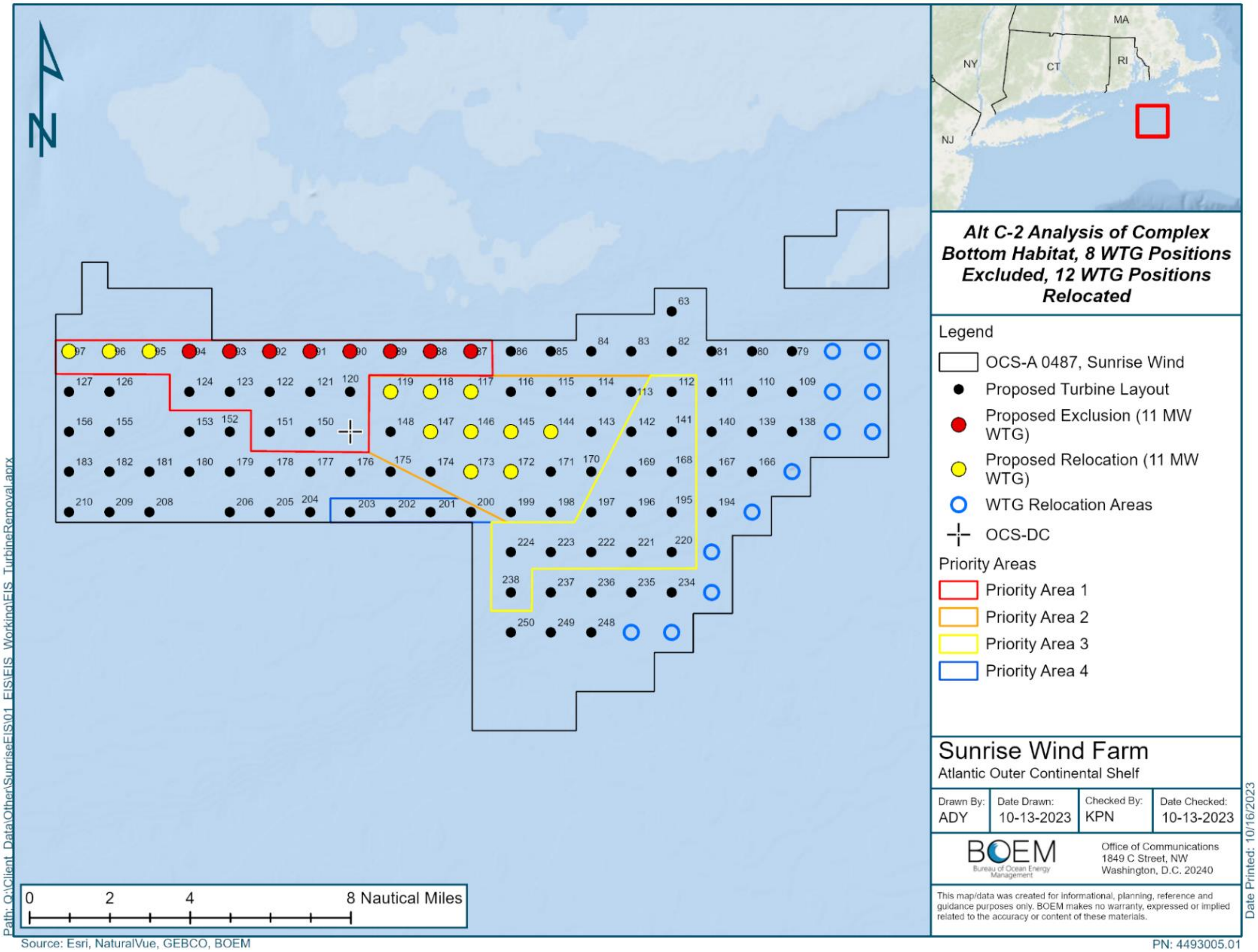

Figure 3.7-6. Alternative C-2a WTG Position Exclusion and Relocation Analysis*

* This alternative is no longer feasible, see Section 2.1.3.2 for details.

3.7.7.2 Alternative C-2b

In Alternative C-2b, WTG positions were excluded within Priority Area 1 if boulders were present. Additional WTG positions were then identified across all the Priority Areas based on boulder density and those WTG positions with the highest densities of boulders were excluded. This resulted in up to 8 WTG positions excluded and up to 2 WTG positions relocated from Priority Area 1, up to 8 WTG positions relocated from Priority Area 2, and then 1 WTG position was relocated from Priority Area 4. Additionally, 1 WTG position was relocated that was not located in a Priority Area (Figure 3.7-7). This alternative does not maintain contiguous habitat but identifies the highest densities of boulders. WTG position Nos. 85 and 203 are isolated from other removal locations. WTG No. 203 is within Priority Area 4 and has a boulder density of 12.4 boulders/155 mi^2 [250 km^2]; WTG No. 85 is not located within a Priority Area and has a boulder density of 15 boulders/155 mi^2 [250 km^2].

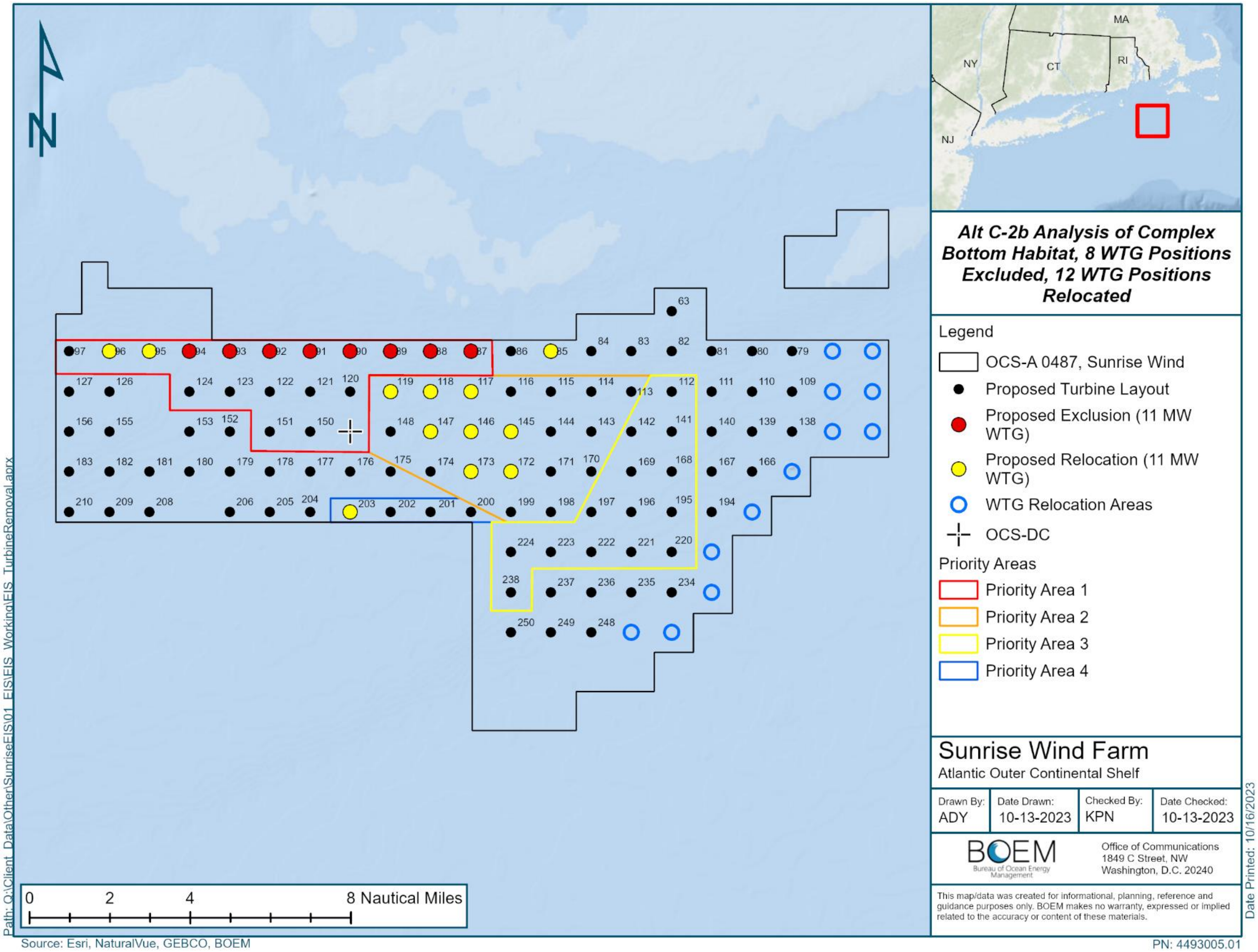

Figure 3.7-7. **Alternative C-2b WTG Position Exclusion and Relocation Analysis***

* This alternative is no longer feasible, see Section 2.1.3.2 for details.

3.7.7.3 Alternative C-2c

Alternative C-2c excluded/relocated up to 16 WTG positions from Priority Area 1 and then relocated up to an additional 4 WTG positions with the highest boulder densities in Priority Area 2 (Figure 3.7-8). This alternative provides continuous habitat with the exception of WTG No. 172 (479 boulders/155 mi^2 [250 km^2]) and WTG No. 173 (204.6 boulders/155 mi^2 [250 km^2]) which are located near the southern portion of Priority Area 2. Initially this alternative was designed to remove all WTG's from Priority Area 1, on September 1, 2023 NMFS recommended adding WTGs 123 and 124 to Priority Area 1. Since this alternative is considered no longer feasible (see Section 2.1.3.2), these new WTG positions were not considered for relocation.

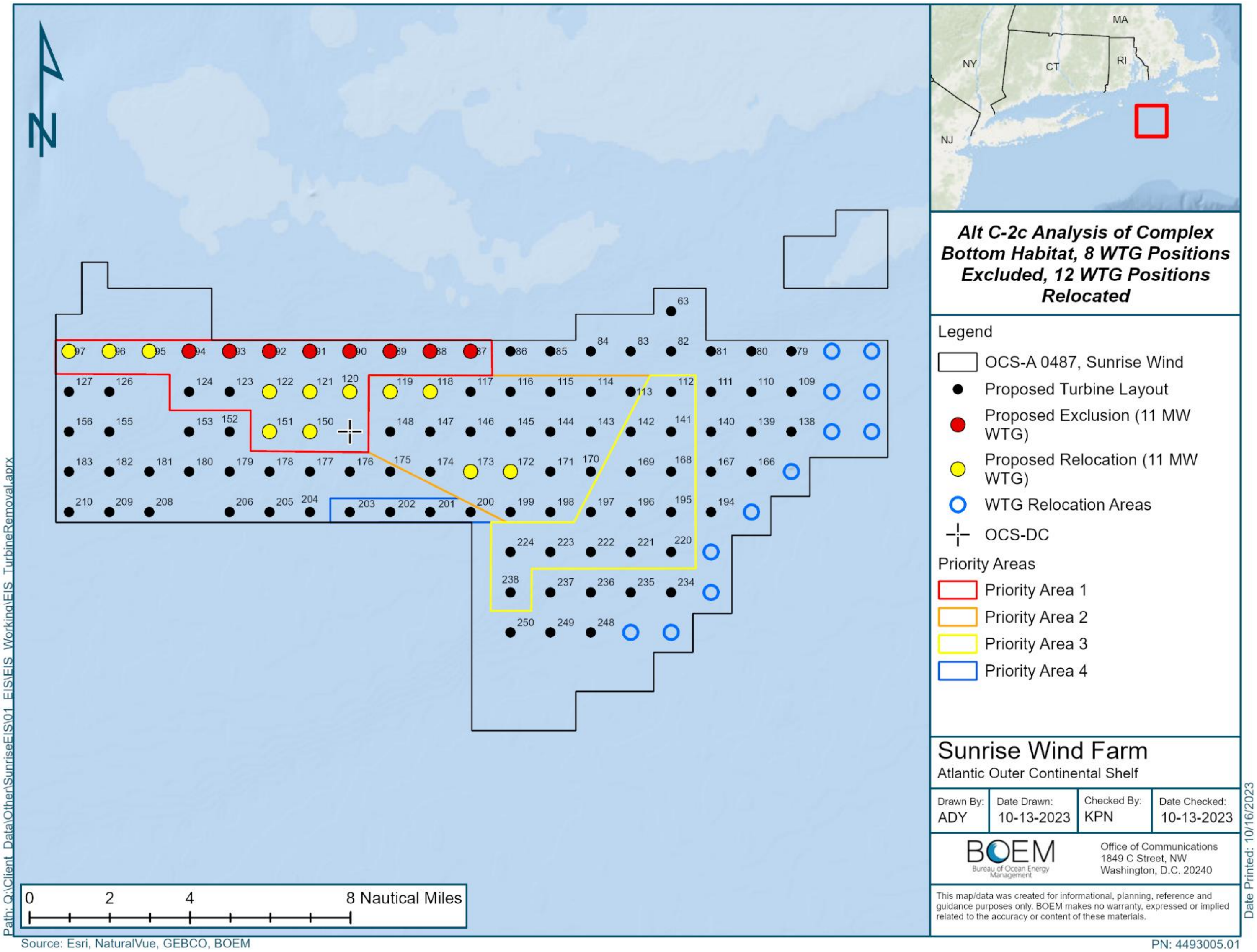

Figure 3.7-8. Alternative C-2c WTG Position Exclusion and Relocation Analysis*

* This alternative is no longer feasible, see Section 2.1.3.2 for details.

3.7.7.4 Alternative C-2d

Alternative C-2d identified the WTG positions with the highest boulder density within Priority Area 1 and excluded/relocated them. Once all WTG positions with boulders in Priority Area 1 were identified for removal/relocation, the analysis moved to Priority Area 2. The remaining up to 9 WTG positions that had the highest boulder densities were identified for removal (Figure 3.7-9). This alternative provides contiguous habitat but excludes WTG No. 97 in the northwestern corner of the Lease Area and Priority Area 1. This alternative provided results similar to Alternative C-2a, the only difference in results was excluding WTG No. 97 from relocation. WTG No. 97 is located in mobile coarse sediment with ripples and complex habitat (Table B-2.2 in Appendix B).

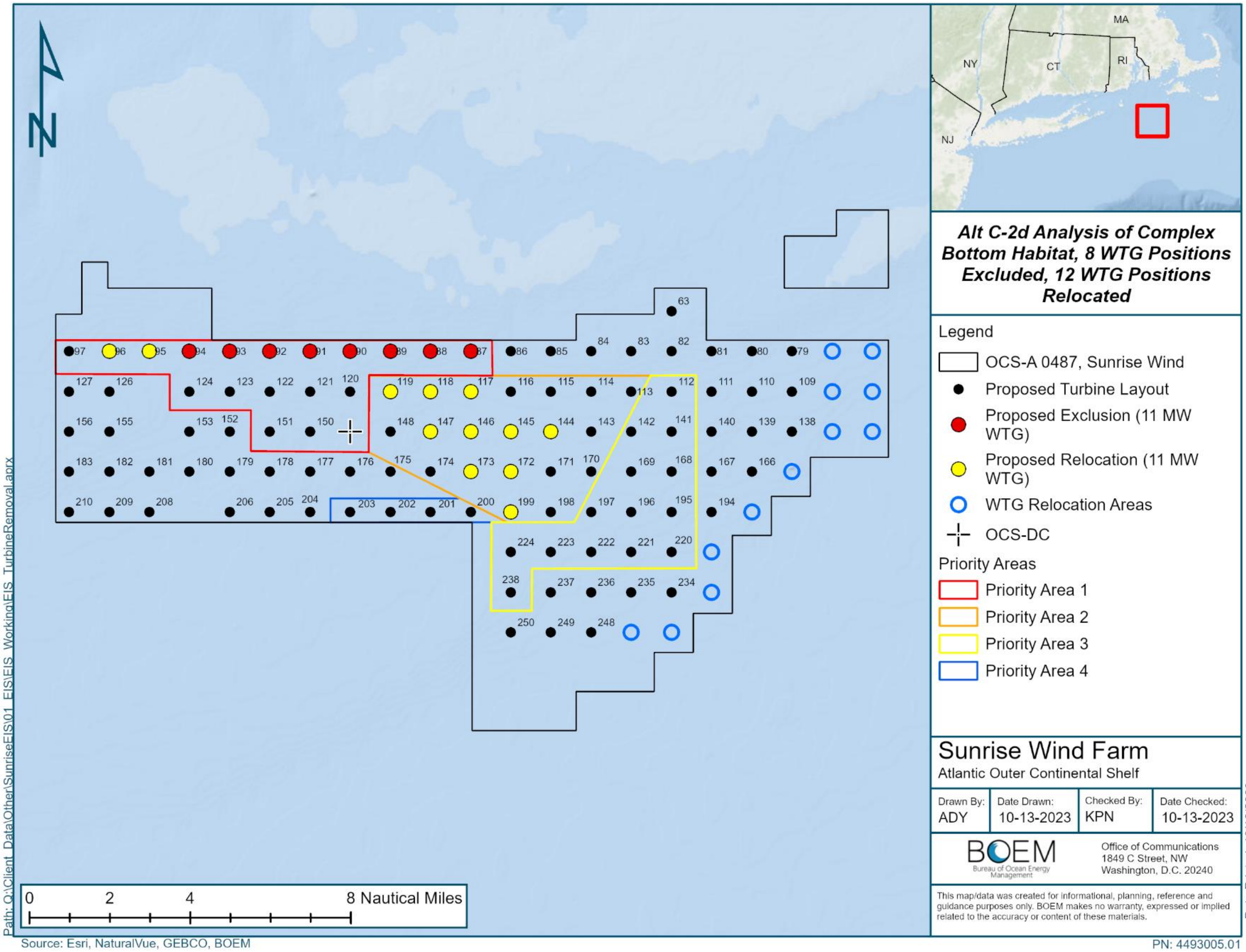

Figure 3.7-9. Alternative C-2d WTG Position Exclusion and Relocation Analysis*

* This alternative is no longer feasible, see Section 2.1.3.2 for details.

3.7.7.5 Construction and Installation

3.7.7.5.1 Onshore Activities and Facilities

No aspect of Alternative C-2 would alter the construction of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to benthic resources due to the construction of the onshore activities or facilities other than what is described under the Proposed Action.

3.7.7.5.2 Offshore Activities and Facilities

As noted above, Alternative C-2 would not change any aspect of the SRWEC alignments described under the Proposed Action; therefore, the discussion of impacts for these alternatives would focus on the SRWF and the Lease Area. Table 3.7-5 summarizes the estimated seafloor disturbance areas for each of the options under Alternative C (C-1 and four variations of C-2). These estimates are based on assumptions for disturbance areas for Project components presented in Table 4-1 of the COP, Appendix M3 (Inspire 2022c).

Seafloor disturbance: The intent of the WTG arrangement proposed under Alternatives C-2 is to reduce seafloor disturbance in areas of higher habitat complexity and relocate those disturbances to less sensitive habitat types. All other aspects of the impacts related to construction of the SRWF would remain unchanged, and the same APMs and mitigation requirements from state and federal permits would apply as well.

Alternative C-2 would exclude the 8 WTG positions described in Alternative C-1 and would shift up to an additional 12 positions to the eastern side of the Lease Area. The avoidance of the approximately 23 ac (9 ha) of large grain complex habitat (Table 3.7-5) for the WTG foundations would reduce the overall level of adverse impacts to benthic resources during construction.

Sediment suspension and deposition: The proposed WTG arrangements under Alternative C-2 would shift some of the seafloor disturbance away from more complex habitat areas (Table 3.7-5). Other than this shift in location, there would be no substantive difference in the level or duration of impacts to benthic resources from sediment suspension or deposition as compared to that described under the Proposed Action.

Noise and vibration: Changing the location of the WTGs for the SRWF is not likely to appreciably affect the noise or vibration generated during the construction phase of the proposed Project as compared to the Proposed Action. The areas of higher complexity habitat that would be avoided would experience less noise and vibration, but otherwise the mechanisms and levels of impact would be expected to be the same as the Proposed Action.

EMF: There would be no substantive difference in the potential for impacts to benthic resources from EMFs under Alternative C-2 as compared to the Proposed Action.

Discharges and releases: There would be no substantive difference in the potential for impacts to benthic resources from discharges or releases under Alternative C-2 as compared to the Proposed Action.

Trash and debris: There would be no substantive difference in the potential for impacts to benthic resources from trash or debris under Alternative C-2 as compared to the Proposed Action.

3.7.7.6 Operations and Maintenance

3.7.7.6.1 Onshore Activities and Facilities

No aspect of Alternative C-2 would alter the O&M of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to benthic resources due to the O&M of the onshore activities or facilities other than what is described under the Proposed Action.

3.7.7.6.2 Offshore Activities and Facilities

Seafloor disturbance: The shift of WTGs and associated IAC out of the higher priority habitat areas on the northwestern portion of the Lease Area would remove impacts to those areas. The Priority Areas have higher levels of boulder density; therefore, it is likely that fewer boulder relocations would be necessary under this alternative which would reduce the adverse impacts to those epifaunal and associated communities. Otherwise, the expected changes from introducing hard bottom habitat to areas of homogenous soft-bottom habitats would be similar to those described under the Proposed Action.

Sediment suspension and deposition: The proposed WTG arrangements under Alternative C-2 would shift some of the seafloor disturbance impacts during O&M from the more complex habitat areas (Table 3.7-5) to the eastern portion of the Lease Area. It is unlikely that this would cause a substantive difference in the level or duration of impacts to benthic resources from sediment suspension or deposition as compared to that described under the Proposed Action.

Noise and vibration: Changing the location of the WTGs for the SRWF is not likely to appreciably affect the noise or vibration generated during the O&M phase of the Project as compared to the Proposed Action. The areas of higher complexity habitat that would be avoided would experience less noise and vibration, but otherwise the mechanisms and levels of impact would be expected to be the same as the Proposed Action.

EMF: There would be no substantive difference in the potential for impacts to benthic resources from EMFs during O&M under Alternative C-2 as compared to the Proposed Action.

Discharges and releases: There would be no substantive difference in the potential for impacts to benthic resources from discharges or releases during O&M under Alternative C-2 as compared to the Proposed Action.

Trash and debris: There would be no substantive difference in the potential for impacts to benthic resources from trash or debris during O&M under Alternative C-2 as compared to the Proposed Action.

3.7.7.7 Conceptual Decommissioning

3.7.7.7.1 Onshore Activities and Facilities

No aspect of Alternative C-2 would alter the decommissioning processes for the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to benthic resources due to the decommissioning of the onshore activities or facilities other than what is described under the Proposed Action.

3.7.7.7.2 Offshore Activities and Facilities

Seafloor disturbance: The shift of WTGs out of the higher priority habitat areas on the northwestern portion of the Lease Area would remove impacts to those areas. As noted under the construction section, some boulders would be avoided and these areas would not need to recover after decommissioning. Otherwise, the expected changes from removing hard bottom habitat associated with the WTG foundations and support structures and returning those areas to homogenous soft-bottom habitats would be similar to those described under the Proposed Action.

Sediment suspension and deposition: The proposed WTG arrangement under Alternative C-2 would shift some of the seafloor disturbance during decommissioning away from more complex habitat areas (Table 3.7-5). Other than this shift in location, there would be no substantive difference in the level or duration of impacts to benthic resources from sediment suspension or deposition during decommissioning as compared to that described under the Proposed Action.

Noise and vibration: Changing the location of the WTGs for the SRWF is not likely to appreciably affect the noise or vibration generated during the decommissioning phase of the proposed Project as compared to the Proposed Action. The areas of higher complexity habitat that would be avoided would experience less noise and vibration, but otherwise the mechanisms and levels of impact would be expected to be that same as the Proposed Action.

EMF: During the decommissioning phase, turbines would cease to be operated and EMFs effects associated with the IAC and SRWEC would be eliminated; therefore, there is the potential for minor beneficial impacts due to the elimination of EMF impacts as a result of decommissioning.

Discharges and releases: There would be no substantive difference in the potential for impacts to benthic resources from discharges or releases during decommissioning under Alternative C-2 as compared to the Proposed Action.

Trash and debris: There would be no substantive difference in the potential for impacts to benthic resources from trash or debris during decommissioning under Alternative C-2 as compared to the Proposed Action.

3.7.7.8 Cumulative Impacts of Alternative C-2

The cumulative impacts of the variations proposed under Alternative C-2 considered the impacts of this alternative in combination with other ongoing and planned wind 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 benthic resources through the primary IPFs of seafloor disturbance, presence of structures, and changes to noise and EMF. The proliferation of offshore wind farms and their associated offshore infrastructure have the potential to change attributes of the seafloor environment within the multiple lease areas.

Climate change: There would be no substantive difference in the potential for cumulative impacts to benthic resources from climate change under Alternative C-2 as compared to the Proposed Action.

3.7.7.9 Impacts of Alternative C-2 on ESA-Listed Species

There are no ESA-listed threatened or endangered invertebrate or coral species, nor are there any benthic species currently proposed for listing in the New England/Mid-Atlantic region as reported by NMFS (NOAA 2021).

3.7.7.10 Conclusions

Impacts of Alternative C-2

Relocating up to 20 WTG positions from areas of higher complexity habitat to areas of soft-bottom, homogeneous habitat could reduce the overall adverse impacts of the WTG array on benthic resources. The magnitude of this reduction would likely be minor, but in the context of the overall offshore wind development planned in this region, impacts would be **moderate** adverse with **minor beneficial** impacts to the OCS habitat overall. BOEM expects the overall impacts to be similar to the Proposed Action.

Cumulative Impacts of Alternative C-2

Alternative C-2 does not differ substantially in size or extent from the Proposed Action, and both are limited in scale compared to some of the offshore renewable energy projects planned in the GAA. Most of the offshore wind projects under consideration or development are larger in scale than this alternative, and many projects could be developed in adjacent lease areas. Depending on how they are located and distributed, the development of multiple large-scale projects could have broader scale cumulative effects on biological communities than an individual project considered in isolation. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with Alternative C-2 and future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, including climate change, and reasonably foreseeable activities would result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts on benthic resources due to the artificial reef effect (habitat conversion).

3.7.8 Alternative C-3 - Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands

Under the Fisheries Habitat Impact Minimization Alternative C-3, the construction, O&M, and eventual decommissioning of the 11-MW WTGs and an OCS within the proposed Project Area and associated inter-array and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. Areas for prioritization were identified by NMFS based on backscatter data, preliminary data suggesting limited Atlantic cod spawning activity in the area (Figure 3.7-10), assumed hard bottom complex substrate, and the presence of large boulders (Figure 3.7-3) (BOEM 2023). However, Alternative C-3 was developed to address concerns regarding pile refusal due to glauconite sands in the southeastern portion of the Lease Area while still minimizing impacts to benthic and fisheries resources. Based on the pile drivability analyses information, up to 22 WTG positions in the southeastern and three of the six positions in the eastern portions of the Lease Area are likely not installable due to glauconite-rich sediment presence. Alternative C-3a, C-3b, and C-3c consider different WTG configurations to avoid sensitive habitats and engineering constraints while still meeting the NYSERDA OREC. This alternative only considered removal of WTGs from Priority Area 1 based on consultation with NMFS. Areas with high density of boulder, complex habitat, and data suggesting Atlantic cod aggregation and spawning were considered when determining which WTGs to remove.

BOEM objectively ranked the WTGs within NMFS Priority Area 1 using a multi-criteria decision algorithm (MCDA). The MCDA ranked alternatives according to a number of decision criteria that included minimizing the standard deviation of backscatter observations within the micrositing buffer and minimizing boulder density (BOEM 2023). The algorithm selected was The Technique for Order Preference by Similarity of Ideal Solution (TOPSIS) for its simplicity, ability to compare criteria with incongruous units (i.e., boulder locations), and a flexibility that allows for tradeoffs. TOPSIS ranks alternatives based on their geometric distance from an ideal solution (i.e., how close the alternative is to the perfect solution). Prior to computing distances, utility scores for each objective are normalized along the same 0 – 1 scale. This way the method can incorporate objective scores with different units (i.e., backscatter and densities). Another advantage of TOPSIS is that not all criteria have to be maximized. Geometric distance is the square root of the difference squared; therefore, preference can be in either direction (positive or negative). TOPSIS allows tradeoffs between criteria, where a poor result in one criterion can be negated by a good result in another.

Observations of the criteria are provided in Table 3.7-6. Boulder density varied within the Project Area (Figure 3.7-4), with densities highest adjacent to Cox Ledge. WTGs that showed higher standard deviations (SD) in backscatter data within the micro-siting area consist of more complex habitat. Table 3.7-6 contains the TOPSIS analysis of WTGs to be removed, where the distance metric represents the distance to the best solution. WTG No. 92 ranked highest for removal/exclusion, while removal/exclusion of WTG No. 120 would be least beneficial for minimizing habitat impacts.

Table 3.7-6. **TOPSIS Analysis for WTGs in Priority Area 1 and Ranking Results, and Status for Each of the Proposed C-3 Arrangements. An X Indicates Locations where WTGs would be Installed.**

Turbine	Backscatter SD	Boulder (#/km^2)	Distance to Best	Rank	C-3a	C-3b	C-3c
92	1	0.919786	1.385563583	1	X	Remove	Remove
89	0.13604	1	1.065851623	2	X	X	X
93	0.156502	0.680459	0.914855718	3	X	Remove	Remove
124	0.747667065	0	0.864677434	4	X	X	X
150	0.627394	0	0.792082229	5	X	X	X
87	0.474531	0.014656	0.69941879	6	X	X	X
96	0.356503	7.33E-07	0.597079553	7	X	X	X
151	0.26316	0	0.512991154	8	X	X	X
121	0.252013	0	0.502009243	9	X	X	Remove
95	0.207951	1.07E-05	0.456027853	10	X	X	Remove
94	0.178996	0.001464	0.424805938	11	X	Remove	Remove
122	0.162894	0	0.403601759	12	X	X	Remove
97	0.153288	0	0.391519511	13	X	X	X
90	0.102467	0.000931	0.321555827	14	X	X	X
88	0.083364	0.001067	0.290569492	15	X	X	X
123	0.018201017	0	0.134911144	16	X	X	X
91	0.006314	2.53E-05	0.079621089	17	X	X	Remove
120	0	0	0	18	X	X	X

Detections of Atlantic cod from telemetry and passive acoustic monitoring (PAM) were then overlaid on the Sunrise Wind Alternative C-3 layout (Figure 3.7-10). Using the ranking data and the Atlantic cod data, BOEM and NMFS collaborated to determine which WTGs would be most appropriate for removal. NMFS guidance to prioritize contiguous habitat, the Atlantic cod observation data from BOEM surveys in 2018, 2019, 2021, and 2022 (Figure 3.7-10); and the TOPSIS analysis were used to develop the Alternative C-3c WTG layout.

To meet the NYSERDA OREC, Alternative C-3a-c added 6 WTGs (WTG Nos. 77, 78, 107, 108, 136, and 137) on the northeast portion of the Lease Area and position 154 on the west side of the Lease Area for further analysis. These positions are outside of the NMFS Priority Areas.

WTG positions were further ranked for priority of removal in the event that some positions are further discovered to be infeasible for installation following further data analysis or during the construction phase. Positions were ranked from 1 to 16, with 1 being the top priority for exclusion of installation.

Table 3.7-7 provides the ranking list for each WTG and the rationale for each removal. Rationale included proximity to Atlantic cod detections and habitat suitability data.

Table 3.7-7. Ranking for WTG Removal and Rational

Rank for Removal	WTG No.	Rationale for Removal
1	93	Closest proximity and overlap with Atlantic cod detection cluster, habitat suitability
2	92	Proximity to cluster of Atlantic cod detections, habitat suitability
3	94	Proximity to cluster of Atlantic cod detections
4	91	Proximity to Atlantic cod detections
5	95	Proximity to Atlantic cod detections
6	123	Proximity to Atlantic cod detections
7	122	Proximity to Atlantic cod detections
8	124	Proximity to Atlantic cod detections, Habitat
9	121	Proximity to Atlantic cod detections, habitat
10	96	Proximity to detection of Atlantic cod in WTG exclusion area, habitat suitability
11	90	Proximity to detection of Atlantic cod just north of the Lease Area and of Atlantic cod to the west of the Lease Area
12	89	High habitat suitability
13	150	High habitat suitability
14	87	High habitat suitability
15	151	Medium habitat suitability
16	97	Low habitat suitability
17	88	Low habitat suitability
18	120	Lowest habitat suitability

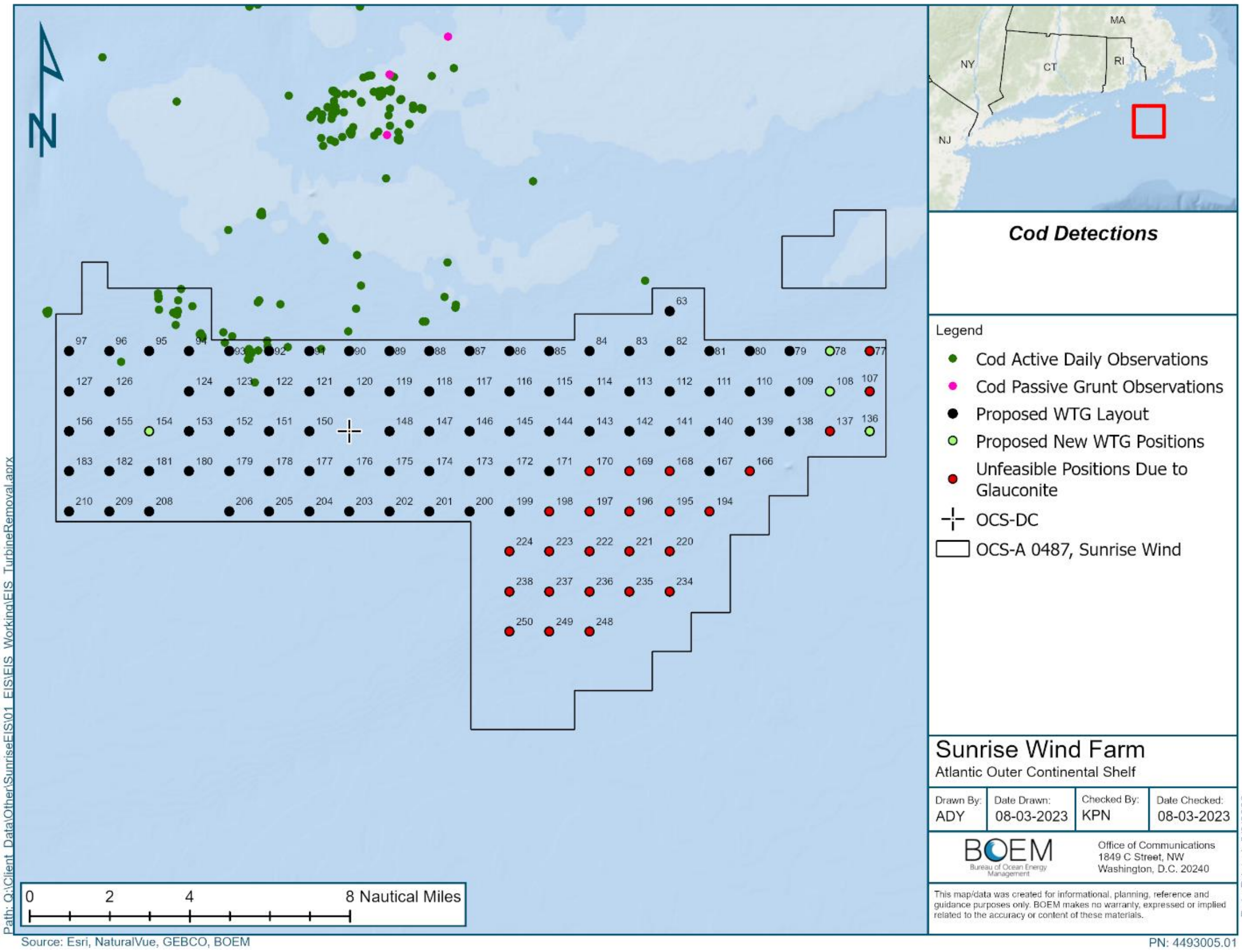

Figure 3.7-10. Cod Detections near the Sunrise Wind Farm with WTG Layout in Alternative C-3

3.7.8.1 Alternative C-3a

Under Alternative C-3a, up to 87 11-MW WTGs would be installed in the 87 potential positions[20]. (Figure 3.7-11). The southeastern portion of the Lease Area would not be developed due to presence of glauconite sands which may result in pile refusal. Two WTG positions would be eliminated due to the glauconite sand presence in Priority Areas 2 and 11 would be eliminated from Priority Area 3. This reduces the potential for habitat impacts in these Priority Areas. The reduction in WTGs reduces the total IAC mileage to 141 mi (226 km). This alternative considers development of the northeastern portion of the Lease Area and WTG No. 154, which is not considered in the Proposed Action. The construction and installation, O&M, and eventual decommissioning of a wind energy facility would occur within the design parameters outlined in the Sunrise Wind Project COP (Sunrise Wind 2023a) subject to applicable mitigation measures. Appendix G-3 Foundation Feasibility Assessment (Public Facing Version;

[20] Based on Appendix G-3 Foundation Feasibility Assessment dated June 30, 2023, only 84 WTGs out of the 87 WTG analyzed are feasible for development. WTG positions No. 77, 107, and 137 were determined to be infeasible due to presence of glauconitic sands (Public Facing Version; Ørsted Offshore North America 2023).

Ørsted Offshore North America 2023) dated June 30, 2023, suggested that all 87 WTG positions might not be installable due to glauconite feasibility issues. BOEM later confirmed WTG Positions 77, 107, and 137 were considered infeasible based on the Foundation Feasibility Assessment, leaving only 84 feasible positions available for this alternative. Consequently, the feasible version of this alternative (with 84 WTGs) is the same as the preferred Alternative C-3(b).

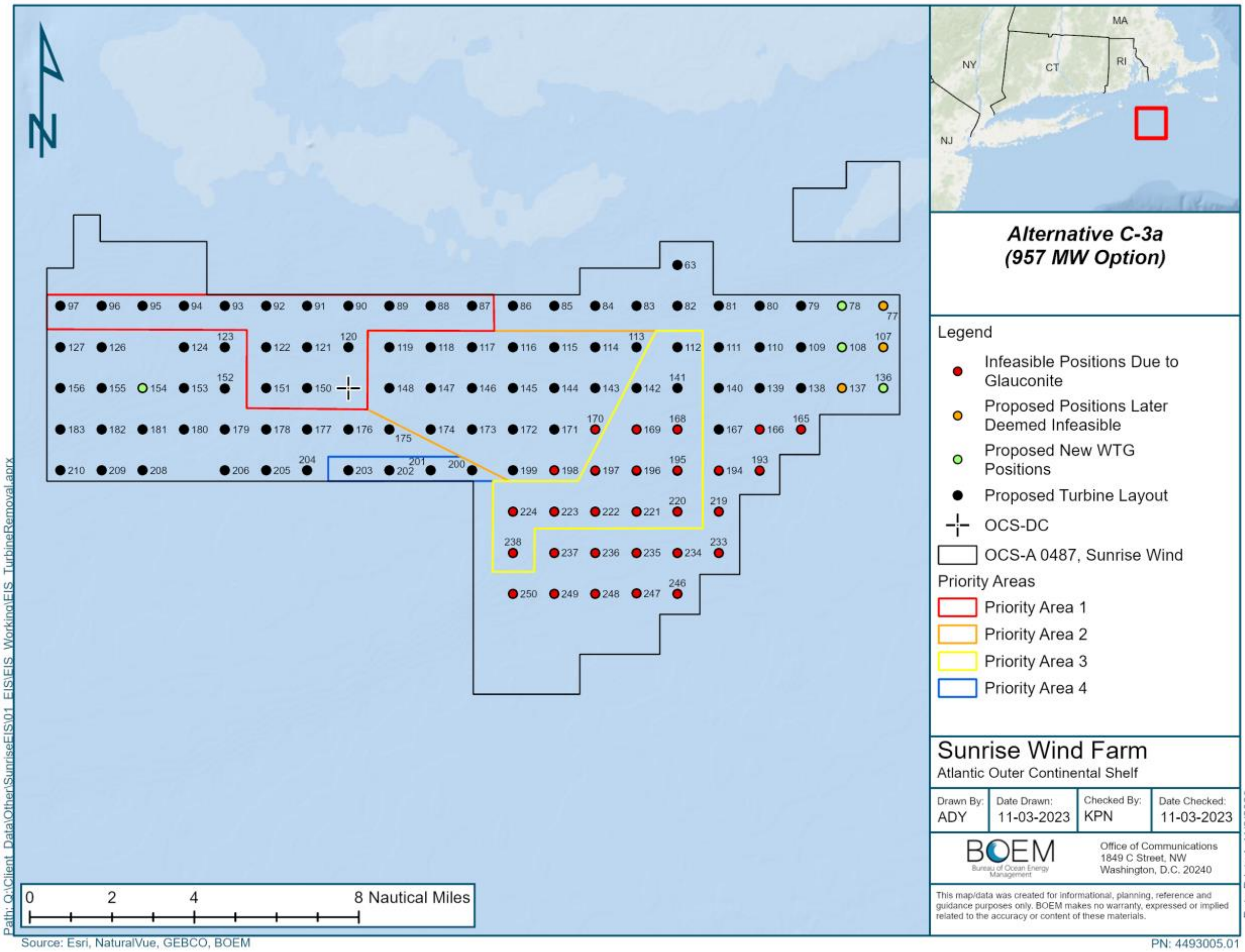

Figure 3.7-11. Alternative C-3a WTG Layout with Priority Areas

3.7.8.2 Alternative C-3b

Under Alternative C-3b, up to 84 WTGs would be installed in the up to 87 potential positions[21] (Figure 3.7-12). The southeastern portion of the Lease Area would not be developed due to presence of glauconite sands which may result in pile refusal. Two WTG positions would be eliminated due to the glauconite sand presence in Priority Areas 2 and 11 would be eliminated from Priority Area 3. This reduces the potential for habitat impacts in these Priority Areas. The reduction in WTGs reduces the

[21] Based on Appendix G-3 Foundation Feasibility Assessment dated June 30, 2023, only 84 WTGs out of the 87 WTG analyzed are feasible for development. WTG positions No. 77, 107, and 137 were determined to be infeasible due to presence of glauconitic sands (Public Facing Version; Ørsted Offshore North America 2023).

total IAC mileage to 135 mi (217 km) (Figure 3.7-13). This alternative considers development of the northeastern portion of the Lease Area and WTG No. 154, which is not considered in the Proposed Action. The construction and installation, O&M, and eventual decommissioning of a wind energy facility would occur within the design parameters outlined in the Sunrise Wind Project COP (Sunrise Wind 2023a) subject to applicable mitigation measures.

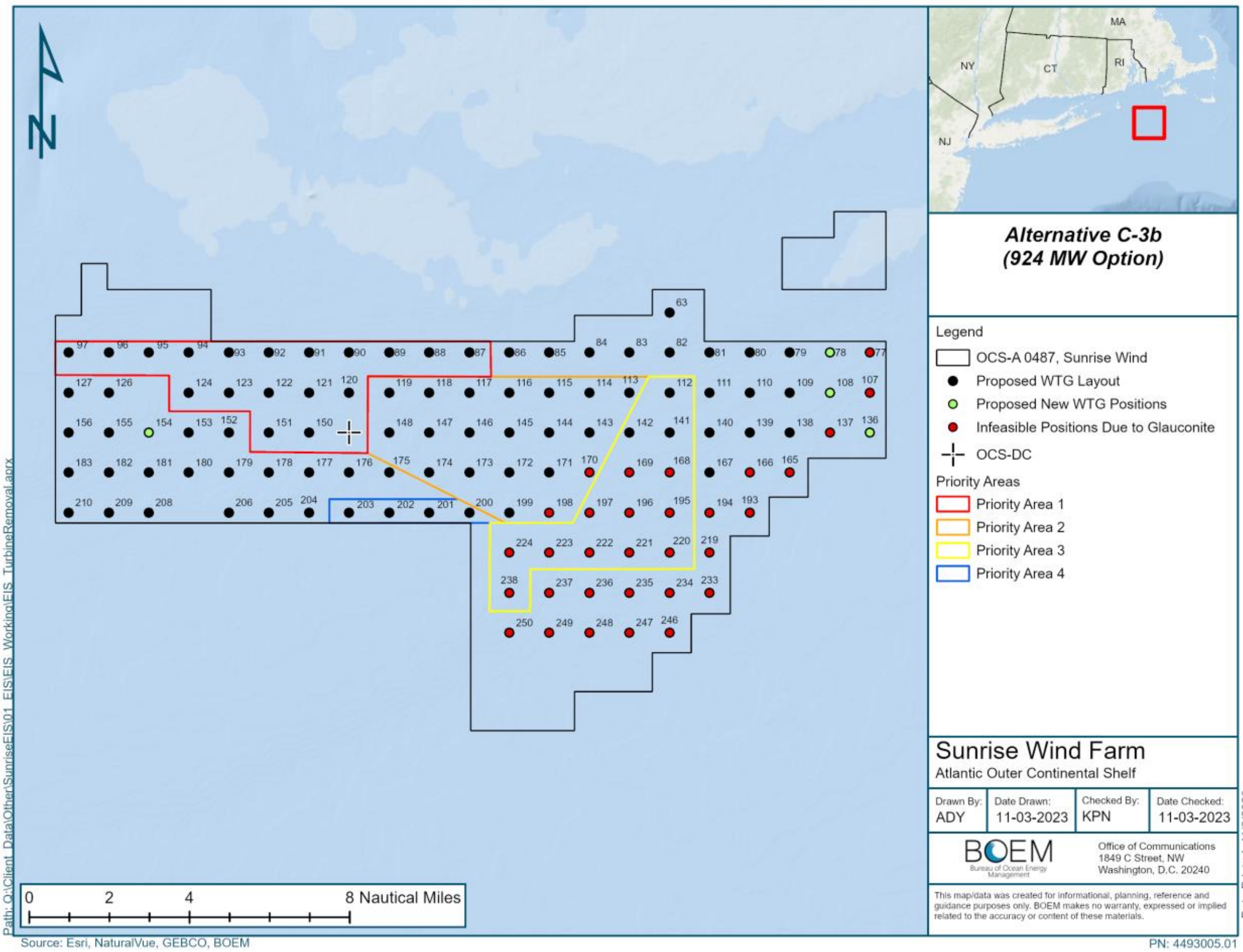

Figure 3.7-12. Alternative C-3b WTG Layout with Priority Areas

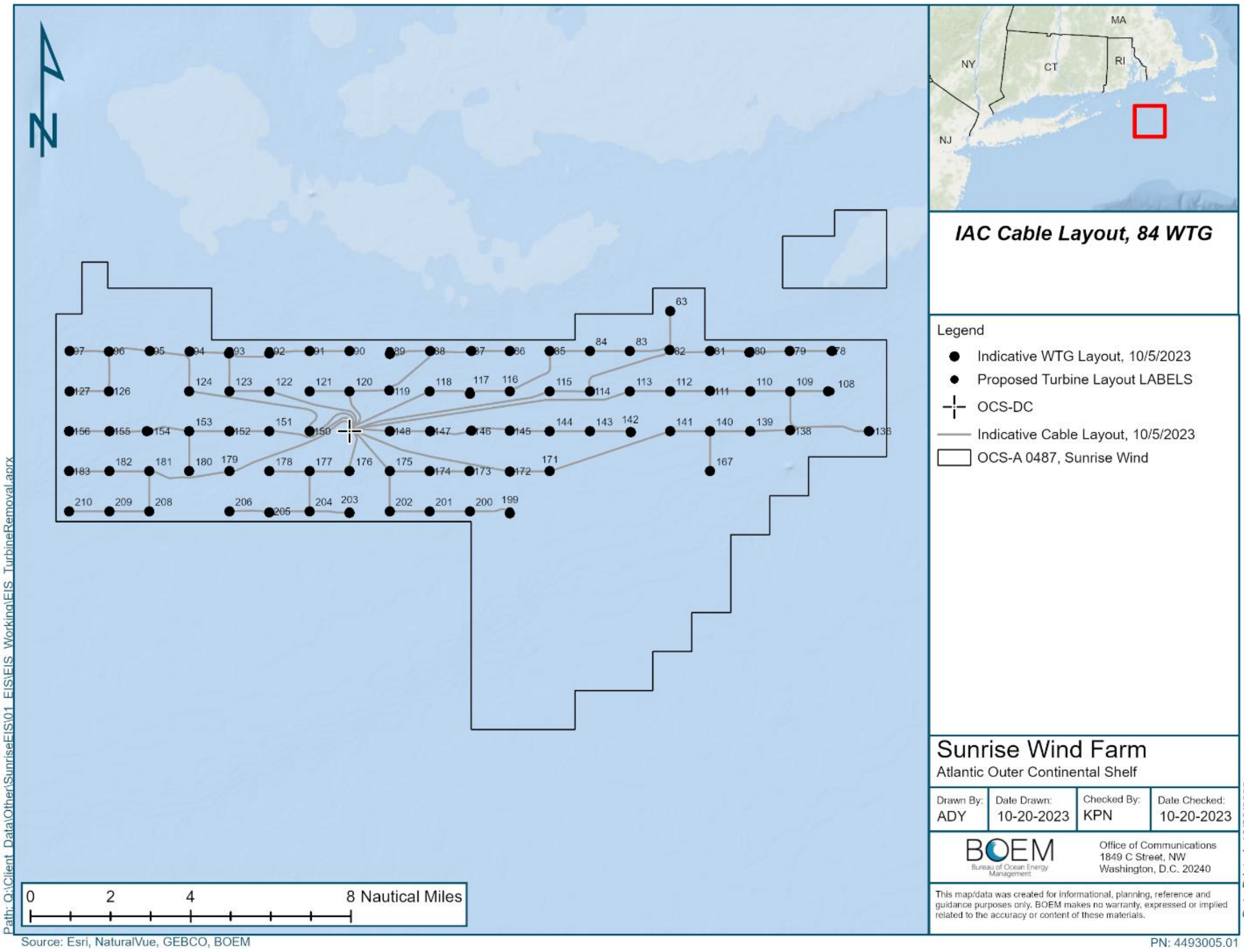

Figure 3.7-13. Indicative IAC Cable Layout for Alternative C-3b (84 WTGs)

3.7.8.3 Alternative C-3c

Under Alternative C-3c, 80 WTGs would be installed in the 87 potential positions (Figure 3.7-14). The southeastern portion of the Lease Area would not be developed due to presence of glauconite sands which may result in pile refusal. Two WTG positions would be eliminated due to the glauconite sand presence in Priority Areas 2 and 11 would be eliminated from Priority Area 3. This reduces the potential for habitat impacts in these Priority Areas. The reduction in WTGs reduces the total IAC mileage to 134 mi (216 km) (Figure 3.7-15). This alternative considers development of the northeastern portion of the Lease Area and WTG No. 154, which is not considered in the Proposed Action. The construction and installation, O&M, and eventual decommissioning of a wind energy facility would occur within the design parameters outlined in the Sunrise Wind Project COP (Sunrise Wind 2023a) subject to applicable mitigation measures. Under Alternative C-3c, WTGs #91 to #94 are excluded from development (Figure 3.7-14). These WTGs were excluded due to proximity to Atlantic cod detections and benthic habitat (Table 3.7-7).

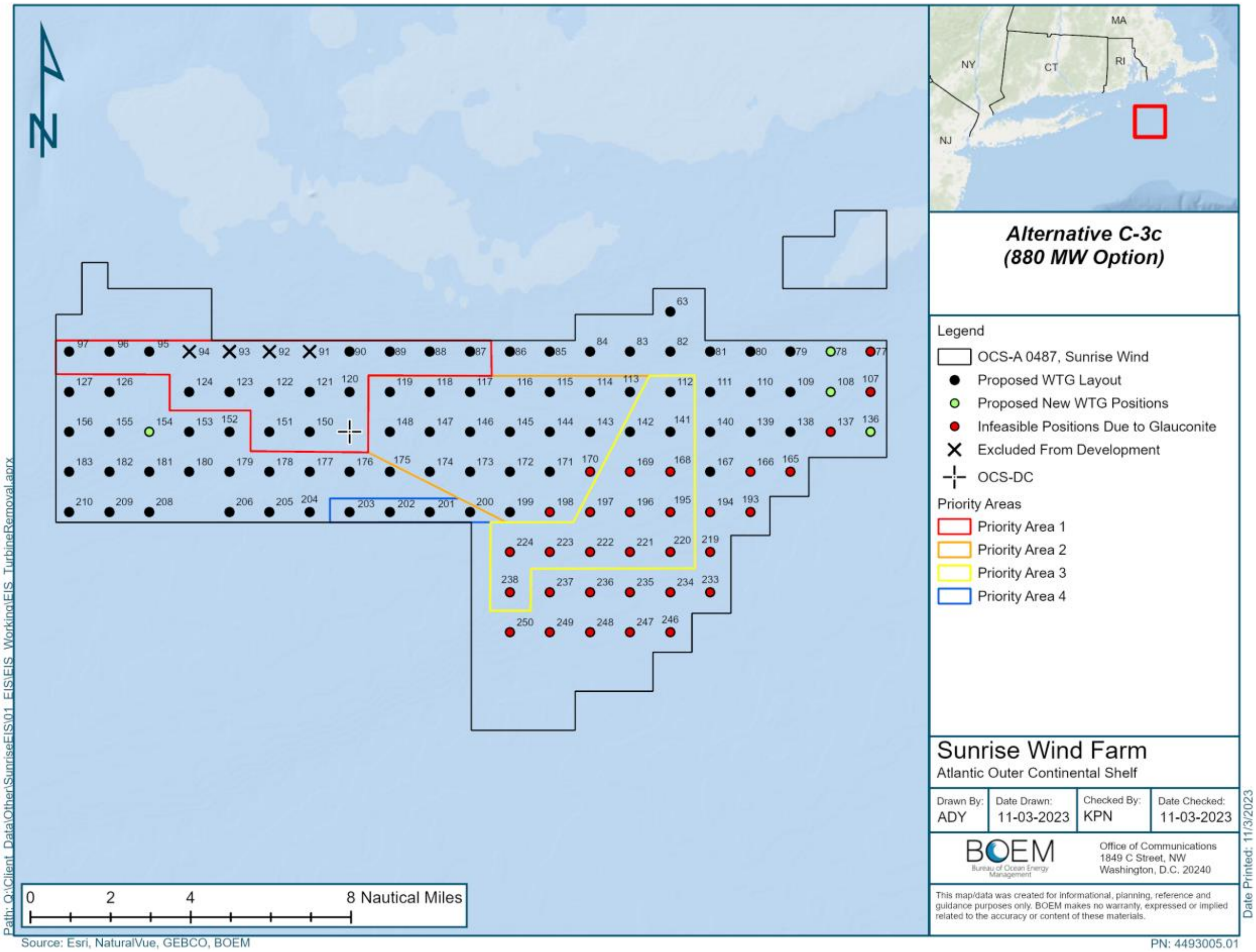

Figure 3.7-14. Alternative C-3c Layout with Priority Areas

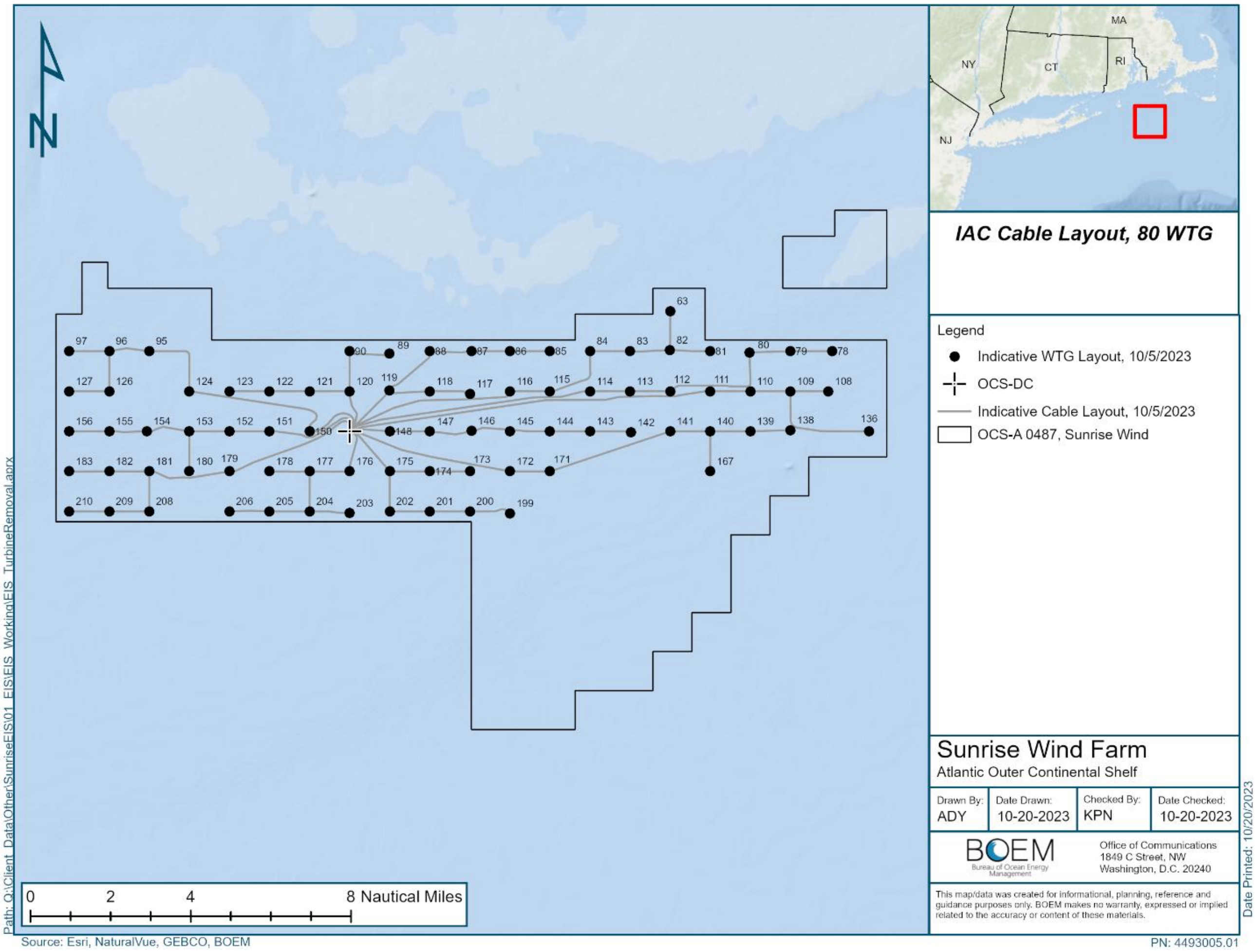

Figure 3.7-15. Indicative IAC Layout for Alternative C-3a (80 WTGs)

3.7.8.4 Construction and Installation

3.7.8.4.1 Onshore Activities and Facilities

No aspect of Alternative C-3 would alter the construction of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to benthic resources due to the construction of the onshore activities or facilities other than what is described under the Proposed Action.

3.7.8.4.2 Offshore Activities and Facilities

As noted above, Alternative C-3 would not change any aspect of the SRWEC alignments described under the Proposed Action; therefore, the discussion of impacts for these alternatives would focus on the SRWF and the Lease Area. Table 3.7-5 summarizes the estimated seafloor disturbance areas for each of the options under Alternative C (C-1, four variations of C-2, and three variations of C-3). These estimates are based on assumptions for disturbance areas for Project components presented in Table 4-1 of the COP, Appendix M3 (Inspire 2022c).

Seafloor disturbance: The intent of the WTG arrangements proposed under Alternatives C-3 is to limit seafloor disturbance in areas of higher habitat complexity and relocate those disturbances to less sensitive habitat types where practicable given the limitations imposed by the presence of glauconite sands in portions of the Lease Area. The C-3 alternatives would install fewer WTGs than the 94 included in the Proposed Action, Alternative C-1, and each of the C-2 arrangements. Alternative C-3a would install 87 WTGs, Alternative C-3b would install up to 84 WTGs, and Alternative C-3c would install 80 WTGs (7, 9, and 14 fewer than the Proposed Action, respectively). The resulting arrangements would reduce temporary and permanent disturbance due to WTG foundations and the total miles of cable needed for the IAC layouts. The IAC layouts for Alternative C-3a, b, and c would completely avoid the southeastern portion of the Lease Area. This would remove the potential for seafloor disturbance for benthic organisms in this portion of the Lease Area. All other aspects of the impacts related to construction of the SRWF would remain unchanged, and the same APMs and mitigation requirements from state and federal permits would apply as well.

Alternative C-3a would install the 8 WTG positions excluded from Alternative C-2, would add up to 6 positions to the eastern side of the Lease Area and install WTG No. 154. The development of the approximately 23 ac (9 ha) of large grain complex habitat (Table 3.7-5) for the WTG foundations would be similar to the overall level of adverse impacts to benthic resources during construction for the Proposed Action.

Sediment suspension and deposition: The proposed WTG arrangements under Alternative C-3 would have similar areas of seafloor disturbance in priority habitat areas as the Proposed Action because 12 to 16 of the 18 WTG locations in Priority Area 1 would be installed (Table 3.7-5). Alternative C-3c removes 4 WTGs from Priority Area 1 and would each reduce the level of sediment suspension and deposition near some of the higher ranked WTG sites (Table 3.7-6). Therefore, there would be some reduction in the level or duration of impacts to benthic resources from sediment suspension or deposition from C-3c as compared to that described under the Proposed Action.

Noise and vibration: Changing the location of the WTGs for the SRWF is not likely to appreciably affect the noise or vibration generated during the construction phase of the proposed Project as compared to the Proposed Action. The areas of soft bottom habitat that would be avoided due to the presence of the glauconite sands would experience less noise and vibration, but otherwise the mechanisms and levels of impact would be expected to be the same as the Proposed Action.

EMF: The IAC layouts for Alternative C-3a, b, and c would completely avoid the southeastern portion of the Lease Area. This would remove the potential for EMF exposure for benthic organisms in this portion of the Lease Area. This would constitute a substantive reduction in the potential for impacts to benthic resources from EMFs under Alternative C-3, but only for this portion of the Lease Area as compared to the Proposed Action.

Discharges and releases: There would be no substantive difference in the potential for impacts to benthic resources from discharges or releases under Alternative C-3 as compared to the Proposed Action.

Trash and debris: There would be no substantive difference in the potential for impacts to benthic resources from trash or debris under Alternative C-3 as compared to the Proposed Action.

3.7.8.5 Operations and Maintenance

3.7.8.5.1 Onshore Activities and Facilities

No aspect of Alternative C-3 would alter the O&M of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to benthic resources due to the O&M of the onshore activities or facilities other than what is described under the Proposed Action.

3.7.8.5.2 Offshore Activities and Facilities

Seafloor disturbance: The Alternative C-3 WTG layouts in Priority Area 1 are very similar to those under the Proposed Action. Alternative C-3 adds up to 3 WTGs on the eastern edge of the Lease Area. The WTGs and associated IAC in the higher priority habitat areas on the northwestern portion of the Lease Area would introduce hard bottom habitats and convert some natural boulder habitat to constructed hard surfaces through boulder relocation. These impacts would be extremely similar to the Proposed Action. The expected changes from introducing hard bottom habitat to areas of homogenous soft-bottom habitats across the Lease Area would be similar to those described under the Proposed Action. As noted under construction, the southeastern area of soft bottom habitat would be avoided and would be expected to have negligible adverse impacts due to O&M activities.

Sediment suspension and deposition: The proposed WTG arrangements under Alternative C-3 would shift some of the seafloor disturbance impacts during O&M from the soft bottom habitat areas in the southeastern areas (Table 3.7-5) to the northwestern portion of the Lease Area. It is unlikely that this would cause a substantive difference in the level or duration of impacts to benthic resources from sediment suspension or deposition as compared to that described under the Proposed Action. As noted under construction, the southeastern area of soft bottom habitat would be avoided and would be expected to have negligible adverse impacts due to O&M activities.

Noise and vibration: Changing the location of the WTGs for the SRWF is not likely to appreciably affect the noise or vibration generated during the O&M phase of the Project as compared to the Proposed Action. The areas of soft bottom habitat that would be avoided would experience less noise and vibration, but otherwise the mechanisms and levels of impact would be expected to be the same as the Proposed Action.

EMF: The IAC layouts for Alternative C-3a, C-3b, and C-3c would completely avoid the southeastern portion of the Lease Area. This would remove the potential for EMF exposure for benthic organisms in this portion of the Lease Area. This would constitute a substantive reduction in the potential for impacts to benthic resources from EMFs under Alternative C-3, but only for the southeastern portion of the Lease Area as compared to the Proposed Action. There would be no substantive difference in the potential for impacts to benthic resources from EMFs during O&M across the rest of the Lease Area under Alternative C-3 as compared to the Proposed Action.

Discharges and releases: There would be no substantive difference in the potential for impacts to benthic resources from discharges or releases during O&M under Alternative C-3 as compared to the Proposed Action.

Trash and debris: There would be no substantive difference in the potential for impacts to benthic resources from trash or debris during O&M under Alternative C-3 as compared to the Proposed Action.

3.7.8.6 Conceptual Decommissioning

3.7.8.6.1 Onshore Activities and Facilities

No aspect of Alternative C-3 would alter the decommissioning processes for the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to benthic resources due to the decommissioning of the onshore activities or facilities other than what is described under the Proposed Action.

3.7.8.6.2 Offshore Activities and Facilities

Seafloor disturbance: The shift of WTGs out of the soft bottom habitat areas on the southeastern portion of the Lease Area would remove impacts to those areas. Otherwise, the expected changes from removing hard bottom habitat associated with the WTG foundations and support structures and returning those areas to their original habitat characteristics would be similar to those described under the Proposed Action.

Sediment suspension and deposition: The proposed WTG arrangement under Alternative C-3 would shift some of the seafloor disturbance during decommissioning away from soft bottom habitat areas (Table 3.7-5). Other than this shift in location, there would be no substantive difference in the level or duration of impacts to benthic resources from sediment suspension or deposition during decommissioning as compared to that described under the Proposed Action.

Noise and vibration: Changing the location of the WTGs for the SRWF is not likely to appreciably affect the noise or vibration generated during the decommissioning phase of the proposed Project as compared to the Proposed Action. The areas of soft bottom habitat that would be avoided would experience less noise and vibration, but otherwise the mechanisms and levels of impact would be expected to be that same as the Proposed Action.

EMF: During the decommissioning phase, turbines would cease to be operated and EMFs effects associated with the IAC and SRWEC would be eliminated; therefore, there is the potential for minor beneficial impacts due to the elimination of EMF impacts as a result of decommissioning.

Discharges and releases: There would be no substantive difference in the potential for impacts to benthic resources from discharges or releases during decommissioning under Alternative C-3 as compared to the Proposed Action.

Trash and debris: There would be no substantive difference in the potential for impacts to benthic resources from trash or debris during decommissioning under Alternative C-3 as compared to the Proposed Action.

3.7.8.7 Cumulative Impacts of Alternative C-3

The cumulative impacts of the variations proposed under Alternative C-3 considered the impacts of this alternative in combination with other ongoing and planned wind 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 benthic resources through the primary IPFs of seafloor disturbance, presence of structures, and changes to noise and EMF. The proliferation of offshore wind farms and their associated offshore infrastructure have the potential to change attributes of the seafloor environment within the multiple lease areas.

Climate change: There would be no substantive difference in the potential for cumulative impacts to benthic resources from climate change under Alternative C-3 as compared to the Proposed Action.

3.7.8.8 Impacts of Alternative C-3 on ESA-Listed Species

There are no ESA-listed threatened or endangered invertebrate or coral species, nor are there any benthic species currently proposed for listing in the New England/Mid-Atlantic region as reported by NMFS (NOAA 2021).

3.7.8.9 Conclusions

Impacts of Alternative C-3

Reducing the total WTGs proposed for the Lease Area from 94 to between 80 and 87 locations would have a commensurate reduction in the total area disturbed for construction as well as the total acres of habitat that would be converted from native habitat conditions to engineered hard surface and armored areas. Permanent impacts (in acres) to large grained complex habitat from each of the C-3 arrangements would be slightly less the Proposed Action (Table 3.7-10.). Temporary and permanent impacts from WTGs to habitat for all Alternatives can be found Table 3.7-10. and Table 3.7-11. The largest reductions in disturbance and impacts would be seen in soft bottom habitats, stemming from the need to avoid the southeastern portion of the Lease Area due to the glauconite sands. Under Alternative C-3c, relocating up to 6 WTG positions from areas of higher complexity habitat to areas of soft-bottom, homogeneous habitat on the eastern edge of the Lease Area could reduce the overall adverse impacts of the WTG array on benthic resources. The magnitude of this reduction would likely be minor, but in the context of the overall offshore wind development planned in this region, incremental decreases in impacts may have **moderate** adverse and **minor beneficial** impacts to the OCS habitat overall. BOEM expects the overall impacts to be similar to the Proposed Action.

Cumulative Impacts of Alternative C-3

Alternative C-3 does reduce the total number of WTGs by as much as 14 locations; however, the reduction does not differ substantially in size or extent of impacts to the more complex and sensitive habitats from the Proposed Action. The Sunrise Wind Project is limited in scale compared to some of the offshore renewable energy projects planned in the GAA. Most of the offshore wind projects under consideration or development are larger in scale than this alternative, and many projects could be developed in adjacent lease areas. Depending on how they are located and distributed, the development of multiple large-scale projects could have broader scale cumulative effects on biological communities than an individual project considered in isolation. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with Alternative C-3 and future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, including climate change, and reasonably foreseeable activities would result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts on benthic resources due to the artificial reef effect (habitat conversion).

3.7.9 Comparison of Alternatives

The three action alternatives differ primarily in the locations of the WTGs with respect to complex habitat. The focus of the fisheries habitat minimization alternatives to the Proposed Action (Alternative B) is on reducing short- and long-term disturbance in the Priority Areas by removing up to 8 WTG positions from the areas with complex habitat features and shifting 8 to 20 WTGs from the northwestern side of the Lease Area where complex habitat is more common to the eastern side where benthic habitat is assumed to be predominately soft-bottom and homogeneous. Alternatives C-1 and C-2 assume that fewer WTGs would be located in higher-value habitat and would reduce the overall impacts to this resource compared to the Proposed Action (Table 3.7-8). Similarly, the 8 and 20 WTG positions proposed to be relocated under Alternatives C-1 and C-2, respectively, would shift impacts from higher-value habitat areas to more homogeneous areas, but the actual locations are not yet finalized.

The arrangements proposed under Alternative C-3 would reduce the total WTGs proposed for the Lease Area from 94 to between 80 and 87 locations and would have a commensurate reduction in the total area disturbed for construction as well as the total acres of habitat that would be converted from native habitat conditions to engineered hard surface and armored areas. Temporary and permanent impacts from WTGs to habitat for all Alternatives can be found in Table 3.7-10. and Table 3.7-11. The largest reductions in disturbance and impacts would be seen in soft bottom habitats, stemming from the need to avoid the southeastern portion of the Lease Area due to the glauconite sands.

Preliminary estimates of the reductions in impacts to higher complexity habitat based on the planned relocations described for Alternatives C-1, C-2, and C-3 are presented in Table 3.7-9. Under Alternative C-3b, 81 (891 MW) to 84 WTGs (924 MW) could be developed. Table 3.7-9 and Table 3.7-10. shows the habitat impacts for each of these scenarios based on the WTG ranking for removal in Table 3.7-7.

Table 3.7-8. Comparison of Alternative Impacts Benthic Habitat Impacts

No Action Alternative Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
No Action Alternative: Construction and long-term addition of up to 944 new WTGs and associated foundations in the MA/RI WEA could result in artificial reef effects that influence benthic community structure within and in proximity to the project footprints. Impacts to benthic resources could range from **minor beneficial** for organisms associated with hard surfaces to **moderate** adverse for organisms associated with soft bottom habitat, which would experience losses in total area. Construction activities including cable placement and WTG development would disturb the sea floor, creating plumes of fine sediment that would disperse and resettle in the vicinity. Generally effects would be short term and	*Proposed Action:* BOEM anticipates the impacts resulting from the IPFs associated with Proposed Action alone would range from negligible to moderate. Therefore, BOEM expects the impact on benthic resources from the Proposed Action and ongoing activities to be **moderate** adverse, as the overall effect would be notable, but would not prevent full recovery of ecosystem function. The primary components with potential to affect benthic resources include seafloor disturbance, the addition of hard surfaces and structures, and sediment suspension and deposition. Additionally, **minor beneficial** impacts may result due to the artificial reef effect from the addition of hard surface habitat	*Alternative C-1:* Impacts resulting from the relocation of the 8 WTGs would be minor, but in the context of the overall offshore wind development planned in this region, incremental decreases in impacts may have **minor beneficial** impacts to the OCS habitat overall. BOEM expects the overall impact on benthic resources to be similar to the Proposed Action, **moderate** adverse. *Cumulative Impacts of Alternative C-1:* Considering all the IPFs together, BOEM anticipates that the overall impacts associated with Alternative C-1 and future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, including	*Alternative C-2:* Impacts resulting from the relocation of the 20 WTGs would be minor, but in the context of the overall offshore wind development planned in this region, incremental decreases in impacts may have **minor beneficial** impacts to the OCS habitat overall. BOEM expects the overall impact on benthic resources to be similar to the Proposed Action, **moderate** adverse. *Cumulative Impacts of Alternative C-2:* Considering all the IPFs together, BOEM anticipates that the overall impacts associated with Alternative C-2 and future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, including	*Alternative C-3:* Reducing the total WTGs for the project would reduce temporary impacts due to sea floor disturbance. Permanent impacts to sea floor habitats would be reduced by similar percentages. Most of these reductions would occur in soft bottom habitats. These incremental decreases in impacts may have **minor beneficial** impacts to the OCS habitat overall. BOEM expects the overall impact on benthic resources to be similar to the Proposed Action, **moderate** adverse. *Cumulative Impacts of Alternative C-3:* Considering all the IPFs together, BOEM anticipates that the overall impacts associated with Alternative C-3 and future offshore wind

No Action Alternative Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
duration, but could have intense effects on the organisms in close proximity to the disturbances. Suspended sediment concentrations close to disturbances could exceed levels associated with behavioral and physiological effects for benthic organisms but would dissipate with distance and would generally return to baseline conditions within a few hours. Therefore, there may be short term **moderate** adverse effects on benthic organisms but long-term effects would be less likely. *Cumulative impacts of the No Action Alternative:* BOEM expects the combination of ongoing activities and reasonably foreseeable activities other than offshore wind to result in **moderate** adverse cumulative impacts on benthic resources, primarily driven by ongoing dredging and fishing activities. BOEM anticipates that the overall impacts associated with future offshore	(habitat conversion to hard bottom). *Cumulative Impacts of the Proposed Action:* In the context of other reasonably foreseeable environmental trends and planned actions, the incremental impacts under the Proposed Action resulting from individual IPFs would range from negligible to moderate, depending on the species and habitat component. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with the Proposed Action and future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, including climate change, and reasonably foreseeable activities would result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts on benthic resources due to the	climate change, and reasonably foreseeable activities would result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts on benthic resources due to the artificial reef effect (habitat conversion to hard bottom).	climate change, and reasonably foreseeable activities would result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts on benthic resources due to the artificial reef effect (habitat conversion to hard bottom).	activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, including climate change, and reasonably foreseeable activities would result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts on benthic resources due to the artificial reef effect (habitat conversion to hard bottom).

No Action Alternative Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, and reasonably foreseeable activities other than offshore wind would result in **moderate** adverse cumulative impacts and could potentially include **moderate beneficial** impacts on benthic resources due to the artificial reef effect (habitat conversion).	artificial reef effect (habitat conversion).			

Table 3.7-9. Comparison of Preliminary Estimate of the Changes in Impacts from WTGs to Higher Complexity Habitat Based on the Planned Relocations Described for Alternatives B, C-1, C-2, and C-3 (BOEM 2023)

Sunrise Offshore Wind Farm Proposed Project Design	Unit of Measure	NOAA Complexity Category			
		Large-Grained Complex	Complex	Soft Bottom	Total
Alternative B, Proposed Action					
Total Permanent Impacts of WTGs	Acres	0.11	40.49	67.53	108.13
	%	0%	37.4%	62.5%	100%
Total Temporary Impacts of WTGs	Acres	22.83	1546.82	2192.03	3,761.68
	%	0.6%	41.1%	58.3%	100%
Alternative C-1, Fisheries Habitat Impact Minimization, Exclusion of 8 WTGs from Priority Area 1					
Total Permanent Impacts of WTGs	Acres	35.53	64.67	100.21	200.41
	%	17.7%	32.3%	50.0%	100%
Total Temporary Impacts of WTGs	Acres	-	1,369.92	2,096.74	3,466.66
	%	0%	39.5%	60.5%	100%
Alternative C-2a, Fisheries Habitat Impact Minimization, Exclusion of 8 WTGs from Priority Area 1, Relocate 12 to Eastern Side of Lease Area					
Total Permanent Impacts of WTGs	Acres	-	33.59	64.01	97.60
	%	0%	34%	66%	100%
Total Temporary Impacts of WTGs	Acres	-	1,368.18	2,063.51	3,431.70
	%	0%	40%	60%	100%
Alternative C-2b, Fisheries Habitat Impact Minimization, Exclusion of 8 WTGs from Priority Area 1, Relocate 12 to Eastern Side of Lease Area					
Total Permanent Impacts of WTGs	Acres	-	35.64	61.95	97.59
	%	0%	37%	63%	100%
Total Temporary Impacts of WTGs	Acres	-	1,413.78	2,017.91	3,431.70
	%	0%	41%	59%	100%
Alternative C-2c, Fisheries Habitat Impact Minimization, Exclusion of 8 WTGs from Priority Area 1, Relocate 12 to Eastern Side of Lease Area					
Total Permanent Impacts of WTGs	Acres	-	35.51	62.09	97.60
	%	0%	36%	64%	100%
Total Temporary Impacts of WTGs	Acres	-	1,439.02	1,992.70	3,431.73
	%	0%	42%	58%	100%
Alternative C-2d, Fisheries Habitat Impact Minimization, Exclusion of 8 WTGs from Priority Area 1, Relocate 12 to Eastern Side of Lease Area					
Total Permanent Impacts of WTGs	Acres	-	34.61	62.98	97.59
	%	0%	35%	65%	100%
Total Temporary Impacts of WTGs	Acres	-	1,390.68	2,041.02	3,431.70
	%	0%	41%	59%	100%
Alternative C-3a, Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 87 WTG positions (957 MW)					
Total Permanent Impacts of WTGs	Acres	0.11	34.88	57.87	92.86
	%	0%	37.6%	62.3%	100%
Total Temporary Impacts of WTGs	Acres	22.77	1,348.19	1,835.04	3,206.00
	%	0.7%	42.1%	57.2%	100%

Sunrise Offshore Wind Farm Proposed Project Design	Unit of Measure	NOAA Complexity Category			
		Large-Grained Complex	Complex	Soft Bottom	Total
Alternative C-3b, Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 84 WTG positions (924 MW)					
Total Permanent Impacts of WTGs	Acres	0.0001	32.42	54.82	87.24
	%	0%	37.2%	62.8%	100%
Total Temporary Impacts of WTGs	Acres	20.76	1,288.43	1,752.51	3,061.70
	%	0.7%	42%	57%	100%
Alternative C-3b, Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 83 WTG positions (913 MW)					
Total Permanent Impacts of WTGs	Acres	-	32.47	53.61	86.08
	%	0 %	38%	62%	100%
Total Temporary Impacts of WTGs	Acres	20.76	1,288.11	1,716.45	3,025.33
	%	0.7%	43%	57%	100%
Alternative C-3b, Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 82 WTG positions (902 MW)					
Total Permanent Impacts of WTGs	Acres	-	31.42	53.61	85.02
	%	0 %	37%	63%	100%
Total Temporary Impacts of WTGs	Acres	20.21	1,255.49	1,713.19	2,988.89
	%	0.7%	42%	57%	100%
Alternative C-3b, Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 81 WTG positions (891 MW)					
Total Permanent Impacts of WTGs	Acres	-	31.42	52.57	83.98
	%	0 %	37%	63%	100%
Total Temporary Impacts of WTGs	Acres	13.60	1,248.77	1,690.07	2,952.44
	%	0.5%	42%	57%	100%
Alternative C-3c, Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 80 WTG positions (880 MW)					
Total Permanent Impacts of WTGs	Acres	-	30.38	52.57	82.94
	%	0 %	37%	63%	100%
Total Temporary Impacts of WTGs	Acres	13.60	1,212.32	1,690.07	2,916.00
	%	0.5%	42%	58%	100%

Source: Acreage estimates are from Table B-2 in the BOEM. 2023. Essential Fish Habitat Assessment for the Sunrise Wind Project, Appendix B. Acreages for Alternatives C-3b and C-3c were updated in the October 2023 Inspire report on Benthic habitat mapping to support the EFH assessment.

Table 3.7-10. Total Acres of Permanent Impacts from WTGs in each NOAA Complexity class under each Alternative as Compared to the Proposed Action. Negative Values Indicate a Decrease in Acres Impacted (BOEM 2023)

Alternative	Total WTGs	NOAA Complexity Category			
		Large Grained Complex	Complex	Soft Bottom	Total
Alternative B: Proposed Action	94	0.00	0.00	0.00	0.00
Alternative C1: Fisheries Habitat Impact Minimization, Exclusion of 8 WTGs from Priority Area 1	94	-0.11	-4.96	-2.86	-7.93
Alternative C-2a: Exclusion of 8 WTGs from Priority Area 1, Relocate 12 to Eastern Side of Lease Area	94	-0.11	-5.40	-2.39	-7.90
Alternative C-2b: Exclusion of 8 WTGs from Priority Area 1, Relocate 12 to Eastern Side of Lease Area	94	-0.11	-3.35	-4.45	-7.91
Alternative C-2c: Exclusion of 8 WTGs from Priority Area 1, Relocate 12 to Eastern Side of Lease Area	94	-0.11	-3.48	-4.31	-7.90
Alternative C-2d: Exclusion of 8 WTGs from Priority Area 1, Relocate 12 to Eastern Side of Lease Area	94	-0.11	-4.38	-3.42	-7.91
Alternative C-3a: Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 87 WTG positions	87	0.00	-5.61	-9.66	-15.27
Alternative C-3b: Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 84 WTG positions	84	-0.11	-8.07	-12.71	-20.89
Alternative C-3b: Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 83 WTG positions	83	-0.11	-6.52	-12.79	-19.42
Alternative C-3b: Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 83 WTG positions	82	-0.11	-7.57	-12.79	-20.48
Alternative C-3b: Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 81 WTG positions	81	-0.11	-7.57	-13.83	-21.52
Alternative C-3c: Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 80 WTG positions	80	-0.1099	-10.11	-14.97	-25.19

Source: Acreage estimates used for the calculations are from the BOEM (2023) Essential Fish Habitat Assessment for the Sunrise Wind Project, Appendix B.

Table 3.7-11. Total Acres of Temporary Impacts from WTGs in each NOAA Complexity class under each Alternative as Compared to the Proposed Action. Negative Values Indicate a Decrease in Acres Impacted (BOEM 2023)

Alternative	Total WTGs	NOAA Complexity Category			
		Large Grained Complex	Complex	Soft Bottom	Total
Alternative B: Proposed Action	94	0.00	0.00	0.00	0.00
Alternative C1: Fisheries Habitat Impact Minimization, Exclusion of 8 WTGs from Priority Area 1	94	-22.83	-176.90	-95.29	-295.02
Alternative C-2a: Exclusion of 8 WTGs from Priority Area 1, Relocate 12 to Eastern Side of Lease Area	94	-22.83	-172.36	-99.86	-295.04
Alternative C-2b: Exclusion of 8 WTGs from Priority Area 1, Relocate 12 to Eastern Side of Lease Area	94	-22.83	-126.76	-145.46	-295.04
Alternative C-2c: Exclusion of 8 WTGs from Priority Area 1, Relocate 12 to Eastern Side of Lease Area	94	-22.83	-101.52	-170.67	-295.01
Alternative C-2d: Exclusion of 8 WTGs from Priority Area 1, Relocate 12 to Eastern Side of Lease Area	94	-22.83	-149.86	-122.35	-295.04
Alternative C-3a: Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 87 WTG positions	87	-0.06	-196.63	-356.99	-555.68
Alternative C-3b: Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 84 WTG positions	84	-2.07	-255.81	-437.24	-695.12
Alternative C-3b: Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 83 WTG positions	83	-2.07	-252.43	-446.92	-701.41
Alternative C-3b: Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 83 WTG positions	82	-2.62	-285.05	-450.18	-737.85
Alternative C-3b: Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 81 WTG positions	81	-9.23	-291.77	-473.30	-774.30
Alternative C-3c: Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands with 80 WTG positions	80	-9.23	-334.50	-501.96	-845.69

Source: Acreage estimates used for the calculations are from the BOEM (2023) Essential Fish Habitat Assessment for the Sunrise Wind Project, Appendix B.

3.7.10 Summary of Impacts of the Preferred Alternative

BOEM has identified Alternative C-3b as the Preferred Alternative as depicted in Figure 2.1-10. Alternative C-3b would include installation of up to 84 WTGs, which is 10 fewer WTGs than the maximum WTGs proposed under the PDE of the Proposed Action. Under Alternative C-3b, impacts on benthic resources from onshore construction would be the same as those described for the Proposed Action. Impacts on benthic resources from offshore activities including construction, O&M, and decommissioning would be slightly less under Alternative C-3b compared to the impacts described above for the Proposed Action, Alternative C-1, and Alternative C-2 because of fewer WTGs and reductions in cable length on the sea floor. Reducing the total WTGs for the project would reduce temporary impacts due to sea floor disturbance by up to 18 percent (976.41 ac [395.1 ha]) for Alternative C-3b and would reduce large grained complex habitat temporary impacts by approximately 2 ac (0.84 ha). The total acres of sea floor habitats impacted permanently would be reduced by a similar percentage (18 percent). The reduction in impacts would be distributed proportionally across the benthic habitat types in the Project Area; therefore, most of these reductions would occur in soft bottom habitats. Alternative C-3 would have permanent impacts to large-grained complex habitat at levels nearly identical to the Proposed Action.

These incremental decreases in impacts from Alternative C-3b may have minor beneficial impacts to the OCS habitat overall as compared to the Proposed Action. BOEM expects the overall impact on benthic resources to be similar to the Proposed Action and has characterized them as **moderate** adverse.

Considering all the IPFs together, BOEM anticipates that the overall impacts associated with Alternative C-3b and future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, including climate change, and reasonably foreseeable activities would cumulatively result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts on benthic resources due to the artificial reef effect (habitat conversion to hard bottom).

3.7.11 Proposed Mitigation Measures

The mitigation measures listed in Table 3.7-12 are recommended for inclusion in the Preferred Alternative.

Table 3.7-12. Proposed Mitigation Measures: Benthic Resources

Measure	Description	Effect
Proposed Boulder Relocation Plan Measure	Prior to inter-array cable corridor preparation and cable installation (e.g., boulder relocation, pre-cut trenching, cable crossing installation, cable lay and burial) and foundation site preparation (e.g., scour protection installation), Sunrise Wind would provide BOEM with a boulder relocation plan for implementation. The plan would include the following: 1. Identification of areas of active (within last 5 years) bottom trawl fishing, areas where boulders >2 m in	Plan includes placing boulders close to where they were extracted to reduce change of benthic habitat.

Measure	Description	Effect
	diameter are anticipated to occur, and areas where boulders are expected to be relocated for project purposes. 2. Methods to minimize the quantity of seafloor obstructions from relocated boulders in areas of active bottom trawl fishing, as identified in #1, as technically or economically feasible. 3. Identification of locations of boulders that would be moved and approximately where they would be place, method(s) for moving boulders, and measures to minimize impacts as technically and economically feasible. Outreach conducted regarding the boulder relocation plan (e.g., notifications to mariners).	
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.	This measure would reduce impacts on benthic habitat composition and structural complexity and, in the case of cable protection, reduce the time required for colonization by habitat-forming organisms. While long-term impacts from these structures would remain, the time required to achieve beneficial effects would decrease.

3.7.11.1 Effect of Measures Incorporated into the Preferred Alternative

The mitigation measures listed in Table 3.7-12. Proposed Mitigation Measures: Benthic Resourcesare recommended for inclusion in the Preferred Alternative. The Boulder Relocation Plan and Cable Protection Measures would reduce changes to benthic habitat composition and structural complexity, this would reduce impacts on benthic resources, including sensitive habitats, but would not reduce the impact level of the Preferred Alternative from what is described in Section 3.7.10.

In addition to the mitigation listed above, NMFS issued EFH conservation recommendations for the Sunrise Wind Project on September 14, 2023, in support of BOEM's consultation with NMFS under the Magnuson-Stevens Fishery Conservation and Management Act (see Table H-3 in Appendix H). BOEM is reviewing the conservation recommendations and would provide a written response to NMFS that identifies the conservation recommendations that have been adopted or partially adopted. If the Sunrise Wind COP is approved, conservation recommendations that have been adopted or partially adopted would be reflected in the ROD.

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3.8 Birds

Please see Appendix Q, Section 3.8 for the analysis of the Birds resource.

3.9 Coastal Habitat and Fauna

Please see Appendix Q, Section 3.9 for the analysis of the Coastal Habitat and Fauna resource.

3.10 Finfish, Invertebrates, and Essential Fish Habitat

This section discusses potential impacts on the existing finfish, invertebrate resources, and designated EFH in the geographical analysis area (see Figure D-7, Appendix D) of the proposed SRWF, the SRWEC, and the onshore transmission cable Project components. It provides a qualitative assessment of the impacts associated with each alternative on finfish, invertebrates, and EFH. This section is closely aligned with Section 3.7, *Benthic Resources*, which discusses benthic invertebrates and habitat resources within the Project. This section is also supported by COP Appendix M1 (Inspire 2022a), Appendix M2 (Inspire 2022b), Appendix N1 (Inspire 2022d), and Appendix N2 (TRC 2023).

The GAA for finfish, invertebrates, and EFH encompasses the Scotian Shelf, Northeast Shelf, and Southeast Shelf large marine ecosystems, which captures most of the movement range within United States (U.S.) marine waters for most species in this group (Appendix D, Figure D-7). Since the EFH, invertebrates, and finfish GAA encompasses the Gulf of Maine down to Cape Hatteras, North Carolina, for the purposes of Project-specific analysis in this Final EIS, the focus is on EFH, invertebrates, and finfish that would be likely to have regular or common occurrences in the SRWF and SRWEC and could be impacted by Project activities. The finfish GAA encompasses the extent of potential effects on finfish and their habitats. Thus, while Project-related impacts to finfish habitat are restricted to a relatively small footprint, the GAA for Project impacts to finfish is necessarily large because marine populations and their dispersal patterns range over broad areas exposed to potential cumulative effects from offshore wind energy development.

3.10.1 Description of the Affected Environment and Future Baseline Conditions

The WEA would be in the offshore waters of Rhode Island and Massachusetts on the northeastern Atlantic Continental Shelf in the Rhode Island Sound. This area represents a transitional area separating Narragansett Bay and the Long Island Sound from the OCS (BOEM 2013). This is a dynamic oceanic environment, known to inhabit a wide variety of fish and invertebrate species. These waters straddle the New England and Mid-Atlantic regions and serve as the southern boundary for some New England species and the northern boundary for some Mid-Atlantic species. Summer flounder HAPC occurs anywhere in this area where SAV or macroalgae occurs.

The SRWF is adjacent to Cox Ledge, an area of concern for fishery managers because it provides important habitat for several commercially and recreationally important species—notably, spawning habitat for Atlantic cod. A portion of Cox Ledge was designated by the NEFMC as a habitat management area to protect EFH for a number of managed fish species. NOAA acknowledged the importance of Cox Ledge but disapproved the designation because it concluded the proposed gear restrictions approved by the NEFMC would likely be ineffective at minimizing impacts on habitat function (NEFMC 2022). The NEFMC (NEFMC 2022) is currently finalizing a new EFH Habitat Area of Particular Concern (HAPC) designation that include complex habitats on Cox Ledge and surroundings used by spawning Atlantic cod and other EFH species. BOEM is currently funding a 3-year study examining movement patterns of Atlantic cod, black sea bass, and other species in the southern New England region, including the Lease Area. The study is being conducted by NMFS and a team comprising a state resource agency, a university, and a nonprofit organization (BOEM 2019). Given concern raised about potential impacts on Cox Ledge and Atlantic cod, available results from the BOEM funded Atlantic cod study are incorporated below. Discussions of potential effects presented in the following sections places emphasis on this and other species of particular concern.

3.10.1.1 Finfish

Finfish off the coasts of NY, MA, and RI include sharks, demersal, and pelagic finfish assemblages (BOEM 2013). These include numerous EFH species and five federally listed species that are known or may occur in the SRWF or SRWEC. There are also important anadromous species, demersal species (groundfish), and highly migratory pelagic finfish found throughout the region. The finfish resources of the region support diverse and highly valued commercial and recreational fisheries with more information provided in Section 3.14, *Commercial Fisheries and For-Hire Recreational Fishing*. BOEM has funded several surveys of finfish species occurrence in the Rhode Island/Massachusetts WEA and Massachusetts WEA, where the Project is located, with findings described by Guida et al. (2017). Guida et al. (2017) noted that there was considerable overlap between the dominant cold and warm season species between the two adjacent WEAs, but a greater number of overall taxa (101) were found in the Massachusetts WEA. The EFH assessment prepared for the Project provides additional detail on federally managed fish species that occur in the geographic area.

Finfish species in southern New England generally have broad distributions, with many ranging from Cape Hatteras, North Carolina to Georges Bank and beyond. The WEA supports finfish species that are typical of the region, with a wide range of diversity of fishes and squid present in the area (Guida et al. 2017). Some species are present in the area in both warm and cold seasons, but the relative abundance varies greatly for most species by season (Guida et al. 2017). Data from the most recent 14-year summary of Northeast Fisheries Science Center (NEFSC) seasonal trawls (2003-2016) in the Rhode Island/Massachusetts WEA demonstrates a diversity of fishes and squid in the area, with 45 taxa collected in the cold months, 45 taxa collected in the warm months, and 59 species collected in total (Guida et al. 2017). In cold months, seasonal trawl samples were dominated by Atlantic herring (*Clupea harengus*), winter skate (*Leucoraja ocellata*), and little skate (*Leucoraja erinacea*), and in warm months, seasonal trawl samples were dominated by longfin squid (*Doryteuthis pealeii*), Atlantic butterfish (*Peprilus triacanthus*), and scup (*Stenotomus chrysops*). Little skate was the only species to dominate catch in both seasons (Guida et al. 2017).

Based on their primary habitat association, finfish can be divided into two general groupings, demersal and pelagic. Demersal species (groundfish) spend at least part of their adult life state on or close to the ocean bottom. Habitat preferences vary between species and life stages. Flatfish and skates spend the majority of their lives directly on the seabed, whereas species like Atlantic cod, haddock (*Melanogrammus aeglefinus*), and black sea bass (*Centropristis striata*) live on or near hard bottom seabed during one or more life stage. Table 4.4.3.-2 of the COP (Sunrise Wind 2023) provides a summary of common habitat types for finfish species known to occur in the region. Demersal fish are important to the ecosystem within the SRWF and have an important economic role in the Project Area.

Pelagic fish are generally schooling fish that occupy the mid- to upper water column as juveniles and adults and are distributed from the nearshore to the continental slope and beyond. Pelagic species occupy the surface to midwater depths (0 to 3,281 ft [0 to 1,000 m]) from the shoreline to the Continental Shelf and beyond. Some species are highly migratory and may be present in the near-coastal and shelf surface waters of the Mid-Atlantic Bight in the summer, taking advantage of the abundant prey in the warm surface waters. Highly migratory finfish travel long distances and often across domestic and international boundaries. Examples of these species include tunas (*Scombridae* spp.), billfishes (*Istiophoridae* spp. and *Xiphias gladius*), and many sharks (*Elasmobranchii* spp.). Coastal migratory pelagic species include fast-swimming schooling fishes that range from shore to the Continental Shelf. These fish use the highly productive coastal waters of the more expansive Mid-Atlantic Bight during the summer months and migrate to deeper and/or distant waters during the remainder of the year (BOEM 2013). Examples of coastal pelagic species that could occur enter the Project Area include forage fish such as anchovy (*Engraulidae* spp.), shad (*Alosa* spp.), and menhaden (*Clupeidae* spp.), and the predatory fish that prey upon them.

Demersal and pelagic finfish encompass a diversity of species that associate with the full range of environment types that occur in the geographic area. Estuarine species are commonly found in nearshore areas where freshwater inputs from large rivers mix with the ocean. Some species are purely marine and are primarily found in offshore environments. Anadromous species migrate between the ocean and lower-salinity riverine environments for spawning. Demersal species of anadromous fish that could potentially be present in the Project Area include striped bass (*Morone saxatilis*) and Atlantic sturgeon (*Acipenser oxyrhynchus*) and pelagic anadromous species that could occur within the Project Area including American shad (*Alosa sapidissima*), alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), Atlantic menhaden (*Brevoortia tyrannus*), and Atlantic sea herring (*Clupea harengus*) (BOEM 2013; Scotti et al. 2010). Table 4.4.3.-1 of the COP (Sunrise Wind 2023) summarizes information on species of economic or ecological importance that are potentially present in the SRWF and surrounding region. These species were selected based on literature review, agency correspondence, fish sampling results from the Block Island Wind Farm, and EFH source document review. This list does not include every species that has the potential to occur in the SRWF.

Additionally, nearshore and onshore Project features could impact riverine systems. The Carmans River is located in the Town of Brookhaven, Long Island, and extends approximately 10 mi (16 km) from central Long Island to Bellport Bay (part of Great South Bay) (NYSDEC 2008). Carmans River is identified as one of only four major riverine systems on Long Island and it contains extensive undeveloped lands. The tidal river begins approximately 2 mi (3 km) north of Bellport Bay and is primarily within the Wertheim National Wildlife Refuge (NYSDEC 2008), which is to the south of the onshore transmission cable. The onshore transmission cable crosses the Carmans River where it is classified as freshwater. The tidal portion of the river supplies important nursey habitat for striped bass and bluefish (*Pomatomus saltatrix*), as well as spawning and nursey habitats for alewife, Atlantic menhaden, white perch (*Morone americana*), and Atlantic silverside (*Menidia menidia*) (NYSDEC 2008). Many freshwater fish species occur in the river including a naturally reproducing population of brook trout (*Salvelinus fontinalis*), yellow perch (*Perca flavescens*), white perch, largemouth bass (*Micropterus salmoides*), black crappie

(*Pomoxis nigromaculatus*), and unusually abundant concentrations of eastern pirate perch (*Aphredoderus sayanus*) (NYSDEC 2008). American eel (*Anguilla rostrata*) juveniles and adults can be found in both the tidal and freshwater portions of the river (NYSDEC 2008.) The Carmans River is also identified as one of the few streams on Long Island that supports concentrations of sea-run brown trout (*Salmo trutta*) and wild brook trout (NYSDEC 2008).

Finfish often consume prey across multiple trophic levels, and their diet may change depending on their life stage. Both demersal and pelagic finfish species may consume fish, invertebrates, planktonic organisms, and detritus, with shellfish, worms, copepods, and other invertebrates being significant types of prey in New England waters. The most common vertebrate finfish prey species include herring, menhaden, northern sand lance (*Ammodytidae* spp.), and silver hake (*Merluccius bilinearis*) (COP Section 4.4.3; Sunrise Wind 2023).

Five federally listed species may occur in the vicinity of the Project Area: Atlantic salmon (*Salmo salar*), Atlantic sturgeon, shortnose sturgeon (*Acipenser brevirostrum*), giant manta ray (*Manta birostris*), and oceanic whitetip shark (*Carcharhinus longimanus*). However, the SRWF does not overlap with critical habitat for any of these species. Of these species, the Atlantic sturgeon is the only one whose occurrence is common enough that they may be exposed to impacts of the Project (COP Section 4.4.3; Sunrise Wind 2023). Atlantic salmon are not known to occur within or near the Project Area, with the only potential for overlap with their distribution being their migration route in the Gulf of Maine. This area may be transited by vessels, but there is no evidence of interactions between vessels and Atlantic salmon, and vessel strikes are not identified as a threat in the listing determination (74 *Federal Register* 29344) or the recent recovery plan (USFWS and NMFS 2018).

Five Distinct Population Segments (DPS)s of Atlantic sturgeon are listed under the ESA: Chesapeake Bay (endangered), Carolina (endangered), New York Bight (NYB) (endangered), South Atlantic (endangered), and Gulf of Maine (threatened) (NMFS 2019). Critical habitat has been designated for all five DPSs of Atlantic sturgeon and includes 31 units within rivers from Maine to Florida (NMFS 2017). No critical habitat for this species extends into the marine environment. The transit routes for project vessels moving between the Project Area and ports travers critical habitat. Port facilities supporting this project that overlap with critical habitat include the Paulsboro Marine Terminal in Paulsboro, New Jersey, on the Delaware River (NYB DPS Unit 4 Delaware River) and the Port of Albany-Rensselaer on the Hudson River (NYB DPS Unit 3 Hudson River).

Atlantic sturgeon spawn in freshwater but spend most of their adult life in the marine environment. Subadult and adult Atlantic sturgeons emigrate from rivers into coastal waters where they may undertake long range migrations. The marine range of Atlantic sturgeon extends from St. Lawrence, Canada, to Cape Canaveral, Florida (NMFS 2012b). Results from genetic analyses indicate that adults intermix with populations from other rivers. For example, Atlantic sturgeon found in the NYB have been matched to not only the NYB DPS but also the Chesapeake Bay and Gulf of Maine DPSs (NMFS 2012b).

Juvenile habitat and migrations are limited to narrow corridors in shallow waters less than 20 m (Dunton et al. 2010). Migratory subadult and adult sturgeon are typically found in shallow (10 to 50 m) nearshore waters with gravel and sand substrates (Erickson et al. 2011; Ingram et al. 2019; Stein et al. 2004b). Depth distribution is known to be seasonal with fish inhabiting deepest waters during winter and shallowest waters during summer and early fall (Erickson et al. 2011). Although extensive mixing occurs in coastal waters, Atlantic sturgeons return to their natal river to spawn (ASSRT 2007). Spawning adults generally migrate upriver in the spring/early summer (Smith and Clugston 1997). Spawning is believed to occur in flowing water between the salt front and fall line of large rivers. Male Atlantic sturgeon have been observing spawning more frequently than females, though females can spawn annually, and they have a greater level of variation in their spawning timings (NMFS 2022). Post-larval juvenile sturgeon move to estuarine waters where they reside for a period of months or years (Moser and Ross 1995). Examination of young fish in the Connecticut River showed evidence that it was recolonized by Atlantic sturgeon from the Hudson River, and once they were post- larval, they remained in the low salinity water of their natal river for one year before transiting into more brackish water; this was supported by a genetic analysis which showed a high number of siblings, which indicated that there was a low number of breeding adults contributing to this cohort (NMFS 2022).

Atlantic sturgeon may occur in the riverine, estuarine, and nearshore portions of the Project Area; however, there are not abundance estimates for the various DPSs (NMFS 2022). In the Hudson and Delaware River and their associated estuaries, Atlantic sturgeon are likely to be present throughout the year as juveniles, and from spring to fall as subadults, adults, and when migrating to spawning areas in those watersheds. Atlantic sturgeon are known to aggregate off southwest Long Island (Erickson et al. 2011) which is part of the known overwintering habitat for juvenile Atlantic sturgeon between the NYB and Virginia (Dunton et al. 2010). Given their anticipated distribution in depths primarily 50 m and less (Stein et al. 2004b), Atlantic sturgeon may occur in the Project Area and the coastal nearshore and river vessel transit routes. Adult and subadult Atlantic sturgeon are expected to occur in the Project Area throughout the year based on tagging and capture data (Dunton et al. 2010; Ingram et al. 2019; Stein et al. 2004a; 2004b). Peak occurrence is expected during the fall and winter based on tagging data which detected a peak in occurrence in Atlantic sturgeon in the New York WEA from November through January and lower numbers of sturgeon in the area during July through September (Ingram et al. 2019).

Atlantic sturgeon are benthic predators (ASSRT 2007). They feed on a variety of prey, including polychaete worms, crustaceans, mollusks, and fish such as sand lance (Johnson et al. 1997; Novak et al. 2017). While no studies have been conducted on Atlantic sturgeon hearing abilities, there are a few studies that document hearing abilities of other species of sturgeon (Hastings and Popper 2005; Lovell et al. 2005; Popper et al. 2014). The primary hearing range of sturgeons is generally described as a lower frequency (under approximately 1 kHz), and swim bladders are not utilized for hearing as with some other fish species (Popper et al. 2014). Atlantic sturgeon hearing may range from 100 to 500 Hz based on data collected from lake sturgeon (Lovell et al. 2005). Regional effects of climate change are influencing finfish. In response to ocean warming, the distribution of both demersal and pelagic finfish resources is undergoing marked changes in the Project Area and across all of southern New England (Hare et al. 2016). In response to increasing water temperatures, the distributional ranges of many groundfish species in New England waters have shifted northward and into deeper waters, and it is predicted that more fish species will follow (Nye et al. 2009; Pinsky et al. 2013). For example, black sea bass has been increasing in abundance over the past several years in New England as water temperatures increase (Kuffner 2018; McBride et al. 2018). Additionally, several pelagic forage species, including Atlantic butterfish, scup, and Atlantic mackerel (*Scomber scombrus*) have been increasing in the waters in and surrounding the SRWF (McManus et al. 2018). Shifts in distribution could possibly be mediated by changes in spawning locations and shifts in spawning time (Walsh et al. 2015). It is expected that further water temperature increases in southern New England are expected to exceed the global ocean average by at least a factor of two, with ocean circulation patterns also projected to change (Saba et al. 2016). The finfish community structure of the Mid-Atlantic and southern New England OCS is also shifting due to fishing pressure and modification of coastal and estuarine habitats (NOAA 2022b).

3.10.1.2 Invertebrates

Invertebrate resources assessed in this section include pelagic invertebrates, specifically squid and pelagic invertebrate eggs and larvae; benthic invertebrates associated with soft sediments; and benthic invertebrates associated with hard surfaces.

Within the analysis area, numerous benthic invertebrate species have pelagic eggs and larvae that utilize currents to disperse offspring. These pelagic eggs and larvae are the prey base for a variety of species during one or more life stages and are a component of EFH. Additionally, squid, specifically longfin inshore squid (*Doryteuthis pealeii*) and northern shortfin squid (*Illex illecebrosus*), are pelagic invertebrate species that could also potentially occur within the analysis area.

The benthic environment of the Rhode Island/Massachusetts and Massachusetts WEA is dominated by sandy sediments, with coarser sediments including gravels, found in shallower areas (Bay State Wind LLC 2019; Deepwater Wind South Fork LLC 2019, Stokesbury 2014; LaFrance et al. 2010). In the Northwest Atlantic OCS, the Soft Sediment Fauna Subclass typically includes deep-burrowing polychaetes, tube-building amphipods and polychaetes, as well as epifaunal species including sand shrimp (*Crangon septemspinosa*), sand dollars (*Clypeasteroida*), and sea stars (*Asteroidea*) (Guida et al. 2017; Stokesbury 2012, 2014; Deepwater Wind South Fork LLC 2019; DWW Rev I LLC 2020). Soft-bottom habitats, including those documented during the site-specific benthic surveys (e.g., sand and mud, sand with ripples, and sand with pebbles/granules) are suitable for the following ecologically and economically important shellfish species: Atlantic sea scallop (*Placopecten magellanicus*), Jonah crab (*Cancer borealis*), Atlantic rock crab (*Cancer irroratus*), channeled whelk, (*Busycotypus canaliculatus*), ocean quahog clam (*Artica islandica*), Atlantic surf clam (*Spisula soliddissima*), and horseshoe crab (*Limulus polyphemus*). Additionally, longfin squid (*Doryteuthis* (Amerigo) *pealeii*) may utilize sand with pebbles/granules habitats (COP Appendix M1; Inspire 2022a). Sea scallops (*Placopecten magellanicus*), ocean quahogs (*Arctica islandica*), and surf clams (*Spisula solidissima*) are all commercially harvested bivalves that inhabit soft-bottom habitats in the Northwest Atlantic OCS. EFH for sea scallop overlaps with the planned SRWEC corridor as well as the western portion of the SRWF and EFH for Atlantic surf clam occurs around the nearshore portions of the SRWEC corridor (NMFS 2020). Additional information on the distribution of commercially fished bivalve species can be found in the EFH assessment.

Hard bottom habitats are limited in regional distribution in the Northwest Atlantic OCS compared to sandy and soft-bottom habitats (CoastalVision and Germano and Associates 2010; Greene et al. 2010; Popper et al. 2014). Hard-surface invertebrates prefer substrates such as boulders and cobbles as complex habitat. Hard-surface invertebrates include a diversity of species, with some that firmly attach to surface and some that crawl, rest, cling to the surface of, and/or shelter in the spaces between hard substrates. These species have adaptations that allow for them to stay in contact with the hard substrate. Examples of mobile hard-substrate invertebrates include American lobster (*Homarus americanus*), crabs, starfish, sea urchins, and amphipods. Examples of attached hard-substrate invertebrates include barnacles, anemones, and tunicates (COP Section 4.4.2; Sunrise Wind 2023).

Several commercially important invertebrate species, such as lobster, Atlantic sea scallop, longfin and shortfin squid, and ocean quahog, occur within the geographical analysis area of the SRWF, the SRWEC, and the onshore transmission cable. The affected environment for invertebrates and many fish species is influenced by commercial and recreational harvest of certain species, habitat modification, benthic habitat disturbance by fishing activities such as vessel anchoring and bottom-disturbing methods, and regional shifts in biological community structure caused by climate change. Some commercial fishing methods, specifically dredges and bottom trawling, are a source of chronic disturbance of seabed habitats. Depending on the frequency of disturbance, this type of fishing activity can impact community structure and diversity and limit recovery (Nilsson and Rosenberg 2003; Rosenberg et al. 2003). The severity and rate of recovery from fishing-related disturbance is variable and dependent on the type of gear used and the nature of the affected habitat. This threat is ongoing and would impact aquatic species in the proposed Project Area regardless of Proposed Action alternatives or other future offshore construction activities.

3.10.1.3 Essential Fish Habitat

The MSFCMA requires federal agencies to consult with NMFS on activities that could adversely affect EFH. NOAA defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (NOAA 2022a). EFH has been defined for various species in the northeastern United States offshore and nearshore coastal waters by NMFS, NEFMC, and the Mid-Atlantic Fishery Management Council (MAFMC). Together, these agencies maintain Fishery Management Plans (FMPs) for specific species or species groups to regulate commercial and recreational fishing and define EFH within their geographic regions. NMFS's Highly Migratory Species Division is responsible for the management of tunas, sharks, swordfish, and billfish in the proposed Project Area. Within state waters associated with the proposed Project Area, commercial and recreational fisheries are further managed by several state regulatory agencies, including the Atlantic States Marine Fisheries Commission (ASMFC), as well as ocean management plans of various types. Additionally, unmanaged forage species such as anchovies, silversides, and sand lances may be found throughout state and federal waters within the proposed Project Area. Many of these species have not been assessed and abundance of most forage species varies annually based on environmental factors independent of the stock biomass (MAFMC 2017).

BOEM has prepared an EFH assessment for the Project under consultation with NMFS. The EFH assessment provides detailed descriptions of preferred habitat and life history information of species with EFH habitat within the Project Area. EFH has been designated for the species or management groups that occur within the Project Area.

- Atlantic herring (*Clupea harengus)*
- Bluefish (*Pomatomus saltatrix*)
- Highly migratory species (e.g., tunas *[Thunnini]*, swordfish *[Xiphias gladius]*, and sharks *[Selachimorpha]*)
- Mackerel (*Scomber scombrus*), squids (*Decapodiformes*), and butterfish (*Peprilus triacanthus*)
- Monkfish (*Lophius americanus*)
- Northeast multispecies (large mesh) (e.g., Atlantic cod *[Gadus morhua]*, Atlantic pollock *[Pollachius virens]*, haddock *[Melanogrammus aeglefinus]* and windowpane flounder *[Scophthalmus aquosus]*)
- Northeast multispecies (small-mesh) (e.g., red hake *[Urophycis chuss]* and silver hake *[Merluccius bilinearis]*)
- Shellfish, Atlantic seascallop *(Placopecten magellanicus)*, Atlantic surfclam *(Spisula solidissima)*, and ocean quahog *(Arctica islandica)*
- Skates (*Rajidae*)
- Spiny dogfish (*Squalus acanthias*)
- Summer founder (*Paralichthys dentatus*), scup (*Stenotomus chrysops*) and black sea bass (*Centropristis striata*)

Within the SRWF, 42 species of fish and invertebrates have life stages with designated EFH, including 26 with demersal life stages and 27 with pelagic life stages (COP Appendix N1; Inspire 2022d). Within a 0.5-mi (800-m) corridor around the SRWEC-NYS centerline, 32 species of fish and invertebrates have life stages within designated EFH, including 20 with demersal life stages and 21 with pelagic life stages (COP Appendix N1; Inspire 2022d). Within Great South Bay, 17 species of fish and invertebrates have life stages with designated EFH (COP Appendix N1; Inspire 2022d).

Southern New England, including Cox Ledge, is known to support Atlantic cod spawning aggregations (Clucas et al. 2019) during the winter months, but the status of Atlantic cod populations and spatiotemporal distribution of spawning in this region is not as well understood as other regions in the northwestern Atlantic (e.g., Gulf of Maine and Georges Bank). The infrequency of Atlantic cod observed in fishery-independent trawl surveys contributes to the poor understanding of stocks in this region (Langan et al. 2020). However, there is information indicating that, unlike other spawning stocks, Atlantic cod in southern New England have increased in abundance during the last 20 years (Langan et al. 2020) and Atlantic cod in this region have shown a tendency to be distributed over larger areas

(Loehrke 2014). Existing (DeCelles et al. 2017) and emerging (BOEM pers. comm. 2022) data also indicate that Atlantic cod spawning occurs throughout the Southern New England region.

The spawning Atlantic cod life stage is considered sensitive and vulnerable for the purpose of the SRWF EFH assessment. While juvenile and adult Atlantic cod are highly mobile, this species has demonstrated high fidelity to specific spawning sites in some studies, meaning they may return to the same location year after year (Dean et al. 2022). Atlantic cod exhibit courtship and spawning behavior, including vocalizations, primarily at night (Dean et al. 2014, Zemeckis et al. 2019), with peak spawning communication occurring approximately 4 – 6 hours after sunset (Zemeckis et al. 2019), although recent studies conducted in 2021 and 2022 found most of the Atlantic cod vocalization in the area occurring during the day around noon (Van Hoeck et al. 2023).

BOEM and other researchers have been conducting monitoring surveys in Southern New England, including within and around the SRWF to document Atlantic cod spawning activity using acoustic telemetry, grunts detected using PAM at fixed stations and on gliders, and hook and line sampling to assess reproductive condition of adults. Recent unpublished results, including acoustic telemetry detections, spawning Atlantic cod detections using PAM, and hook and line sampling and supporting information sources, are presented in Figure 3.10-1. During the studies, Atlantic cod have been detected in the northwest corner of the SRWF where fixed station telemetry receivers have been installed.

The presence of spawning Atlantic cod has been documented near the SRWF from October through March (Van Hoeck et al. 2023). Van Hoeck et al. (2023) recorded peaks in grunt detections from an inferred spawning aggregation in November through between 2013 and 2015. Spawning maturation data from Atlantic cod captured via hook and line both within and outside the SRWF have found spawning-condition Atlantic cod (both males and females) from December through March. These data indicate that pile driving could occur when maturing and mature spawning Atlantic cod are present near the maximum work area during a portion of their spawning season. However, the proportion of Atlantic cod spawning sites in southern New England that occur within the SRWF remains unknown (Van Hoeck et al. 2023).

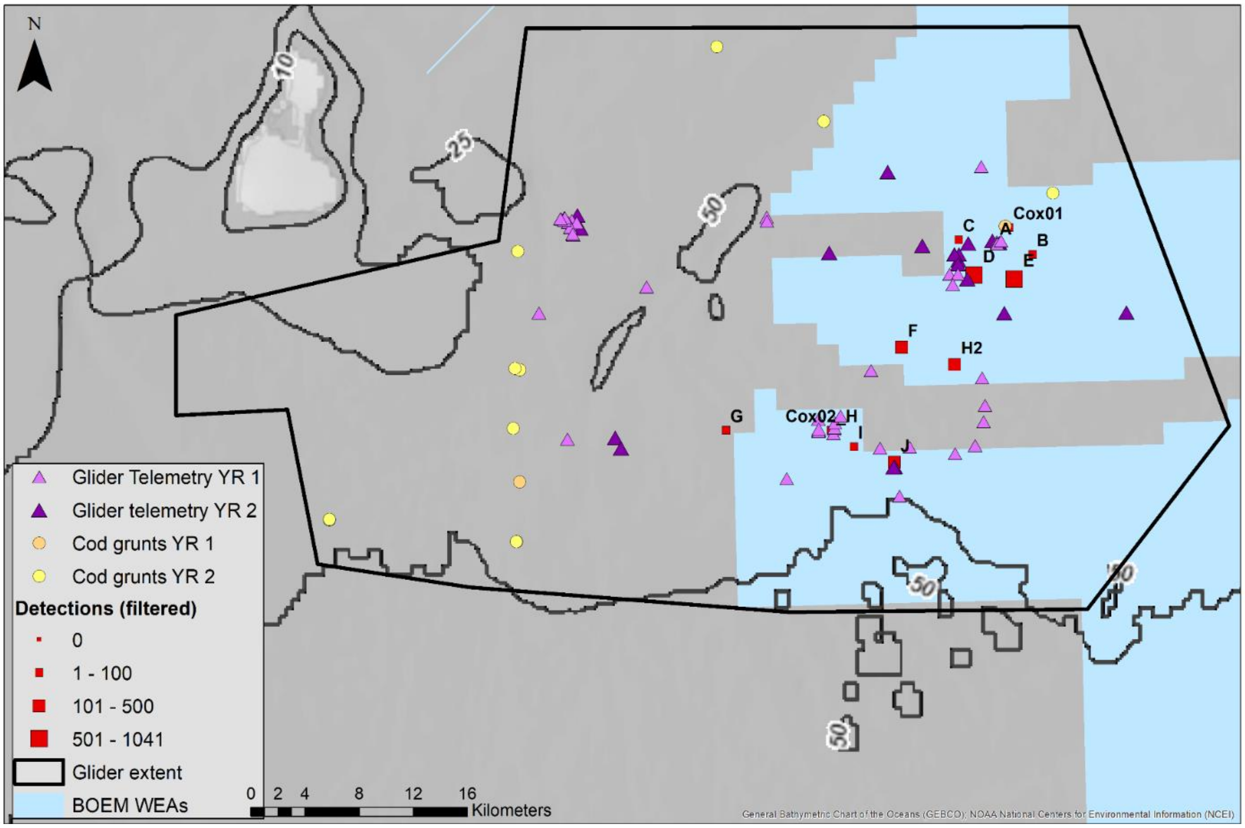


Figure 3.10-1. Preliminary Results from Atlantic Cod Monitoring Surveys Conducted in 2021 and 2022 in the Cox Ledge Area

Atlantic cod continue to be managed in U.S. waters as two units: the Gulf of Maine and the Georges Bank management units. An Atlantic cod Stock Structure Working Group formed in 2018 recently carried out a multidisciplinary evaluation of Atlantic cod structure in U.S. waters and identified a number of mismatches between the current management units and biological stock structure. Using evidence from an evaluation of early life history characteristics, an examination of genetic analyses, fishermen's ecological knowledge, and tagging studies, the Atlantic cod Stock Structure Working Group concluded that Atlantic cod in Southern New England represent a unique biological stock, with demographics that are largely independent of neighboring populations (McBride and Smedbol 2022). In general, tagging studies have indicated that spawning groups in southern New England exhibit a high degree of residency; however, some tagging efforts have indicated extensive movements of Atlantic cod from the Great South Channel to the western Gulf of Maine, with some movement into Southern New England (Wise 1963; Tallack 2009; 2011; McBride and Smedbol 2022). A subsequent working group convened by the NEFMC is currently reviewing the available data and evaluating whether Atlantic cod in Southern New England should be managed as a discrete stock. A decision to recognize Atlantic cod in Southern New England (and other regions in the northeast) as a unique biological stock will have fisheries management implications, including the development of new stock/population assessments, that would allow managers to better work towards rebuilding Atlantic cod populations.

Recent findings from NEFMC concluded, "… insufficient information is available to determine the source populations of Atlantic cod larvae and juveniles occurring in Southern New England waters and it is uncertain if the area is fully supported by self-recruitment"(NEFMC 2022). Further, Atlantic cod spawning appears to occur throughout the Southern New England region (DeCelles et al. 2017; BOEM pers. comm. 2022), which could help buffer against any potential impacts to planktonic eggs and larval transport. While hydrodynamic effects on these species could potentially be more significant, the available information does not suggest that such effects are likely.

Pile driving is considered a short-term temporary impact in which the effects (i.e., sound) would end when the activity ceases. Underwater sound from pile driving could impact Atlantic cod, hake, and black sea bass, which belong to the hearing specialist group and rely on sound for communication and other important behaviors (Rowe and Hutchings 2006; Stanley et al. 2020). Stanley et al. (2020) determined that impulsive underwater noise from activities like impact pile driving could interfere with black sea bass communication during spawning but concluded that they would likely return to normal spawning behavior once the impact ceased. In a separate study, Stanley et al. (2022) found that in a controlled environment, the effect of replayed pile-driving sound resulted in decreased swimming and increased resting behavior in non-spawning black sea bass; however, opportunistic observations of the same sampled black sea bass revealed spawning within 1 month of exposure to pile-driving sounds. Other species, such as Atlantic cod, may be more sensitive to noise impacts. Some researchers have observed or speculated that Atlantic cod could suspend spawning and even abandon preferred spawning habitats when exposed to intense disturbance associated with commercial fishing activity or sound associated with seismic surveys (Andersson et al. 2016; Dean et al. 2012). In contrast, other research on the effects of impulsive seismic survey sound that can last weeks to months has indicated that this level of behavioral response is unlikely (McQueen et al. 2022; Meeken et al. 2021). For example, Meekan et al. (2021) observed no short-term (days) or long-term (months) effects of exposure to the composition, abundance, size structure, behavior, or movement to assemblages of tropical demersal fishes, including hearing specialist species (e.g., *Lutjanidae* sp.), in Western Australia exposed to noise from a commercial-scale seismic air gun survey with received SELs of up to approximately 180 dB re 1 µPa2·s. McQueen et al. (2022) examined the responses of spawning Atlantic cod in the North Sea exposed to seismic air gun noise over two 1-week periods, with fluctuating SELs of up to 145 dB re 1 µPa2·s, comparable to a full-scale industrial survey 3 to 25 mi (5 to 40 km) away. Tagged Atlantic cod in this study were found not to be displaced from spawning grounds (McQueen et al. 2022). McQueen et al. (2022) speculated that strong affinity to selected spawning sites overcame the behavioral effects of stressor exposure. Although the sound source (i.e., seismic air guns) is not analogous to pile driving, they both produce high-intensity, impulsive sound primarily in the approximately 100-Hz or lower frequency bands that overlap the spectral range of Atlantic cod communication and hearing sensitivity and are informative in the absence of studies assessing the impacts of pile driving to Atlantic cod.

Overall, these findings suggest that, although noise exposure during sensitive life stages is a potential concern, disturbances resulting from impulsive sound sources, such as pile driving or seismic air guns, may not necessarily result in adverse effects, such as the complete abandonment of an area for the duration of a spawning season versus temporary displacement or disturbance of Atlantic cod or other hearing specialist species. It is expected that sound attenuation systems, such as bubble curtains, would be used to reduce received SELs from pile-driving noise. However, even with sound attenuation systems, monopile installation is still the largest acoustic impact from the Proposed Action. Van Hoeck et al (2023) found that, based on temporal patterns of Atlantic cod grunts, spawning in southern New England waters is concentrated in November and December, which may overlap the timeline of construction. Although there remain some data gaps regarding spawning Atlantic cod response to pile driving, empirical studies with Atlantic cod and seismic surveys and recent work with black sea bass and pile driving suggest that any responses are likely temporary.

In the northeast region, NMFS and the regional management councils have identified subsets of EFH as HAPC. These are habitat types and/or geographic areas identified by regional fishery management councils and NMFS as priorities for habitat conservation, management, and research, but the HAPC designation does not confer any specific habitat protection (MAFMC 2016). These areas are identified based on one or more of the following considerations: (1) the importance of the ecological function provided by the habitat, (2) the extent to which the habitat is sensitive to human-induced environmental degradation, (3) whether, and to what extent, development activities are, or would be, stressing the habitat type, and (4) the rarity of the habitat type (MAFMC 2016). The MAFMC identifying HAPC for summer flounder as “All native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH” (MAFMC 2016). Additionally, HAPC for juvenile Atlantic cod, defined as occurring between the mean high water line and a depth of 66 ft (20 m) in rocky habitats, in SAV, or in sandy habitats adjacent to rocky and SAV habitats for foraging from Maine through Rhode Island, can be found in the region, but it does not occur within the footprint of the SRWF, nor its immediate vicinity (COP Section 4.4.3; Sunrise Wind 2023). However, video surveillance confirmed that SAV and benthic macroalgae covered a very small area (1.7 ac [0.7 ha]) within the assessment area surrounding the ICW-HDD route (COP Appendix N1, Inspire 2022d)

On July 30, 2022, the NEFMC approved a new HAPC designation to address concerns over potential adverse impacts from offshore wind development on sensitive hard-bottom habitats and Atlantic cod spawning activity. The Southern New England HAPC comprises all large-grained complex and complex benthic habitats wherever present within the area bounded by a 6.2-mi (10-km) buffer around the Rhode Island/Massachusetts and Massachusetts WEAs (Plante 2022). The designation is intended to protect high value complex habitats within this area, emphasizing currently known and potentially suitable areas used by Atlantic cod for spawning (Bachman and Couture 2022; NEFMC 2022). This EFH designation was informed by the findings of a three-year, BOEM-funded study investigating the use of Cox Ledge and surroundings by spawning Atlantic cod (#AT-19-08) (BOEM pers. comm. 2021).

The designation would also apply to large-grained complex and complex benthic habitats used by Atlantic herring, Atlantic sea scallop, little skate, monkfish, ocean pout, red hake, silver hake, windowpane flounder, winter flounder, winter skate, and yellowtail flounder. This new HAPC designation has not yet been implemented and is pending final approval by NMFS.

3.10.2 Impact Level Definitions for Finfish, Invertebrates, and Essential Fish Habitat

This Final EIS uses a four-level classification scheme to analyze potential impact levels on finfish, invertebrates, and EFH from the alternatives, including the Proposed Action Table 3.10-1 lists the definitions for both the potential adverse impact levels and potential beneficial impact levels for finfish, invertebrates, and EFH. Table G-9 in Appendix G identifies potential IPFs, Issues, and Indicators to assess impacts to finfish, invertebrates, and EFH. Impacts are categorized as beneficial or adverse and may be short-term or long-term in duration. Short-term impacts may occur over a period of a year or less. Long-term impacts may occur throughout the duration of a project.

Table 3.10-1. Definition of Potential Adverse and Beneficial Impact Levels for Finfish, Invertebrates, and Essential Fish Habitat

Impact Level	Adverse	Beneficial
Negligible	Impacts on species or habitat would be so small as to be unmeasurable.	Impacts on species or habitat would be so small as to be unmeasurable.
Minor	Most impacts on species would be avoided; if impacts occur, they may result in the loss of a few individuals. Impacts on sensitive habitats would be avoided; impacts that do occur would be short-term in nature.	Impacts on species and their habitat are detectable and measurable. The effects are likely to benefit individuals, be localized and/or be short-term and unlikely to lead to population-level effects.
Moderate	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.	Impacts on species and/or their habitat are detectable and measurable. These benefits may affect large areas of habitat, be long-term, and/or affect a large number of individuals and may lead to a detectable increase in populations but is not expected to improve the overall viability or recovery of affected species or population.
Major	Impacts would affect the viability of the population and would not be fully recoverable or permanent. Impacts on habitats would result in population-level impacts on species that rely on them.	Impacts on species and/or their habitat are detectable and measurable. These impacts on habitat may be short-term, long-term, or permanent and would promote the viability of the affected species/population and/or increase the affected species/population levels.

3.10.3 Impacts of Alternative A - No Action on Finfish, Invertebrates, and Essential Fish Habitat

When analyzing the impacts of the No Action Alternative on finfish, invertebrates, and EFH, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions. 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 E (*Planned Activities Scenario*).

3.10.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for finfish, invertebrates, and EFH described in Section 3.10.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing offshore wind activities within the GAA that contribute to impacts on finfish, invertebrates, and EFH are generally associated with pile-driving noise, new cable emplacement, and the presence of structures and climate change. These impacts are expected to continue at current trends and have the potential to affect finfish, invertebrates, and EFH species through short-term and permanent habitat removal and noise impacts, which could cause avoidance behavior and displacement. Mortality of individual species 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 GAA that contribute to impacts on finfish, invertebrates, and EFH include:

- Continued O&M of the Block Island project (5 WTGs) installed in State waters,
- Continued O&M of the CVOW project (2 WTGs) installed in OCS-A 0497, and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of Block Island and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect finfish, invertebrates, and EFH through the primary IPFs of with pile-driving noise, new cable emplacement, and the presence of structures. 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 the following section for planned offshore wind activities, but the impacts would be of lower intensity.

3.10.3.2 Cumulative Impacts of the No Action Alternative

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

Baseline conditions for finfish, invertebrates, and EFH would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities within the GAA that contribute to impacts on finfish, invertebrates, and EFH are generally associated with commercial harvesting and fishing activities, fisheries bycatch, water quality degradation and pollution, effects on benthic habitat from dredging and bottom trawling, accidental fuel leaks or spills, and climate change. Some mobile invertebrates can migrate long distances and encounter a wide range of stressors over broad geographical scales (e.g., longfin and shortfin squid). Their mobility and broad range of habitat requirements may also mean that limited disturbance may not have measurable effects on their stocks (populations). However, longfin and shortfin squid may be more negatively impacted as sand wave leveling may affect their spawning grounds. Finfish populations are composed largely of long-range migratory species; it would be expected that their mobility and broad ranges would preclude many short-term impacts associated with ongoing offshore impacts throughout the GAA. However, as more wind farms are installed the construction impacts become additive and species may not be able to entirely avoid effects. Invertebrates with more restricted geographical ranges or sessile invertebrates or life stages can be subject to the above stressors over time and can be more sensitive (Guida et al. 2017).

Accidental releases and discharges: As future offshore wind energy activities continue, there is the potential for accidental releases during construction activities, operations, and any decommissioning of offshore facilities. Accidental releases include things such as contaminants to water quality, trash, and debris. The typical hazardous materials that are accidentally released from marine construction activities include fuels, lubricating oils, and petroleum products. These releases have the potential to cause localized increases in water pollution.

Regulations from BOEM currently prohibit any discharge or dumping of solid debris into offshore waters during activities associated with construction and operation of offshore energy facilities (30 *CFR* 250.300). The United States Coast Guard (USCG) also prohibits any dumping of trash or debris that may pose entanglement or ingestion risk (MARPOL, Annex V, Public Law 100−220 (101 Stat. 1458)). The ability to comply with these regulations would minimize release of trash and other debris into the associated waters.

Offshore wind construction projects would cause an increase in vessel traffic that may lead to the introduction of invasive species during ballast and bilge water discharges. The impacts from the release of invasive species on finfish, invertebrates, and EFH can have the potential to be adverse, widespread, and potentially permanent if the species were to become established and outcompete native species (Piet et al. 2021). All offshore wind related construction vessels would be required by BOEM to adhere to state and federal regulations for ballast and bilge water discharges which include the USCG ballast discharge regulations (33 *CFR* 151.2025) and the USEPA NPDES Vessel General Permit standards. Water quality trends are likely to continue with little to no change in the future with the consideration of projects following these requirements. Accidental releases due to future offshore wind energy activities are likely to be localized and the impacts would be short-term, and minor on finfish, invertebrates, and EFH.

Anchoring: In the future offshore wind scenario, there would be increased vessel anchoring during survey activities and during the construction, installation, maintenance, and decommissioning of offshore components. In addition, anchoring/mooring of meteorological towers or buoys could be increased. Anchoring causes short-term disturbance to seafloor, which would be considered short-term impacts that occur regularly throughout the GAA. These activities would increase turbidity and could result in direct mortality of benthic, finfish, and invertebrate resources or degradation of sensitive hard-bottom habitats, including EFH. Anchoring would cause increased turbidity levels and would have the potential for physical contact to cause lethal or sublethal effects on invertebrates. The construction, operation, and maintenance of future offshore wind projects would disturb seafloor habitat, increasing turbidity and potentially disturbing, displacing, or injuring benthic habitat, finfish, and invertebrates. This disturbance would be localized and short-term, representing considerably less than 1 percent of the total available benthic habitat within the GAA. Potential impacts would be minimized by the implementation of mitigation measures. For finfish specifically, it is unlikely that adult fish would be directly affected by anchoring and impacts would be negligible. However, less-mobile life stages such as eggs and larvae could experience direct mortality or smothering from turbidity with impacts occurring at a local, small scale, not at population or species level, and they would be short-term, minor, and localized. It would be expected that recovery of any affected species would occur in the short term, although degradation of sensitive habitats could persist in the long term.

Physical seabed disturbance due to anchoring would generally result in localized and short-term impacts on invertebrate resources, with recovery in the short term. Mobile invertebrates would be temporarily displaced, whereas sessile and slow-moving invertebrates could be subject to localized lethal and sublethal impacts. Demersal eggs and larvae would be particularly vulnerable to sediment disturbance and resettlement. High rates of mortality can occur in longfin squid egg masses if exposed to abrasion. In contrast, if the anchoring activity leads to the restructuring of patchy cobble boulder habitat into more linear, continuous cobble habitat, the change may provide juvenile lobsters with higher-value small-scale habitat, where predation rates would be expected to be lower (Guarinello and Carey 2020).

Impacts would be expected to be localized, turbidity would be short-term, and mortality of sessile invertebrate and life stages from contact would be recovered in the short term. Degradation of sensitive habitats, such as eelgrass beds and hard-bottom habitats, if it occurs, could be long-term to permanent. The overall impacts of anchoring on finfish, invertebrates, and EFH are likely to be minor, localized, and short-term.

Cable emplacement/maintenance: Cable emplacement and maintenance activities (including dredging) would disturb sediments and cause sediment suspension, which could disturb, displace, and directly injure finfish species and EFH. Short-term disturbance of seafloor habitats could disturb, displace, and directly injure or result in mortality of invertebrates in the immediate vicinity of the cable-emplacement activities. Sediment disturbance and resettlement could also affect eggs and larvae, particularly demersal eggs such as winter flounder, ocean pout, and longfin squid eggs as well as skate egg cases, which have high rates of mortality if egg masses are exposed to abrasion. When new cable emplacement and maintenance cause resuspension of sediments, increased turbidity could have an adverse impact on filter-feeding fauna such as bivalves. Depending on the substrate being disturbed, invertebrates could be exposed to contaminants via the water column or resuspended sediments, but effects would depend on the degree of exposure.

Cable emplacement and maintenance activities could result in short-term impacts and over time may result in long-term habitat alterations. The intensity of impacts would depend on multiple factors, including time of year, sediment type, and habitat type being affected where activities occur with recovery time increasing with increased complexity. For example, in areas where sand is the predominant sediment type, disturbed sediments would be expected to settle out of the water column relatively quickly and travel shorter distances than if the seabed was dominated by finer sediments (mud). The impact of increased turbidity on invertebrates depends on both the concentration of suspended sediment and the duration of exposure. Plume modeling completed for other wind development projects within the region and with similar sediment characteristics (Vineyard Wind 1, Block Island Wind Farm, and Virginia Offshore Wind Technology Advancement) predict that suspended sediment would usually settle well before 12 hours have elapsed (Ocean Wind 2021). Sediment transport modeling for the SRWF estimated that elevated levels of TSS due to jet plow methods for installation of the SRWEC and IAC would return to ambient levels within 0.3 hours (COP Appendix H; Woods Hole Group 2022). BOEM, therefore, expects relatively little impact from increased turbidity (separate from the impact of direct sediment deposition) due to cable-emplacement and maintenance activities. The cable routes for future projects are under discussion and have not been fully determined at this time. This IPF could cause impacts during construction and maintenance activities. Assuming future projects use installation procedures similar to those proposed in Appendix E, the extent of impacts would be limited to approximately 6 ft (0.9 m) to either side of each cable. Therefore, the duration and extent of impacts would be limited and short-term, and it would be expected that finfish and invertebrates would recover following this disturbance; however, EFH and other habitats such as eelgrass or hard-bottom habitats may remain permanently altered (Hemery 2020), as eelgrass would be expected to require a greater amount of time to recover. Affected hard-bottom habitats would not be expected to recover.

Based on the assumptions provided in Appendix E, impacts associated with offshore cables of future wind projects would be similar to those of the Project, including inter-array cables, substation/converter interconnection cables, and offshore export cables. The GAA for finfish and invertebrates is over 16,000,000 ac (64,750 km^2) in size. The total seafloor disturbance would represent less than 0.1 percent of the GAA, and suspended sediment should settle well before 12 hours. Cable routes that intersect sensitive EFH such as eelgrass beds or rocky bottom and other more complex habitats may cause long-term or permanent impacts; otherwise, impacts of habitat disturbance and mortality from physical contact with finfish and invertebrates would be recovered in the short term, and overall impacts would be expected to be minor to moderate.

EMF: Several submarine power and communication cables exist in the Mid-Atlantic, the Southern OCS and surrounding coastal locations that emit an EMF due to electric charges and the movement of electric charges. EMFs are present in the marine environment naturally and from anthropogenic sources. Under the no action alternative, BOEM is anticipating several proposed offshore energy projects throughout the next decade in the vicinity of SRW that would generate EMFs. EMF effects from these future projects on finfish, invertebrates, and EFH would vary in extent and significance depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or HVDC, transmission voltage). EMF strength diminishes rapidly with distance, and EMF that could elicit a behavioral response in an organism would likely extend less than 50 ft (15.2 m) from each cable. When submarine cables are laid, installers typically maintain a minimum separation distance of at least 330 ft (100 m) from other known cables to avoid inadvertent damage during installation, which also precludes any additive EMF effects from adjacent cables.

Population-level impacts on finfish have not been documented for EMF from alternating current cables (CSA Ocean Sciences Inc. and Exponent 2019). There is no evidence to indicate that EMF from undersea alternating current power cables adversely affects commercially and recreationally important fish species within the southern New England area (CSA Ocean Sciences Inc. and Exponent 2019). A more recent review by Gill and Desender (2020) supports these findings, where fish were found to be affected by EMF at high intensity for a small number of individual finfish species; however, response in finfish was not found to occur at the EMF intensities associated with marine renewable energy projects. For example, behavioral impacts have been documented for benthic species such as skates near operating direct current cables (Hutchison et al. 2018, 2020b). Skates exhibited changes in behavior in the form of increased exploratory searching and slower movement speeds near the EMF source, but EMFs did not appear to present a barrier to animal movement.

The effects of EMF on invertebrate species have not been extensively studied, and studies of the effects of EMF on marine animals have mostly been limited to commercially important species such as lobster and crab (e.g., Love et al. 2017; Hutchison et al. 2020b). Burrowing infauna may be exposed to stronger EMFs, but scientific data are limited. Recent reviews by Gill and Desender (2020), Albert et al. (2020), and CSA Ocean Sciences Inc. and Exponent (2019) of the effects of EMF on marine invertebrates in field and laboratory studies concluded that measurable effects could occur for some species, but not at the relatively low EMF intensities representative of marine renewable energy projects. For example, behavioral impacts were documented for lobsters near a direct current cable (Hutchison et al. 2018) and a domestic electrical power cable (Hutchison et al. 2020b), including subtle changes in activity (e.g., broader search areas, subtle effects on positioning, and a tendency to cluster near the EMF source), and only when the lobsters were within the EMF. There was no evidence of the cable acting as a barrier to lobster movement and no effects were observed for lobster movement speed or distance traveled. Additionally, faunal responses to EMF by marine invertebrates, including crustaceans and mollusks (Hutchison et al. 2018; Taormina et al. 2018; Normandeau et al. 2011), include interfering with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Taormina et al. 2018).

EMF levels would be highest at the seabed and in the water column above cable segments that cannot be fully buried and are laid on the bed surface under protective rock or concrete blankets. Invertebrates in proximity to these areas could experience detectable EMF levels and minimal associated behavioral effects. These unburied cable segments would be short and widely dispersed. CSA Ocean Sciences, Inc. and Exponent (2019) found that offshore wind energy development as currently proposed would have negligible effects, if any, on bottom-dwelling finfish and invertebrates residing within the southern New England area. For pelagic species within the same area, no negative effects were expected from offshore wind energy development as currently proposed because of their preference for habitats located at a distance from the seabed.

Cable routes that intersect sensitive EFH such as eelgrass beds or rocky bottom and other more complex habitats may cause long-term or permanent impacts; otherwise, impacts of habitat disturbance and mortality from physical contact with finfish and invertebrates would be recovered in the short term, and overall impacts would be expected to be minor to moderate.

Light: Light can be an attraction source to finfish and invertebrates and can sometimes influence biological cycles such as spawning. Future offshore wind project activities would produce additional light from vessels and from offshore structures. Vessels that are lit during construction, maintenance, or decommissioning would follow the lighting guidelines from BOEM. The guidelines issued by BOEM for construction vessels to avoid and minimize artificial lighting impacts from offshore energy facilities should minimize any adverse effects to fish and other aquatic organisms (Orr et al. 2016). Future activities would be required to adhere to these guidelines and because many of the navigation and vessel lights are not downward facing, the amount of light penetrating the water is anticipated to be minimal. Impacts from vessel lighting would likely be insignificant relative to activities not related to offshore wind that occur throughout the GAA. Furthermore, potential impacts from lighting would be anticipated to have little impact on finfish and invertebrates during daylight hours and would be limited by the depth of the water in the offshore wind lease areas.

The overall impacts of light on finfish, invertebrates, and EFH are likely to be negligible, localized, and short-term, resulting in little change to these resources. As such, light from future offshore wind development would not be expected to appreciably contribute to overall impacts on these resources and impacts would be negligible.

Noise: Under the No Action Alternative, human activities would continue to generate underwater noise with the potential to affect finfish, invertebrates, and EFH. Existing and future sources of anthropogenic underwater noise include commercial, government and military, research, and recreational vessel activity, and the development and operation of other wind energy projects on the OCS. Several offshore wind project construction periods would overlap between 2022 to 2030 (see Appendix E). Construction from these projects, most notably pile driving, would create airborne and underwater noise with moderate potential to affect marine organisms, including finfish and invertebrates, as well as EFH. These effects range from low-level behavioral effects, foraging, mating, predator avoidance, and navigation to short-term hearing impairment (Madsen 2006; Weilgart 2007). Permanent sublethal hearing injuries, although possible, are unlikely to occur based on current and anticipated future impact avoidance and minimization requirements. Other sources of noise from wind projects include helicopters and aircraft used for transportation and facility monitoring, G&G surveys, WTG operation, and vessel traffic associated with these activities.

The noise associated with offshore wind project construction and operation generally falls into two categories: (1) impulsive noise sources, such as impact pile driving, which generate sharp instantaneous changes in sound pressure and (2) intermittent non-impulsive noise sources, such as vessel engine noise, vibratory pile driving, and WTG operation, which remain relatively constant and stable over a given time period. Impulsive and non-impulsive noise sources associated with offshore wind projects and other activities likely to occur on the OCS in the future are discussed below.

Noise impacts from G&G activities are anticipated to occur annually for the foreseeable future but would be localized. Seismic surveys that are used for oil and gas exploration create high intensity impulsive noise that penetrate into the seabed and could potentially cause injury or behavioral impacts on finfish and invertebrates (BOEM 2012). It is important to note that seismic surveys for the purposes of offshore wind are generally used to investigate shallow hazards and hard bottom areas for the purposes of evaluating the feasibility of turbine installation; as such, seismic surveys for offshore wind do not require use of seismic air guns (used for oil and gas exploration), which penetrate miles into the seabed. Consequently, seismic surveys for offshore wind have far fewer impacts than those for oil and gas exploration. Oil and gas exploration on the Atlantic OCS is currently unlikely. These impacts would be highly localized around the sound source and would be short-term in duration. Finfish and invertebrates in the general area but not in the immediate vicinity of the sound source could experience short-term stress and short-term behavioral changes in a larger area affected by the sound.

The most significant impulsive noise source associated with offshore wind projects is pile-driving noise during the construction phase. WTG foundation installation involves impact pile driving, which produces high SPLs in both the surrounding in-air and underwater environments. Pile-driving noise is produced intermittently during construction for a period of 4 to 6 hours per day. Potential noise exposure events would occur intermittently over several weeks during the allowable construction window (which may vary and would be determined through consultation with NMFS) in the GAA. Under the No Action Alternative, construction of potentially 3,027 WTGs would generate short-term and intermittent impulsive underwater noise with the potential to impact finfish and invertebrates. These effects would be limited to specific construction windows beginning in 2022 and continuing through 2030.

Depending on their distribution in relation to construction activities and the timing of that construction, the duration and frequency of any exposure of finfish and invertebrates to construction noise would be variable. An individual may be exposed to anywhere from a single pile-driving event (lasting no more than a few hours on a single day) to intermittent noise over a period of weeks if an individual travels over the larger GAA where pile-driving may be occurring. The potential effects of exposure to pile-driving noise would range from minor, short-term behavioral with no biological consequences to injury or mortality. Highly mobile finfish likely would be displaced from the area, most likely showing a behavioral response; however, fish in the immediate area of pile-driving activities could suffer injury or mortality. Affected areas would likely be recolonized by finfish in the short term following completion of pile-driving activity. Early life stages of finfish, including eggs and larvae, could experience mortality or developmental issues because of noise; however, thresholds of exposure for these life stages are not well studied (Weilgart 2018). As explained above, the use of measures to mitigate exposure is expected to reduce the potential for injury. The probability and extent of potential impacts are situational and dependent on several factors including pile size, impact energy, duration, site characteristics (i.e., water depth, sediment type), time of year, and species, among others that have been considered in the acoustic exposure modeling (COP, Appendix I1, Küsel et al 2022).

Impacts from pile-driving noise on finfish would also depend on other factors that affect local fish populations, including time of year. Impacts from noise would be greater if occurring during spawning periods or in spawning habitat, particularly for species that are known to aggregate in specific locations to spawn, use sound to communicate, or spawn once in their lifetime. Prolonged localized behavioral impacts on specific finfish populations over the course of years could reduce reproductive success for multiple spawning seasons for those populations, which could result in long-term decline in local populations. However, based on behavioral studies of black sea bass (Jones et al. 2020), fish behavior returns to a pre-exposure state following completion of noise impacts. Additionally, as acoustic impacts decline with distance, it is unlikely that impacts of pile-driving from offshore wind farms outside of a certain threshold distance would result in any local population being subject to multiple years of acoustic impacts that would result in long-term impacts on the population. Therefore, impacts on finfish from pile driving are anticipated to be short-term and intermittent during periods when pile driving is actively occurring. It is important to note that no future non-offshore wind pile-driving activities have been identified within the GAA for this resource other than current ongoing activities.

Marine invertebrates lack internal air spaces and gas-filled organs needed to detect sound pressure and so are considered less likely to experience injury from over-expansion or rupturing of internal organs, the typical cause of lethal noise-related injury in vertebrates (Popper et al. 2001). Noise thresholds for adult invertebrates have not been developed because of a lack of available data, but some invertebrates are responsive to particle motion and are therefore capable of vibration reception (e.g., crustaceans, squid) (Mooney et al. 2020). This is supported by other studies that found American lobster and shore crabs (*Carcinus maenas*) to have some capability to detect and respond to sound (Jézéquel et al. 2021; Aimon et al. 2021).

The longfin squid has been found to exhibit an initial startle response, comparable to that of a predation threat, to pile-driving impulses recorded from a wind farm installation, but upon exposure to additional impulses, the squid's startle response diminished quickly, indicating potential habituation to the noise stimulus (Jones et al. 2020). After a 24-hour period, the squid seem to re-sensitize to the noise, which is an expected response to natural stimuli, as well. Squid schooling and shoaling behavior could be interrupted when exposed to pile-driving impulse noises, which could affect predation risk. Feeding behavior in longfin squid was disrupted by exposure to playbacks of pile-driving noise, resulting in increased failure of predation attempts on killifish (*Fundulus heteroclitus*). Regardless of whether they were hunting, squids exhibited comparable alarm responses to noise. Hearing measurements confirmed the noise was detected by the squid (Jones et al. 2021).

Noise transmitted through water and through the seabed can cause a disturbance response in invertebrates within a limited area around each pile and short-term stress and behavioral changes in individuals over a greater area (e.g., discontinuation of feeding activity). The extent depends on pile size, hammer energy, and local acoustic conditions, with the affected areas recolonized in the short term. These impacts are therefore anticipated to be short-term and intermittent, occurring only during active impact and vibratory pile driving.

The majority of anthropogenic underwater noise in the marine environment is continuous noise from large vessel engines, specifically ocean-going cargo, tanker, and container vessels. Other sources of noise like small vessels, wind farm operations, and other activities are likely to account for a small percentage of the total anthropogenic sound energy in the future ocean environment. Virtually all of the long-term noise effects associated with offshore wind energy projects during operations would be intermittent and non-impulsive in nature. Non-impulsive noise sources include helicopters and fixed-wing aircraft used for facility monitoring, vibratory pile driving, construction and O&M vessel noise, and operational noise from WTGs.

Helicopters and fixed-wing aircraft, and vessels may be used during initial site surveys, protected species monitoring prior to and during construction, crew transportation, and facility monitoring; however, little noise from aircrafts propagates through the water column. Therefore, impacts on finfish from aircraft use are not likely to occur. Future activities related to offshore wind presumably would be related to increased vessel traffic associated with both construction and maintenance of WTGs and associated facilities. Vessels associated with construction were found to be loud enough at a distance of up to 10 ft (3 m) to induce avoidance of finfish and invertebrates but not cause physical harm to the fish (MMS 2009). The behavioral avoidance impacts would be short-term.

WTG operation is another source of continuous noise but is not expected to result in biologically significant effects on marine organisms. According to measurements at the Block Island Wind Farm, low-frequency noise generated by turbines reach ambient levels at 164 ft (50 m) (Miller and Potty 2017). Other studies have observed noise levels ranging from 109 to 127 dB re 1 µPa at 46 and 65.6 ft (14 and 20 m), respectively, at operational wind farms (Tougaard et al. 2009). Operational noise and ambient noise both increase in conjunction with wind speed, meaning that WTG noise is only audible within a short distance from the source (Kraus et al. 2016; Thomsen et al. 2015). The overall impacts of noise on finfish, invertebrates, and EFH are likely to be moderate.

Port utilization: Port expansion and upgrades along the east coast would be likely throughout the next decade to support the construction of offshore wind developments. The general trend along the east coast of the United States from Virginia to Maine indicates that port activity would increase modestly in the foreseeable future. These increases in port activity may require port modifications that could cause localized, minor impacts on finfish and EFH, likely resulting in short-term displacement of finfish. Existing ports within the GAA have already affected finfish, invertebrates, and EFH. It is anticipated that modifications of ports would cause short-term and localized impacts on finfish, invertebrates, and EFH, likely resulting in behavioral responses, such as avoiding the area during port modification activities. These impacts would be limited to the short term and would not be expected to affect finfish and invertebrate species at a population level; however, mortality at less-mobile life stages such as eggs and larvae could occur if individuals were present in the immediate vicinity of port modification activity. The overall impacts of port utilization on finfish, invertebrates, and EFH are likely to be negligible to minor, localized, and short-term. As such, the impacts from future offshore wind development would be expected to be minor.

Presence of structures: Presence of structures could lead to impacts on finfish, invertebrates, and EFH through entanglement, gear loss or damage, hydrodynamic disturbance, fish aggregation, habitat conversion, and migration disturbances. These impacts could occur through addition of buoys, meteorological towers, WTG foundations, scour/cable protection, and transmission cable infrastructure. Over the next 35 years, development is expected to continue within the GAA, providing additional structures on the seafloor. Based on assumptions of development for future offshore wind projects, an estimated 3,096 foundations would be developed in the GAA (Appendix E). BOEM assumes that proposed future wind projects would include similar components for construction, i.e., WTGs, offshore and onshore cable systems, OSS, onshore O&M facilities, and onshore interconnection facilities, all of which would increase the total number of structures within the GAA over the next 35 years. In the GAA, structures are anticipated predominantly on sandy bottom, except for cable protection, which is more likely to be needed where cables pass through hard-bottom habitats. The potential locations of cable protection for planned activities have not been fully determined at this time; however, any addition of scour protection/hard-bottom habitat would represent substantial new hard-bottom habitat, as the GAA is predominantly composed of sand, mud, and gravel substrates.

No future activities were specifically identified within the GAA specific to entanglement and gear loss and damage; however, it is reasonable to assume that fishing activities (both commercial and recreational) may increase over time in the vicinity of structures due to the likelihood of fish and crustacean aggregation. Damaged and lost fishing gear caught on structures may result in ghost fishing or other disturbances, potentially leading to finfish mortality. Impacts from fishing gear would be localized; however, the risk of occurrence would remain if the structures were present. The presence of structures in an otherwise primarily sandy benthic environment would provide a more complex environment, likely to attract finfish and invertebrates such as mobile crustaceans of commercial value. As such, entanglement and gear loss may cause increased impacts on finfish, including mortality and alteration of habitats. These impacts would be localized and short-term; however, they would likely persist intermittently if structures remained in place.

The addition of future structures and underwater foundations associated with future offshore wind projects would influence benthic habitats during construction. Once in place, these structures could provide the addition of artificial reefs that can influence benthic habitats and change the abundance and distribution of fish and invertebrate community structures. These effects would most likely be localized to the areas adjacent to the structures underwater, but as more structures are installed, they could produce more overall effects due to habitat loss and habitat conversion favoring structure-oriented species in the future. It is likely that the abundance of some fish species may increase with the new structures in place. The ecological response to new underwater structures would be an increase in diversity and biomass of flora and fauna that colonize the structural habitat. The long-term impacts of these structures would need to be studied in more detail to understand the lasting effects these structures may have on ecological communities (Degraer et al. 2020).

In light of the above information, BOEM anticipates that the impacts associated with the presence of structures may be negligible to moderate and long-term. The impacts on finfish, invertebrates, and EFH resulting from the presence of structures would persist for the duration for which the structures remain.

Seafloor disturbance: Seafloor habitat is routinely disturbed through dredging (for navigation, marine minerals extraction, and military purposes) and commercial fishing use of bottom trawls and dredge fishing methods. While fishing occurs over a large geographic area, bottom-tending gears have much shallower penetration depths into the sediment than most offshore construction techniques or excavation tools. Abandoned or lost fishing gear remains in the aquatic environment for extended time periods, often entangling or trapping mobile invertebrate and fish species. Based on data from NOAA, bycatch affects many species throughout the GAA—most notably, windowpane flounder, blueback herring, shark species, and hake species; the majority of bycatch is a result of open area scallop trawls, large-mesh otter trawls, conch pots, and fish traps (NOAA 2019). Water quality impacts from ongoing onshore and offshore activities affect nearshore habitats, and accidental spills can occur from pipeline or marine shipping. Invasive species can be accidentally released in the discharge of ballast water and bilge water from marine vessels. The resulting impacts on invertebrates and finfish depend on many factors but can be widespread and permanent, especially if the invasive species becomes established and outcompetes native species.

Ongoing dredging for the purposes of navigation results in short-term, localized impacts, such as habitat alteration and change in complexity, on finfish, invertebrates, and EFH. Dredging would be expected to occur most often in areas of sand waves where jet plowing would not be sufficient to meet target burial depths for cables, pipelines, etc. It would be expected that plumes of sediment resulting from dredging activities would redeposit to areas composed of similar sediments, due to the sandy nature of the seafloor throughout much of the GAA. Sandy or silty habitats, which are abundant in the GAA, are quick to recover from dredging disturbance. Newcombe and MacDonald (1991) suggest impacts from settlement of resuspended sediment plumes increase with the concentration of resuspension and the duration over which invertebrates are exposed to that plume. When studying the dredge plume dynamics of New York/New Jersey Harbor, USACE (2015) noted that sediment concentrations decreased exponentially with time and distance in the down-current direction (within 15 minutes of release, concentrations were noted to be less than 50 mg/L). Resuspension of coarse-grained sands within the offshore wind lease areas is expected to be limited in duration, resulting in a relatively short exposure of finfish and invertebrates to the plume. Seabed profile alterations could cause long-term or permanent impacts on EFH. Mechanical trenching, used in more resistant sediments (e.g., gravel, cobble), causes seabed profile alterations during use, although the seabed is typically restored to its original profile after utility line installation in the trench. Habitat function in these areas would be expected to recover in the short term following dredging activities.

Habitat alterations resulting from dredging would have minor impacts on finfish and invertebrates that would be short-term; however, long-term or permanent impacts on EFH could be possible.

Sediment deposition: Under the No Action Alternative, future offshore wind projects could disturb over 20,276 ac (8,205 ha) of seabed while installing associated undersea export cables, and 48,395 ac (19,584 ha) of seabed disturbance for IAC installation, causing an increase in suspended sediment. This disturbance would result in short-term plumes of suspended sediments in the immediate construction areas. Research from the Block Island Wind Farm concluded that suspended sediment levels due to construction were found to be 100 times lower than model predictions completed before construction (Elliot et al. 2017) and dissipated to baseline levels less than 50 ft (15.2 m) from the disturbance. Both the modeled TSS effects, which are conservatively high, and the observed TSS effects were short-term and within the range of baseline variability. These effects would be short-term (lasting only a few tide cycles) due to the low mobility of sediments (primarily sand) in the proposed cable lay down area (Stantec 2020).

Finfish are unlikely to be affected by sediment deposition or burial; however, sessile life stages of some finfish such as eggs and larvae could be smothered by sediments, causing mortality. Impacts would be expected to vary by time of year, based on when any finfish species may spawn. Overall impacts due to sediment deposition and burial would be considered negligible to minor, localized, and short-term.

Dredging and mechanical trenching used during cable installation could cause localized, short-term impacts (habitat alteration, lethal and sublethal effects) on invertebrates through sediment deposition and seabed profile alterations. Sediment deposition could result in adverse impacts on invertebrates, including smothering. The tolerance of invertebrates to being covered by sediment (sedimentation) varies among species and life stage. Some sessile shellfish may only tolerate 0.4 to 0.8 in (10 to 20 mm), while other benthic organisms can survive burial in upward of 7.9 in (200 mm) (Essink 1999). Demersal eggs and larvae would be particularly vulnerable to sediment disturbance and resettlement. For example, high rates of mortality can occur in winter flounder, ocean pout eggs, longfin squid egg masses, and skate egg cases if exposed to abrasion. For migratory invertebrate species, impacts would be expected to vary by time of year, based on the species’ presence in the vicinity of the cable lay down area. Overall impacts from sediment deposition would be short-term and minor. Disturbance of sand waves that may impact finfish and invertebrate use may take a longer time to recover than other habitats.

Regulated fishing effort: Regulated fishing is an ongoing activity that impacts finfish, invertebrates, and EFH. Fishing can modify the distribution, bottom disturbance, and mortality of fisheries in the area. Ongoing offshore wind activities and construction developments can influence the management measures chosen to support fisheries management goals, altering the nature, distribution, and intensity of fishing-related impacts on fish, invertebrates, and EFH. Reduced fishing activity due to restrictions associated with wind energy development may benefit some overfished finfish and invertebrate species by reducing fishing pressure and allowing some recovery. Regulated fishing aims to achieve a sustainable loss of biomass for commercially regulated finfish and invertebrate populations. Fishing activity also has indirect impacts through bycatch and ghost fishing by abandoned and lost fishing gear. Changes to the management of commercial fisheries enforced by states, municipalities, or NOAA (depending on jurisdiction) could result in changes to the distribution and intensity of fishing-related impacts on finfish and invertebrate populations. However, the commercial fisheries buffer zone regulations and recreational catch limits are not expected to change or result in any population decline. Overall, the intensity of impacts resulting from regulated fishing effort is anticipated to be long-term and qualify as minor to moderate.

Climate change: Future trends for climate change predict that fish, invertebrates, and EFH may experience adverse effects going forward. Several factors of climate change impact the world's oceans including increasing water temperatures, ocean acidification, and changing weather patterns. These factors are causing a shift in the distribution of many important fish species toward cooler or deeper waters. These changes can and would have significant impacts on not only the commercial and recreational fishing industry, but on the health of fish stocks in the North Atlantic (Alexander et al. 2020, Sumaila et al. 2020). Ocean acidification is another process being accelerated by climate change that is causing the oceans to become more acidic as more carbon dioxide enters the atmosphere. This increased acidity can have adverse effects on invertebrate groups that rely on calcareous shells to thrive, as well as fish that utilize reef systems for protection and habitat (Espinel-Velasco et al. 2018). Global climate change has the potential to affect the distribution and abundance of invertebrates and their food sources, primarily through increased water temperatures but also through changes to ocean currents and increased acidity. The Northeast Shelf (including New England) has experienced increasingly elevated temperatures in both surface and bottom depths (NOAA 2022c). Finfish and invertebrate migration patterns can be influenced by warmer waters, as can the frequency or magnitude of disease (Hare et al. 2016). Regional water temperatures that increasingly exceed the thermal stress threshold may affect the recovery of the American lobster fishery off the east coast of the United States (Rheuban et al. 2017). Ocean acidification driven by climate change is contributing to reduced growth and, in some cases, decline of invertebrate species with calcareous shells. Increased freshwater input into nearshore estuarine habitats can result in water quality changes and subsequent effects on invertebrate species (Hare et al. 2016).

Based on a recent study, northeastern marine, estuarine, and riverine habitat types were found to be moderately to highly vulnerable to stressors resulting from climate change (Farr et al. 2021). In general, rocky and mud bottom, intertidal, SAV, kelp, coral, and sponge habitats were considered the most vulnerable habitats to climate change in marine ecosystems (Farr et al. 2021). Similarly, estuarine habitats considered most vulnerable to climate change include intertidal mud and rocky bottom, shellfish, kelp, SAV, and native wetland habitats (Farr et al. 2021). Riverine habitats found to be most vulnerable to climate change include native wetland, sandy bottom, water column, and SAV habitats (Farr et al. 2021). As invertebrate habitat, finfish habitat, and EFH may overlap with these habitat types, this study suggests that marine life and habitats could experience dramatic changes and decline over time as impacts from climate change continue.

Planned non-offshore wind activities that may affect finfish, invertebrates, and EFH include new submarine cables and pipelines, tidal energy projects, marine minerals extraction, dredging, military use, marine transportation, fisheries use and management, global climate change, and oil and gas activities These activities would result in the same types of impacts as described for ongoing non-offshore wind activities. Appendix E, Attachment 1, provides additional information on finfish, invertebrates, and EFH impacts associated with ongoing and planned activities.

3.10.3.3 Impacts of Alternative A on ESA-Listed Species

Impacts to endangered species associated with ongoing offshore wind activities are likely to be insignificant. Subadult and adult Atlantic sturgeon are known to occur in marine waters year-round and many of the IPFs discussed in the above sections could apply. The most sensitive IPF to sturgeon would most likely be the noise associated with construction, including pile driving; however, those activities are most likely to occur from May to December. Atlantic sturgeon utilize more nearshore and riverine water in the Summer, reducing their risk significantly during that time frame (Ingram et al. 2019). Under the No Action Alternative, ESA listed fish species would likely continue to be affected by existing environmental trends in the region. Ongoing activities are expected to have continued short-term and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on ESA listed species. Continuation of existing environmental trends and activities under the No Action Alternative would result in moderate impacts on ESA listed species.

3.10.3.4 Conclusions

Impacts of the No Action Alternative

Under the No Action Alternative, finfish, invertebrates, and EFH would likely continue to be affected by existing environmental trends in the region. Ongoing activities are expected to have continuing, short-term, and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on finfish, invertebrates, and EFH. The primary source of impact from ongoing activities would include noise, seafloor disturbance, cable emplacement and maintenance, EMF, regulated fishing efforts and climate change. Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts on finfish, invertebrates, and EFH.

The overall impacts of light on finfish, invertebrates, and EFH are likely to be negligible, localized, and short-term, resulting in little change to these resources. Impacts from accidental releases and discharges, anchoring, and sediment deposition would be localized, short-term and minor. The impacts on finfish, invertebrates, and EFH resulting from the presence of structures would be negligible to moderate and persist for the duration for which the structures remain. Regulated fishing efforts and climate change are anticipated to have a minor to moderate impact on finfish, invertebrates, and EFH.

Minor to moderate impacts are anticipated from new cable emplacement and EMF. Cable routes that intersect sensitive EFH such as eelgrass beds or rocky bottom and other more complex habitats may cause long-term or permanent impacts; otherwise, impacts of habitat disturbance and mortality associated with cable emplacement would be recovered in the short term. EMF effects from future projects would vary in extent and significance depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design. Potential impacts of EMF on finfish, invertebrates, and EFH would not be minimized or eliminated by installing transmission cables with shielding or by burying them at sufficient depths. Cable burial depth could mitigate impacts of heat emission from cables. Further research is needed to fully understand the scale of impacts of EMF on finfish, invertebrates, and EFH.

Under the No Action Alternative, human activities, including commercial, government and military, research, recreational vessel activity, and the development and operation of other wind energy projects on the OCS, would continue to generate underwater noise. Underwater noise is anticipated to have a moderate impact on finfish, invertebrates, and EFH. Continued seafloor disturbance from dredging and commercial fishing would also have a moderate impact. Future habitat conversion could influence fish and invertebrate community structure, causing long term and moderate adverse impacts.

Cumulative Impacts of the No Action Alternative

Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and fish, invertebrates, and EFH would continue to be affected by natural and human-caused IPFs. Any responses would be dependent on the continued anthropogenic activities. Even though the current project would not be constructed under the No Action Alternative, BOEM anticipates several renewable offshore projects to be constructed in the next decade that could have short-term or potentially permanent impacts on fish, invertebrates, and EFH. Possible impacts could include benthic habitat disturbance and degradation, displacement of species, injury, or mortality. Aside from renewable energy construction activities, the trend of commercial fishing pressures and climate change would continue to be a moderate threat to fish, invertebrates, and EFH.

Activities other than offshore wind developments have the potential to impact fish, invertebrates, and EFH in the reasonably foreseeable future. These activities include increased vessel traffic, any new submarine cable installations or pipelines, onshore construction activities, marine survey or explorations, mineral extractions, port expansions, channel dredging activities, and the installation of any new offshore structures, buoys, or piers (Appendix E). These reasonably foreseeable activities and their cumulative impacts on fish, invertebrates and EFH are anticipated to be **moderate.** The sections below describe the impact determinations for each IPF.

3.10.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The number, size, and locations of WTGs;
- Total length of the IAC;
- Number and locations of OCS-DC;
- Total length of interconnector cable; and
- Time of year during which construction occurs.

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

- WTG number, size, and locations: The level of hazard related to WTG is proportional to the number of WTGs installed, with fewer WTGs requiring fewer foundations, resulting in less construction-related impacts.
- Offshore cable route and OCS-DC footprint: The route of the cable and footprint of the OCS-DC would determine that type and amount of seafloor habitat impacts.

- Season of construction: Finfish vary in their migration movements, meaning that certain species and lifestages may be present at during different seasons, and their chosen depth in the water column may also be influenced by season and water temperature. Some mobile invertebrates also vary in their migration movements, and sensitive life stages are present at certain times of the year. Any construction window would affect finfish species, such as Atlantic sturgeon.

Although some variation is expected in the design parameters, the assessment of impacts to finfish, invertebrates, and EFH in this section considers the maximum-case scenario.

3.10.5 Impacts of Alternative B - Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat

3.10.5.1 Construction and Installation

SRWF would be located within federal waters (Atlantic Ocean) on the OCS, specifically in the Lease Area, approximately 16.4 nm (18.9 mi, 30.4 km) south of Martha's Vineyard, Massachusetts; approximately 26.5 nm (30.5 mi, 48.1 km) east of Montauk, New York; and approximately 14.5 nm (16.7 mi, 26.8 km) from Block Island, Rhode Island. A detailed map showing the locations of all proposed WTGs, IAC, and the OCS-DC is provided in Figure 3.3.4-1 in the COP (Sunrise Wind 2023).

The Proposed Action would consist of up to 95 foundations for the WTGs and OCS-DC, with a maximum embedment depth of up to 164 ft (50 m) for monopile foundations, and 295 ft (90 m) for OCS-DC piled jacket foundations. The maximum area of seafloor footprint per foundation, inclusive of scour protection and CPS stabilization is 1.06 ac (4,289.67 m^2) for WTG monopile foundations and 2.64 ac (10,683.70 m^2) for the OCS-DC foundation structure.

The SRWEC would consist of one 320-kV DC export cable bundle buried to a target depth of 4 to 6 ft (1.2 to 1.8 m) with a maximum total corridor length of approximately 105 mi (169 km), a maximum individual cable diameter of 7.8 in (200 mm), a maximum disturbance corridor width of 98 ft (30 m), a maximum seafloor disturbance for HDD exit pits of 61.8 ac (25 ha), and a maximum disturbance for Landfall Work Area (onshore) of up to 6.5 ac (2.6 ha).

The SRWF would include a stationary OCS-DC which would collect the medium voltage alternating current (AC) power generated by the WTGs, convert it to direct current (DC), transform it to higher voltage for transmission, and transport that power to the Project's onshore electrical infrastructure via the SRWEC. The OCS-DC would withdraw seawater for cooling and discharge the heated effluent to the surrounding environment. The withdrawal of raw seawater would occur through a CWIS to dissipate heat produced through the AC to DC conversion and then discharge this heated water as effluent to the marine receiving waters. The DIF for the OCS-DC is 8.1 mgd; however, the average intake flow would generally range from 4.0 mgd to 5.3 mgd.

3.10.5.1.1 Onshore Activities and Facilities

Seafloor and land disturbance: Onshore facilities would be expected to have minimal impacts on EFH, including littoral zone habitats such as SAV and tidal wetlands, due to the majority of the facilities being on land, as well as the use of HDD where the onshore transmission cable crosses the ICW between Bellport Bay and Narrow Bay, just west of the Smith Point bridge. The proposed ICW-HDD route may cross under SAV or macroalgae, which is considered HAPC for summer flounder (Figure 2.1-3). Video surveillance confirmed that SAV and benthic macroalgae covered a very small area (1.7 ac [0.7 ha]) within the assessment area surrounding the ICW-HDD route (COP Appendix N1, Inspire 2022d).

Installation of the cable via HDD would avoid direct impacts to marine vegetated habitats as this methodology avoids disturbance to the seafloor; HDD exit pits and work areas would not overlap with littoral zone habitats in the ICW-HDD Assessment Area (COP Appendix N1, Inspire 2022d). Similarly, the extent of wetlands within the ICW-HDD Assessment Area were mapped using NYSDEC tidal wetlands data (NYSDEC 1974); and no impacts would be anticipated to these habitats from the ICW HDD installation as use of this methodology avoids disturbance to the seafloor; however, impacts could occur in the unlikely event of an inadvertent release of drilling fluid (addressed below).

A Temporary Landing Structure that may be installed to aid in the transport of equipment and materials for the Landfall HDD and ICW HDD could potentially impact EFH in its direct vicinity. The pile-supported trestle would be located to the west of the existing fishing pier, and would be approximately 16 ft (5 m) wide and extend 242 ft (74 m) offshore. The trestle structure would be comprised of a light aluminum deck system (or a similar alternative) supported on steel or aluminum girders framed into driven steel piles. The piles would be placed in the mudline by a barge-based crane. Sunrise Wind has estimated that approximately 21 driven piles would be required. The Temporary Landing Structure would be secured to the seabed with spuds. The tidal range in the ICW is approximately 2 ft (0.6 m) and depending on the tides and water depths at the selected location, a portion of the Temporary Landing Structure may be grounded at times, particularly closer to the shoreline. The temporary landing structure may need to remain in place year-round but the use would be limited to fall and spring. The temporary landing structure may be used during two construction periods since the Landfall HDD, ICW HDD, and SRWEC pull-in may be done in different years.

The east and west pier assessment areas were examined for SAV and benthic macroalgae extent, as well as wetland presence. No recent SAV or benthic macroalgae habitats were mapped in these areas (see Table 3.4.1-1; Figure 3.4-1 of COP Appendix N1, Inspire 2022d). Historical data from 2018 and 2002 indicate the potential presence of 0.8 ac (3,237.5 m^2) of SAV in the west area; however, the 2020 video survey of this area did not document the presence of any SAV or benthic macroalgae. Historical data from 2002 indicate the potential presence of 0.3 ac (1,214.1 m^2) of SAV in the east area. A video survey was completed in October 2022 to document the presence and extent of SAV beds within 100 m of the ICW-HDD. There were six observations of SAV, specifically eelgrass, all located on the north side of the channel. The density of the eelgrass was very low: a maximum of one to three shoots were observed within a single video frame. All eelgrass observations were within dense macroalgal beds and often the eelgrass shoots appeared to be uprooted and deposited within the macroalgal bed. SAV was not observed on the south side of the channel, despite an SAV bed being documented in this area previously (NYDOS 2020). Results from video transects completed in October 2022 confirmed the presence of some seagrass but did not indicate any significant populations of eelgrass in the proposed temporary landing site at Smith Point County Park. Most (four of six observations) of the observed eelgrass occurred as single, unrooted shoots that were likely the result of drifting/rafted eelgrass flower shoots.

Should subtidal vegetated habitat (SAV and/or benthic macroalgae) be present in the area at the time of construction and could not be avoided in siting the pier, up to 1,500 ft^2 (138 m^2) could be indirectly and temporarily impacted if these habitats completely overlap with the planned pier location. Short-term indirect impacts over the entire area of overlap between the pier and the vegetated habitats would result from shading effects that could reduce the photosynthetically active radiation available to SAV. Depending on the ultimate pier location, direct short-term impacts of no more than approximately 960 ft^2 (89.2 m^2) to vegetated benthic habitat would be possible during times that portions of the pier would be grounded and from direct contact with spuds from the Temporary Landing Structure and barge. A pre-construction SAV survey would be conducted prior to construction to confirm current presence of SAV. The likelihood of impacts to intertidal and subtidal vegetated habitats would be considered very low given that the proposed Temporary Landing Structure would be positioned to avoid and minimize impacts to these sensitive habitats to the extent practicable. Use of the proposed Temporary Landing Structure would occur between fall and spring, and thus would minimize impacts to any SAV present during the growing season.

The NYSDEC tidal wetlands (1974) category of "coastal shoals, bars, and mudflats" was the only tidal wetlands mapped within the assessment areas–0.9 ac (3,642.2 m^2) in the west area and 0.05 ac (202.3 m^2) in the east area (see Table 3.4.1-1 and Figure 3.4-1 in COP Appendix N1, Inspire 2022d). This category is defined as "The tidal wetland zone that at high tide is covered by saline or fresh tidal waters, at low tide is exposed or is covered by water to a maximum depth of approximately one foot and is not vegetated." Direct short-term impacts of up to approximately 960.0 ft^2 (89.2 m^2) to this habitat would be possible during times when portions of the pier would be grounded and from direct contact of spuds from the Temporary Landing Structure and barge.

Subtidal (below low tide) portions of the east and west pier assessment areas could be suitable habitat for benthic eggs, such as winter flounder. Only a small area directly under the spuds and the portion of the pier that rests on subtidal seafloor would have an impact on these habitats. Direct short-term impacts to egg habitat would be expected to be extremely minor given the very small area of impact and the low amounts of sedimentation expected from pier construction. In addition, and although the current EFH definition for winter flounder eggs includes mud and muddy sand (NEFMC 2017), Wilber et al. (2013) found that in New York harbors winter flounder had very specific habitat preferences and were more likely to utilize sandy sediments than muddy or silty bottoms or bottoms with a high percentage of total organic carbon. Should the subtidal sediments in the area selected for siting the pier have higher components of mud than sand, the potential for egg habitat and, thus, the potential for the Temporary Landing Structure to impact winter flounder eggs, would be further reduced. Seafloor and land disturbance effects on finfish, invertebrates, and EFH during construction and installation activities would be minimal, short-term in nature and have negligible impacts.

Sediment deposition: Construction of the onshore transmission cable would be accomplished using HDD methodology where the proposed route crosses the ICW. The proposed onshore transmission cable route would cross under SAV habitat in the ICW that is considered HAPC for summer flounder. The use of HDD would avoid impacts to tidal wetlands and SAV; however, impacts could occur in the unlikely event of an inadvertent release of drilling fluid. An inadvertent release occurs when drilling fluids (i.e., naturally occurring bentonite clay) migrate unpredictably to the surface of the seafloor through fractures, fissures, or other conduits in the underlying rock/sediments. An inadvertent release of drilling fluid along the HDD segment could cause a short-term turbidity plume; however, bentonite clay particles would be expected to settle quickly due to the natural flocculation of clay particles in seawater. Although bentonite by itself is non-toxic, it is a fine particulate material that could become entrained in the water column and transported to other locations if sufficient current velocities were present, causing turbidity and sedimentation.

Mobile species could be temporarily displaced by a turbidity plume and, depending on the thickness of materials settling on the seafloor, demersal eggs/larvae could be at risk of smothering or other injury. Demersal/benthic finfish eggs and larvae in the vicinity of a release could potentially experience short-term, direct impacts from a short-term increase in sedimentation/ deposition. Eggs and larvae can be more sensitive to sediment deposition (Berry et al. 2003), as they may be unable to relocate from the affected areas and, therefore, would be more susceptible to impacts from an inadvertent release compared to juveniles and adults. Impacts on EFH species, if they were to occur, would be minor, short-term and localized, and would generally be limited to individuals in the immediate vicinity of the release. Disturbance of sand waves that may impact finfish and invertebrate use may take a longer time to recover than other habitats.

Accidental release: Although no impacts from discharges and releases are anticipated, spills or accidental releases of fuels, lubricants, or hydraulic fluids could occur during use of trenchless installation and duct bank installation methods, installation of the onshore transmission cable or onshore interconnection cable, or during construction activities at the OnCS-DC. A SPCC Plan would be developed, and any discharges or release would be governed by NYS regulations. Any unanticipated discharges or releases within the Onshore Facilities during construction would be expected to result in minimal, short-term impacts; activities would be heavily regulated, and discharges and releases would be considered accidental events that would unlikely occur. Additionally, where HDD would be utilized, an Inadvertent Return Plan would be prepared and implemented to minimize the potential risks associated with release of drilling fluids. The potential for a significant loss of drilling fluid in this inshore environment would be considered low. Given this information, impacts on summer flounder HAPC, finfish, and EFH as a result of an inadvertent release of drilling fluid would not be expected. Effects on finfish, invertebrates, and EFH from accidental release would be minimal, short-term in nature and have negligible impacts.

3.10.5.1.2 Offshore Activities and Facilities

Offshore construction of the SRWF and SRWEC could likely result in potential impacts to finfish, invertebrates and EFH that are discussed below.

Accidental release and discharge: As discussed above in the No Action Alternative, BOEM and the USGS would ensure all construction activity vessels are prohibited from the discharge of trash and debris and procedures would be in place and followed such as spill prevention and response plans throughout construction phase to minimize and avoid accidental releases and spills of any hazardous materials during all phases of construction. Under these guidelines, Project construction-related impacts to finfish, invertebrates and EFH from potential accidental releases would be negligible. However, studies conducted by Almeda et al.(2014) indicate that chemical dispersants as well as petroleum-based products such as crude oil are highly toxic to marine zooplankton in low concentrations and the synergistic effects of these chemicals increase the toxicity to marine zooplankton (Almeda et al. 2014; Rico-Martinez et al. 2013).

Most small accident spills impacts would be localized in area and action would be put in place immediately to address and mitigate any potential impacts from emergency spills. If an unlikely larger spill occurs, the impacts on species would be moderate due to the potentially adverse impacts to water quality. Spills that may occur are expected to do so at the surface and impact the upper or surface-mixed layer of the water column.

Anticorrosion and anti-biofouling contamination substances necessary to maintain offshore infrastructures can result in contamination due to galvanic anodes emitting substantial amounts of metals and organic coatings may release organic substances due to weathering or leaching (Kirchgeorg et al. 2018). Contaminations from chemical emissions may include organic compounds such as bisphenol A and metals such as aluminum, zinc, and indium from corrosion and biofouling protection measures and sacrificial anodes (Lloret et al. 2022). Lloret et al. (2022) report that these substances are presently considered to have a low environmental impact but monitoring data are not sufficient to assess the environmental impact of this new source.

As discussed in the No Action Alternative, the risk of the release of invasive species if appropriate guidelines are followed would be low and the attributable impacts would be negligible. If any accidental spill of invasive species occurred directly related to construction vessel activities and the invasive species were to become established and outcompete native species, the impacts could potentially be major. Ongoing trends and future planned activities would cause additional risk for the likelihood of accidental spills beyond those attributed to the proposed Project. If appropriate guidelines are followed, effects on finfish, invertebrates, and EFH from accidental release and discharge would be minimal, short-term and have negligible impacts.

Anchoring: The short-term impacts of vessel anchoring on finfish, invertebrates, and EFH would include direct contact of anchors and associated equipment with the seafloor bottom. The impacts of anchor contact with the bottom would cause increased turbidity in the immediate, localized areas with the potential to temporarily disturb finfish, invertebrates, and EFH. Injury, mortality, and potential habitat degradation could be possible and would mostly impact invertebrates if occurred. Direct contact of an anchor with a finfish is possible but the likelihood is very rare. Localized impacts would be short-term, and any physical contact would be recovered in the short-term.

Sensitive habitat areas such as eelgrass beds, or hard bottom substrates would be more susceptible to anchoring with the potential for longer-term or permanent impacts. While anchor placement and chain sweep may damage seagrass blades, anchor drag and retrieval are likely to damage or uproot seagrass rhizomes, which may take years to recover (Orth et al. 2017). Habitat characterization and mapping, along with the required development of an anchoring plan would minimize any anchoring in sensitive habitats and reduce the area of sensitive habitats to be affected. If degradation of sensitive habitat were to occur, the impacts could be longer-term, but the impacts from anchoring during construction are no greater than the impacts of anchoring proposed from ongoing and planned future activities in the future. The combined impacts of anchoring on finfish, invertebrates, and EFH in the context of foreseeable environmental trends and ongoing and planned activities are expected to be minor.

Light: Any artificial lighting from construction activities would be attributed to deck lighting and navigation purposes of vessels from dusk to dawn. Vessels would be required to comply with guidance from BOEM to minimize or reduce lighting that affects the aquatic environment. Finfish and invertebrate impacts due to artificial light are highly species-dependent and can either cause attraction or avoidance (Orr et al. 2016). Most impacts are associated with more permanent light sources associated with nearshore or overwater permanent structures. Any lighting effects on finfish, invertebrates, and EFH during construction activities would be minimal, short-term in nature and have negligible impacts.

Noise: Noise and vibration associated with construction activities such as pile driving, geological surveys, and dredging could impact finfish, invertebrates and EFH. Impacts are dependent on a variety of factors, including the source and intensity of the noise source, as well as the species in the area. Pile-driving activity is likely to produce the most intense underwater noise levels and have the potential to initiate a response from finfish and invertebrates. Typical responses may include short-term displacement, or disruption of common activities during feeding and movement, with less likely and more severe responses including physiological reactions that could lead to mortality (Popper et al. 2014). The Fisheries Hydroacoustic Working Group (2008) established conservative thresholds for the impacts from sound on fish (Table 3.10-2). There are currently no established thresholds for the impacts of sound on invertebrates. In general, crustaceans and mollusks lack internal air spaces and as a result are less sensitive to noise-related injury than fish.

Offshore construction activities associated with the Proposed Action primarily from pile-driving activities could cause fish to suffer behavioral and/or physiological responses based on distance from the sound source, equipment used, substrate and environmental conditions (Popper et al. 2014).

Noise-induced stress would affect mainly those species that do not have the potential to relocate or delay spawning, for example, those species that are bound to specific spawning grounds and have a restricted spawning period. In contrast to the spawning period, most species seem to be relatively resilient to stress during egg development and parental care. Masking and hearing-loss would mainly affect species for which sound is crucial to reproduction, such as species that use sound to locate spawning grounds and those that use acoustic communication during spawning (de Jong et al. 2020). Noise research on black sea bass (Stanley et al. 2020), and cuttlefish (Sole et al. 2022) resulted in conclusions that younger life stages may be more susceptible to exposure to noise. Stanley et al. (2020) reported that juvenile black sea bass had the significantly lower noise thresholds, with auditory sensitivity decreasing in the larger size classes. Sole et al. (2022) reported that noise had negative effects on different development stages of the common cuttlefish (*S. officinalis*) a shallow water cephalopod. The exposed larvae of cuttlefish showed a decreased survival rate with an increasing sound level when they were exposed to maximum pile-driving and drilling sound levels. They found that these effects can be considered acute only in the very vicinity of the sound source where they have the potential to affect cephalopod populations and their offspring.

The variations of fish chorusing intensity and duration were recently investigated in the Taiwan Strait. Two types of fish choruses (Types 1 and 2) were found to repeat over a diurnal pattern. In the 2 days after the pile driving, Type 1 chorusing showed lower intensity and longer duration, while Type 2 chorusing exhibited higher intensity and no changes in its duration. During the operational phases in 2017 and 2018, both choruses were longer in duration (2–3 h for Type 1; 0.5–1 h for Type 2). The intensity of Type 1 chorus increased by 5– 10 dB, but no significant variation was recorded for Type 2 (Siddagangaiah et al. 2022).

The current threshold classification considers effects on fish mainly through sound pressure without taking into consideration the effect of particle motion. Popper et al. (2014) and Popper and Hawkins (2018) suggest that extreme levels of particle motion induced by various impulsive sources may also have the potential to affect fish tissues and that proper attention needs to be paid to particle motion as a stimulus when evaluating the effects of sound on aquatic life. However, considerable uncertainty remains about fish sensitivity to particle motion and no thresholds have been established to analyze these effects (Popper and Hawkins 2018). Recent researched has suggested that mitigation techniques such as bubble curtains and steel barriers could significantly reduce exposure to particle motion (Sigray et al. 2022).

Table 3.10-2. Acoustic Metrics and Thresholds for Fish for Impulsive and Non-impulsive Sound Sources

<table>
<tr><th rowspan="4">Faunal Group</th><th colspan="3">Impulsive</th><th colspan="4">Non-Impulsive</th></tr>
<tr><th colspan="2">Injury</th><th rowspan="2">Behavior</th><th colspan="2">Injury</th><th>Impairment</th><th rowspan="2">Behavior</th></tr>
<tr><th colspan="2">PTS</th><th colspan="2">PTS</th><th>TTS</th></tr>
<tr><th>Lpk</th><th>LE</th><th>Lp</th><th>LE</th><th>Lp</th><th>Lp</th><th>Lp</th></tr>
<tr><td>Large Fish (≥2 g)</td><td rowspan="2">206</td><td>187</td><td rowspan="2">150</td><td>-</td><td>-</td><td>-</td><td rowspan="2">150</td></tr>
<tr><td>Small Fish (<2 g)</td><td>183</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Fish without swim bladder</td><td>213</td><td>216</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Fish with swim bladder not involved in hearing</td><td>207</td><td>203</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Fish with swim bladder involved in hearing</td><td>207</td><td>203</td><td>-</td><td>-</td><td>170</td><td>158</td><td>-</td></tr>
</table>

Source: Küsel et al. 2022
Notes:
L_{pk} = peak sound pressure level (dB re 1 µPa)
L_E = sound exposure level (dB re 1 µPa^2·s)
L_p = root-mean-square sound pressure (dB re 1µPa)
PTS = permanent threshold shift
TTS = temporary threshold shift, which are recoverable hearing effects

Acoustic propagation modeling of the impact pile driving activities for the Proposed Action was undertaken to determine distances to the established injury and disturbance thresholds for fish (Küsel et al. 2022). Two types of piles were considered: 7/12 -meter tapered monopiles (23 ft [7 m] at the waterline and 39 ft [12 m] at the mudline) and 4-meter jacket pin piles. Impact hammer installation of the monopile foundations would produce the most intense underwater noise impacts with the greatest potential to cause injury-level effects on fish; therefore, these effects are the focus of the assessment below. Sound fields from 7/12-meter monopiles and jacket piles were each modeled at one representative location in the offshore Project Area using IHC S-4000 impact hammers. Hammer energy levels included in the model ranged from 1000 kJ to 3200 kJ for 7/12 m monopiles, and 1000 kJ to 4000 kJ for jacket piles. The modeling also used a 10-dB-per-hammer-strike noise attenuation to incorporate the use of a single noise-abatement system (e.g., one or multiple bubble curtain[s]). The resulting values represent a radius extending around each pile where potential injurious-level or behavioral effects could occur and are presented in Table 3.10-3. Acoustic radial distances for the two pile driving methods were modeled for average summer and average winter sound speed (Table 3.10-3). Soft start during impact pile driving is a mitigation technique that involves the gradual increase in hammer blow energy to allow marine life to leave the area. Soft starts would be employed prior to commencement of any impact pile driving. Soft starts would include at least 20 minutes of four to six strikes per minute at 10 to 20 percent of the maximum hammer energy.

Table 3.10-3. Summary of Acoustic Radial Distances (R95 in kilometers) with 10dB Attenuation for Fish during Monopile and Jacket Foundation Impact Pile Installation during Summer and Winter Sound Speed Conditions

Faunal Group and Threshold Type	Threshold Type	Threshold Level	Summer		Winter	
			Monopile (3200 kJ hammer energy)	Jacket Pile (4000 kJ hammer energy)	Monopile (3200 kJ hammer energy)	Jacket Pile (4000 kJ hammer energy)
Small Fish (<2 g) - Injury_	L_E	183	8.04	15.18	9.36	21.61
Large Fish (≥2 g) – Injury	L_E	187	6.19	11.73	6.97	15.03
All Fish - Injury	L_{pk}	206	0.13	0.09	0.13	0.09
All Fish – Behavior	L_p	150	11.18	14.85	14.57	19.36
Fish without swim bladder - Injury	L_E	219	0.14	0.52	0.14	0.53
	L_{pk}	213	0.03	0.05	0.03	0.05
Fish with swim bladder not involved in hearing - Injury	L_E	210	0.64	1.83	0.67	1.86
	L_{pk}	207	0.12	0.09	0.12	0.09
Fish with swim bladder involved in hearing - Injury	L_E	207	0.95	2.51	0.98	2.58
	L_{pk}	207	0.12	0.09	0.12	0.09
Eggs and Larvae	L_E	210	0.64	1.83	0.67	1.86
	L_{pk}	207	0.12	0.09	0.12	0.09

Source: Küsel et al. 2022

Notes: Radial distances to thresholds for fish modeled for a single 7/12 m tapered monopile and a four-legged 4 m jacket pin pile using a IHC S-4000 hammer.

L_E = unweighted sound exposure level (dB re 1 µPa^2·s) over the entire pile (so encompasses all hammer energies)

L_{pk} = unweighted peak sound pressure level (dB re 1 µPa)

L_p = unweighted sound pressure level (dB re 1µPa)

PTS = permanent threshold shift

Sound exposure guidelines and regulations designed to protect finfish are described in terms of sound pressure levels, but the observable effects of high intensity noise sources on finfish may actually be caused by exposure to particle motion (Popper and Hawkins 2018). However, the particle motion levels associated with a high intensity noise source are difficult to measure and isolate from sound pressure levels. There is currently very limited understanding of the potential effects of particle motion on finfish and invertebrates.

All fishes (including elasmobranchs) detect and use particle motion, even for those fishes that are also sensitive to sound pressure (Popper and Hawkins 2019). Fishes that do not possess a swim bladder (sharks, mackerel, flatfish), as well as fishes with a swim bladder distant from the ear (salmon, tuna, most teleosts) are thought to primarily be sensitive to particle motion (Hawkins et al. 2020). Fishes with the swim bladder close to the ear (Atlantic cod, eels) or where the swim bladder is connected to the ear (herrings) are able to detect sound pressure as well as particle motion (Hawkins et al. 2020). In these finfish, the swim bladder and other gas-filled organs may act as a type of acoustic transformer, converting sound pressure into particle motion (Popper and Hawkins 2018). The movement of these organs may indirectly stimulate the otolith structures such that fishes experience particle motion both from the noise source and from this indirect signal (Popper and Hawkins 2018).

Cephalopods, including cuttlefish, octopus, and squid species, are likely sensitive to particle motion rather than sound pressure (e.g., Packard et al. 1990; Mooney et al. 2010), with the lowest particle motion thresholds reported at 1 to 2 Hz (Packard et al. 1990). Particle motion thresholds were measured for longfin squid between 100 and 300 Hz, with a threshold of 110 dB re 1 µPa reported at 200 Hz (Mooney et al. 2010). No other studies have measured particle motion. Cephalopods appear to be particularly sensitive to low-frequency sound. Solé et al. (2017) estimated that trauma onset may begin to occur in cephalopods at received sound pressure levels root mean square (SPL_{rms}) from 139 to 142 dB re 1 µPa at one-third octave bands centered at 315 Hz and 400 Hz. A recent study found impulsive pile-driving noise resulted in a change in squid (*Doryteuthis pealeii*) behavior, with squid exhibiting body pattern changes, inking, jetting, and startle responses (Jones et al. 2020).

Longfin squid (*Doryteuthis pealeii*) are known to spawn inshore in southern New England waters from May to July (Hatfield and Cadrin 2002). Noise from impact pile driving and/or vibratory pile driving may temporarily cause a disturbance to spawning habitat, however the majority of spawning habitat occurs inshore of the Project Area (MAFMC 2011) and therefore pile-driving noise is not expected to result in measurable impacts on spawning squid habitat.

Sessile invertebrates such as bivalves may respond to sound exposure by closing their valves (e.g., Kastelein 2008; Roberts et al. 2015; Solan et al. 2016) much as they do when water quality is temporarily unsuitable. In one study, the duration of valve closure was shown to increase with increasing vibrational strength (Roberts et al. 2015). Clams may respond to anthropogenic noise by reducing activity and moving to a position above the sediment–water interface.

For exposed species, noise from impact pile driving and/or vibratory pile driving may temporarily reduce habitat quality and cause mobile species to temporarily vacate the area (Hawkins et al. 2014; Neo et al. 2015). Some fish species may move away from the area before noise levels exceed the threshold for injury, but given the size of the potential zones of ensonification exceeding the behavioral disturbance threshold, harassment of individual fish would be possible (Popper et al. 2014; Neo et al. 2015). During summer months the radial distances to maximum sound exposure level (L_E) injury thresholds from 7/12 m monopile installation are a maximum of 3.8 mi (6.19 km) for large fish and 5.0 mi (8.04 km) for small fish; during winter months radical distances to L_E injury thresholds are a maximum of 4.3 mi (6.97 km) for large fish and 5.8 mi (9.36 km) for small fish; these L_E estimates assume fish remain stationary during pile driving and that this sound level occurs throughout the entire water column (Table 3.10-3; Küsel et al. 2022). In reality, fish would be moving around, possibly reducing the impact for some species during pile driving, which would only occur for an approximately 4-hour period each day. Atlantic cod winter spawning grounds have been identified in a broad geographical area that includes Cox Ledge and surrounding locations. Historically, Atlantic cod have been managed in U.S. waters as two units: the Gulf of Maine and the Georges Bank management units. Recently, an Atlantic cod Stock Structure Working Group was formed and identified a number of mismatches between the current management units and biological stock structure and proposed a new biological stock structure that accounts for inshore and offshore separation and spawning timing. McBride and Smedbol (2022) summarize several lines of evidence supporting the conclusion that the Atlantic cod found in the Southern New England waters of the Mid-Atlantic Bight are one of five reproductively isolated spawning stocks that occur in U.S. waters.

In Southern New England, Atlantic cod begin spawning in November, with peak grunt and telemetry detections occurring during the daytime from November through January (Van Hoeck et al. 2023). Review of ichthyoplankton data indicates spawning success occurs later in the spawning season, with peak success occurring between January and March (McBride and Smedbol 2022). Atlantic cod produce “grunts” which may play a significant role in their reproductive behavior (Rowe and Hutchings 2004; Stanley et al. 2017). Courtship and spawning behavior, including vocalizations, occur primarily at night (Dean et al. 2014, Zemeckis et al. 2019), with peak spawning communication occurring approximately 4 – 6 hours after sunset (Zemeckis et al. 2019). Noise impacts from impact pile driving could be greater if pile driving occurs in spawning habitat, occurs during peak spawning periods, and/or results in reduced reproductive success in one or more spawning seasons, which could result in long-term effects to populations if one or more-year classes suffers suppressed recruitment. During environmental noise impacts such as pile driving, acoustic masking may occur when animals fail to detect biologically important acoustic cues, such as spawning communication. However, acoustic masking is an environmental stressor that ceases as soon as the noise stops, with no lingering effects (Confluence 2023). For example, Atlantic cod, hake, and black sea bass belong to the hearing specialist group and rely on sound for communication and other important behaviors. Stanley et al. (2020) determined that noise from activities like impact pile driving could interfere with spawning black sea bass communication during spawning but concluded that the fish would likely return to normal spawning behavior once the acoustic impact ceased.

Cod display high spawning site fidelity, meaning that a spawning population will return to the same locations year after year (McBride and Smedbol 2022). Alteration of the ambient noise environment during evening spawning periods could interfere with communication and alter behavior in ways that could disrupt localized Atlantic cod spawning aggregations (Dean et al. 2012; Rowe and Hutchings 2006), raising concerns about noise impacts from impact pile driving from the Proposed Action. No impact pile driving would occur in the SRWF from January 1 through April 30 to protect North Atlantic right whales (NARWs), which would also be protective of spawning Atlantic cod during that time. Additionally, the use of sound attenuation (e.g., bubble curtains) would reduce the area of potential impacts from impact pile driving.

Additional studies funded by BOEM to describe Atlantic cod use of the habitats within and in proximity to the SRWF are ongoing. Two years of data have been collected in the three-year study, although no formal reports analyzing the data have been completed. During the studies, Atlantic cod have been detected in the Northwest corner of the SRWF where fixed station telemetry receivers have been installed. However, to date no Atlantic cod grunts have been detected in the SRWF area.

Short-term and short-range impacts on EFH could also occur due to geophysical surveys, vessel noise, construction equipment noise, and/or aircraft noise. Limited research has been conducted on underwater noise from mechanical/hydro-jet plows. Generally, the noise from this equipment is expected to be masked by louder sounds from vessels. Also, as most noise generated by these pieces of equipment would be below the sediment surface and associated with the high-pressure jets, noise levels are not expected to result in injury or mortality to EFH species but may cause mobile species to temporarily vacate the area. The duration of noise at a given location would be short, as the installation vessel would only be present for a short period at any given location along the cable route.

Short-term, localized geophysical surveys during the construction period may include the use of multi-beam echosounders, side-scan sonar, shallow penetration sub-bottom profilers, medium penetration sub-bottom profilers and marine magnetometers. The survey equipment to be employed would be equivalent to the equipment utilized during survey campaigns associated with Lease Area OCS-A 0500 conducted in 2016, 2017, 2018, 2019, and 2020 and with Lease Area OCS-A 04876 conducted in 2018, 2019, and 2020 (CSA Ocean Sciences Inc. 2020) and would not be expected to result in measurable impacts on EFH.

Helicopters could be used for crew transfers between the SRWF and shore. Underwater noise associated with helicopters would be generally brief as compared with the duration of audibility in the air (Richardson et al. 1995). The noise generated by aircraft would be similar to the range of noise from existing aircraft traffic in the region and is not expected to substantially affect the existing underwater noise environment.

Vessel noise may also cause mobile species to temporarily vacate the area. Vessel sound source levels have been shown to cause several different effects, the most common of which are behavioral responses, including avoidance, alteration of swimming speed and direction, and alteration of schooling behavior (Vabø et al. 2002; Handegard and Tjøstheim 2005; Sarà et al. 2007; Becker et al. 2013; Slabbekoorn et al. 2019). These studies also demonstrated that the behavioral changes generally were short-term or that fish habituated to the noises. EFH species in the vicinity of construction vessels may be affected by vessel noise but the duration of the disturbance would occur over a very short period at any given location. Noise from vessel traffic is also expected to be similar to existing background vessel traffic noise in the area.

Construction noise associated with the Proposed Action is likely to result in short-term impacts that may cause a range of responses from fishes and invertebrates. The effects may include behavioral responses with the potential to cause direct injury and mortality only if fish are in the immediate area of the sound source, but many are likely to avoid such disturbance. The overall impacts of construction noise impacts on finfish and invertebrates would likely be minor to moderate.

Seafloor disturbance: Habitat alteration and seafloor disturbance from offshore construction activities could cause injury or mortality to benthic/demersal species and affect their habitat and spawning. Specifically, seafloor-disturbing activities could result in a loss of spawning habitat for Atlantic cod, as studies suggest that Atlantic cod often demonstrate spawning site fidelity, returning to the same fine-scale bathymetric locations year after year to spawn (Hernandez et al. 2013; Siceloff and Howell 2013). An active Atlantic cod winter spawning ground has been identified in a broad geographical area that includes Cox Ledge and surrounding locations (Zemeckis et al. 2014; Cadrin et al. 2020; Dean et al. 2020; Langan et al. 2020). There is currently a BOEM funded acoustic telemetry study to better understand the distribution and habitat use of spawning Atlantic cod on and around Cox Ledge. Recent evidence has indicated large areas of continuous, large-grained and complex habitats, including medium- and low-density boulder fields in the SRWF support spawning Atlantic cod (BOEM pers. comm. 2022). Direct mortality, disturbance of spawning Atlantic cod aggregations, and damage to complex habitats (including attached fauna and epifauna present that support adult Atlantic cod) could negatively impact Atlantic cod. Adults of EFH species in the area are likely to exhibit behavioral avoidance responses to construction and would not be subject to lethal crushing, burial, or jet plow entrainment effects. However, during placement of material on the substrate, there is potential for adult fish utilizing benthic or epibenthic habitats to be crushed or buried. For example, ocean pout, monkfish, winter flounder, winter skate, little skate, Atlantic cod, and red hake are benthic or epibenthic EFH species known to be associated with the various bedform features (i.e., low- to medium-boulder fields, ripples, and linear depressions) and CMECS Substrate Subgroup types (e.g., gravelly sand, sandy gravel, coarse sand, medium sand, and fine sand) present in each Lease Area zone and subject to impacts from seabed preparation for WTG and OSS foundations. Construction-related disturbance, specifically boulder relocation and the installation of foundations and scour protection, would also result in long-term to permanent impacts to EFH species and habitats by modifying the structure and composition of pelagic and benthic habitat. Benthic or epibenthic eggs that occur within the Project Area could be exposed to lethal crushing burial, or entrainment effects. This includes eggs and larvae of EFH species, and eggs and larvae that provide prey for EFH species. Pelagic eggs and larvae of Atlantic cod and the pelagic eggs of red hake, two species of federally managed fish that are currently below target population levels and that have rebuilding plans in place, would be particularly vulnerable to mortality from entrainment effects. The areas affected by seabed preparation activities described above would be rendered temporarily unsuitable for EFH species associated with complex, large-grained complex, and soft bottom benthic habitats during one or more life stages.

Impacts on EFH species that have pelagic early and/or later life stages within the SRWF are expected to be limited as pelagic habitats would not be directly affected by seafloor preparation, aside from temporary seawater intake associated with CFE equipment used with sand wave leveling. However, these species may temporarily vacate the area of disturbance and entrainment in construction equipment is not expected to result in population-level impacts.

Extensive geophysical surveys through the Project Area have identified individual boulders (stones of 0.5 m diameter or greater) scattered throughout the SRWF area, with boulder fields (20 boulders or more within 100 m by 100 m area) predominantly in the northern extent of the site. The highest concentration of boulder fields occurs in the northwest portion of the SRWF. Smaller areas of boulder fields are further to the southeast. The higher density areas of boulders identified in the north and northwest of the SRWF generally conform with areas of glacial drift deposits. Large boulders are present in these areas, with heights in excess of 4 m (13 ft). According to the Boulder Relocation Plan prepared by Sunrise Wind, boulders ranging from 0.5 m (1.6 ft) to 2.4 m (7.9 ft) in diameter would be relocated via boulder grab for WTG and OCS-DC foundation installation. Boulders encountered within the foundation seabed preparation area would be moved to the edge of the 220 m (772 ft) disturbance area of WTG foundation installation and away from sensitive benthic habitat. Sunrise Wind has estimated that 70 of the 87 WTG positions may require boulder relocation, although additional boulders may be identified during construction that could also require relocation (personal communication, M. Evans, 2023b).

There is a potential to encounter boulders during the proposed construction and installation of the offshore infrastructure. During construction activities, the presence of boulders can impact exposed or shallow buried cables that may require post-lay cable protection, can obstruct cable installation equipment that could result in failure to reach target cable burial depth, equipment damage, and/or delayed cable installation, and risk of damage to cable assets. Along the SRWEC, boulder fields were only identified in the nearshore area of the SRWEC-NYS, predominately consisting of smaller cobble-sized boulders. Boulder fields were not encountered anywhere else along the SRWEC, although individual boulders were identified in some locations and would be relocated. Prior to installation, geophysical surveys would be performed to determine where boulders occur and to inform micrositing decisions. Impacts on EFH associated with boulder clearance and related seafloor preparation activities would be longer term. Damage to habitat forming invertebrates on relocated boulders and cobbles could take several years to decades to fully recover (Auster and Langton 1999; Collie et al. 2005; Tamsett et al. 2010) and would constitute a long-term and indirect impact to EFH species present in the Project Area as these features provide both refuge from predators, attachment surfaces, and foraging opportunities. For example, crabs and shrimps are a common prey items for many EFH species present in the Project Area (e.g., groundfish and longfin squid). This would constitute a long-term effect on benthic habitat structure.

Boulder habitats provide three-dimensional structure that plays an important ecological role for fish as shelter and refuge from predators (Auster 1998; Auster and Langton 1999; NRC 2002; Stevenson et al. 2004). The relationship between benthic habitat complexity and demersal fish community diversity has also been positively correlated (Malek et al. 2010). Boulder habitats are inherently complex, where their physical complexity provides crevices for species to seek shelter from predation and flow, these habitats also provide a substrate for macroalgal and epibenthic growth that can increase the functional value of these habitats as refuge for juvenile fish. These habitats with added complexity from invertebrate communities and macroalgal cover serve as important shelter and forage habitat for a variety of species including black sea bass, red hake, striped bass, cunner, tautog and scup. Multiple managed fish species have life history stages that are dependent on, or mediated by, these habitats and their associated attributes such as Atlantic cod, scup, and others (Auster 2001; Auster and Lindholm 2005; Methratta and Link 2006).

Invasive species are those organisms introduced to new habitats from various vectors that produce harmful impacts on the natural marine ecosystem. While there have been no studies in offshore waters encompassing the GAA, invasive species are known to inhabit nearshore waters in this region and include species such as green crab, Asian shore crab, Chinese mitten crab, and common periwinkle (*Littorina littorea*). In addition to these inshore or nearshore invasive species, there are few instances of invasive offshore species; one of the most successful offshore invasive species is the colonial tunicate, *Didemnum* sp., which is not among the most dominant species in estuarine and coastal waters of the New England states (Pederson et al. 2005).

Impacts on EFH associated with seafloor disturbance from impact pile driving and/or vibratory pile driving and installation of the foundations (WTG and OCS-DC) and scour protection are expected to be similar to those produced from seafloor preparation. Impact pile driving and/or vibratory pile driving, and foundation installation could crush benthic/demersal species, particularly eggs and larvae, but also less mobile, older life stages that could not vacate the area. Limited impacts on EFH are expected for pelagic species because they are not expected to be near the seafloor during work activities or subject to crushing or injury through placement of the piles and foundations.

Impacts on EFH associated with the IAC installation would be expected to result in similar impacts as those for seafloor preparation, as the cables would be installed in the same area that would have been disturbed during seafloor preparation. Because of the slow speed of the cable installation equipment and limited size of the impact area, it would be expected that most mobile benthic/demersal and pelagic finfish would temporarily leave the area of disturbance; however, eggs, larvae, and other sessile or slower moving species could be subject to injury or mortality. Additionally, fish eggs and larvae (ichthyoplankton), as well as zooplankton, could be entrained during jet plow installation of the IAC and CFE for targeted-area cable installation. During these activities, seawater would be used to circulate through hydraulic motors and jets during installation. The water withdrawal volumes are expected to be approximately 250 to 650 million gallons (946 to 2,460 million liters) for the jet plow and approximately 191 to 516 million gallons (724 to 1,953 million liters) for CFE equipment. Although this seawater would be released back into the ocean, species could be drawn into the water intake (entrained), and it is assumed that all entrained eggs, larvae, and zooplankton would be killed. These losses would be expected to be very low, based on a previous assessment conducted for South Fork Wind, which found that the total estimated losses of zooplankton and ichthyoplankton from jet plow entrainment were less than 0.001 percent of the total zooplankton and ichthyoplankton abundance present in the study area that encompassed a linearly buffered region of 9.3 mi (15 km) around the export cable and 15.5 mi (25 km) around the wind farm (Inspire 2018). Only early life stages of fishes would be impacted by the jet plow; later life stages would not be impacted.

For dredging, a trailing suction hopper dredge is proposed and involves the use of a drag arm which is pulled along the seafloor from the dredge and hopper vessel at the surface. The drag arm fluidizes sediment at the seafloor which is then hydraulically pumped to the hopper portion of the vessel where the sediment is able to settle out of suspension. During this operation, there is often a continuous overflow of water and any sediments remaining in suspension from the hopper at the water surface. Once the hopper is filled with sediment, disposal is made either hydraulically at the surface or the vessel transports to a designated disposal site and the sediment is released from the bottom of the hopper through a hatch in the vessel's hull, or more carefully position material subsea via means of a downpipe. If needed, THSD disposal would likely occur via downpipe disposal in the adjacent sand wave field, within the survey corridor. The survey corridor width varies between 400-m (0.25-mi) and 800-m (0.5-mi) wide, depending on water depth, so disposal would occur approximately 150 m (0.1 mi) to 350 m (0.2 mi) from the corridor centerline.

Short-term disturbance activities to prepare the seafloor may potentially impact approximately 3,798.8 ac (1,537.3 ha), primarily categorized as soft bottom 2,189.4 ac (886.0 ha), with some area categorized as complex 1,586.5 ac (642.0 ha) and heterogeneous complex 22.9 ac (9.3 ha). Construction-related disturbance, specifically boulder relocation and the installation of foundations and scour protection, would also result in long-term to permanent impacts to EFH species and habitats by modifying the structure and composition of pelagic and benthic habitat.

EFH species would be expected to move back into the area after construction; however, in areas of seafloor disturbance, demersal/benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to preimpact levels. (AKRF Inc. et al. 2012; Germano et al. 1994; Hirsch et al. 1978; Kenny and Rees 1994). Recolonization of sediments by epifaunal and infaunal species and the return of mobile fish and invertebrate species would allow this area to continue to serve as foraging habitat. Pelagic species/life stages could be indirectly affected by the short-term reduction of benthic forage species, but these impacts would be expected to be minor given the availability of similar habitats in the area. Other species could be attracted to the disruption and prey on dislodged benthic species or other species injured or flushed during seafloor preparation, IAC installation, and vessel anchoring activities. The overall impacts of seafloor impacts on finfish and invertebrates would likely be moderate.

Sediment deposition and suspension: Seabed disturbance during Project construction would result in short-term plumes of suspended sediments in the immediate construction area. Research conducted for the Block Island Wind Farm suggests that observed TSS levels were far lower than levels predicted using the same modeling methods, dissipating to baseline levels less than 50 ft (15.2 m) from the disturbance. Both the modeled TSS effects, which are conservatively high, and the observed TSS effects were short-term and within the range of baseline variability. However, these effects would be short-term (lasting only a few tide cycles) due to the low mobility of sediments (primarily sand) in the proposed cable lay down area (Stantec 2020).

Sediment transport modeling for the Project was performed by Woods Hole Group using the PTM in the Surface-Water Modeling System (see COP Appendix H; Woods Hole Group 2022). Several model simulations were run to evaluate the concentrations of suspended sediments, spatial extent and duration of sediment plumes, and the seafloor deposition resulting from IAC and SRWEC burial activities. The grain size distributions used for modeling were based on grab samples from federal waters collected during field studies performed for the Project, and USGS sediment core data for NYS waters (USGS 2014).

For the Project IAC, a representative segment of installation by jet plow was simulated and the modeling results indicate that sediment plumes with TSS concentrations exceeding the ambient conditions by 100 mg/L could extend up to 3,346 ft (1,020 m) from the cable centerline. The model estimated that the elevated TSS concentrations would be of short duration and expected to return to ambient conditions within 0.3 hours following the cessation of cable burial activities. The modeling results indicate that sedimentation from IAC burial is expected to exceed 0.4 in (10 mm) of deposition out to a maximum of 220 ft (67 m), with a total of 7.4 ac (3.0 ha) of seafloor experiencing more than 0.4 in (10 mm) of sediment deposition during construction. Additionally, the TSS plume is expected to be primarily contained within the lower portion of the water column, approximately 8.2 ft (2.5 m) above the seafloor.

During installation of the SRWEC-OCS, modeling results indicate that during jet plowing, sediment plumes with TSS concentrations exceeding the ambient conditions by 100 mg/L could extend up to 2,969 ft (905 m) from the cable centerline in federal waters. The model estimated that the elevated TSS concentrations would be of short duration and expected to return to ambient conditions within 0.4 hours following the cessation of cable burial activities. Sedimentation from SRWEC-OCS burial is predicted to exceed 0.4 in (10 mm) of deposition up to 791 ft (241 m) from the cable centerline. This thickness of sedimentation is expected to cover approximately 832.3 ac (336.8 ha) in federal waters, and the TSS plume is expected to be primarily contained within the lower portion of the water column, approximately 6.6 ft (2.0 m) above the seafloor.

For sand wave leveling associated with SRWEC-OCS construction, modeling results indicate that sediment plumes with TSS concentrations exceeding ambient conditions by 100 mg/L could extend up to 5,052 ft (1,540 m) from the cable corridor centerline in federal waters (trailing suction hopper dredge with bulk disposal scenario). The model estimated that the elevated TSS concentrations from sand wave leveling would be of short duration and expected to return to ambient conditions within up to 0.4 hours following the cessation of sand wave leveling activities in federal waters. Sedimentation from sand wave leveling along the SRWEC-OCS is predicted to exceed 0.4 in (10 mm) of deposition up to 1,427 ft (435 m) from the activity (CFE sand wave leveling scenario). This thickness of sedimentation is expected to cover approximately 174.2 ac (70.5 ha) in federal waters. Longfin squid spawning generally occurs from May to July in the nearshore portions of the SRWEC-OCS corridor (Hatfield and Cadrin 2002). Longfin squid lay eggs on a wide variety of substrates (MAFMC 2011) and impacts to squid egg mops could occur from sediment suspension and deposition from sand wave leveling within this time frame. Most marine species have some degree of tolerance to higher concentrations of suspended sediment because storms, currents, and other natural processes regularly result in increases in turbidity (MMS 2009). Direct impacts on benthic/demersal EFH could include mortality, injury, or short-term displacement of the organisms living on, in, or near the seafloor. Suspended sediment poses a threat to fish as it may physically clog their gills and limit oxygen intake (Lake and Hinch 1999). Larval states are more vulnerable than adult life history stages due to more limited mobility, as well as larger gills and higher oxygen consumption in proportion to body size (Auld and Schubel 1978; Partridge and Michael 2010). Sediment deposition on eggs or larvae may result in smothering, potentially resulting in mortality (MMS 2007). Demersal/benthic early life stages in or near the area of disturbance would be most affected, but these impacts are not expected to result in population-level effects. Pelagic species could also be affected but are expected to temporarily vacate the area to avoid the disturbance and pelagic habitat quality is expected to quickly return to pre-disturbance levels. The overall impacts of sediment deposition and suspension impacts on finfish and invertebrates would likely be minor.

3.10.5.2 Operations and Maintenance

3.10.5.2.1 Onshore Activities and Facilities

Seafloor disturbance: Minimal impacts on EFH would not be expected from O&M of the onshore transmission cable, as it would be buried beneath the seabed of the ICW, between Bellport Bay and Narrow Bay. Any non-routine maintenance would occur through the HDD cable duct and would not impact the environment or organisms within the ICW. The overall impacts of seafloor disturbance on finfish and invertebrates would likely be minor.

EMF: As discussed for the SRWEC-OCS, a modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the onshore transmission cable was performed by Exponent Engineering, and results are included in the COP Appendix J2 (Exponent Engineering 2020). It is not expected that finfish, invertebrates, and EFH would be measurably affected by EMF from the onshore transmission cable and impacts would be minor.

Accidental releases: The OnCS-DC would require various oils, fuels, and lubricants to support its operation, and SF_6 gas would also be used for electrical insulating purposes. As described above in the construction section, accidental discharges, releases, and disposal could indirectly cause habitat degradation, but risks would be avoided through implementation of the measures described in the SPCC. The overall impacts of accidental releases on finfish and invertebrates would likely be minor.

3.10.5.2.2 Offshore Activities and Facilities

Accidental releases: Impacts due to accidental release during the O&M phase are expected to be similar to, but of lesser likelihood than during, construction as there would be fewer Project-related marine vessels during this phase, and regulatory requirements and preventative measures would still apply. Unpermitted discharges or releases are considered accidental events, and, in their unlikely occurrence, these are expected to result in minimal, short-term impacts. Permitted discharges are not expected to pose an adverse impact to marine resources as they would quickly disperse, dilute, and biodegrade (BOEM 2013). Because the effects of authorized discharges would be extremely localized and accidental discharges are considered to be very unlikely, impacts from discharges and releases during O&M would be negligible.

Cable maintenance: During O&M, impacts due to cable maintenance would be similar although less intense and on a more limited scale than that described for the construction phase. Non-routine maintenance activities could require exposing and reburying portions of the IAC or SRWEC for repair, as well as maintenance of the cable protection where present. The seafloor overlaying the buried IAC and SRWEC would be expected to return to pre-maintenance conditions over time and no long-term changes would be expected due to cable maintenance. The overall impacts of cable maintenance on finfish and invertebrates would likely be minor.

Light: Artificial lighting during O&M would be associated with vessels, the WTGs, and the OCS-DC for operational safety and security purposes. As discussed for the construction phase, the response of fish species to artificial lights is highly variable and depends on several factors such as the species, life stage, and the intensity of the light. Small organisms are often attracted to lights, which in turn attract larger predators to feed on the prey aggregations. Other species may avoid artificially illuminated areas. However, lighting would be limited to the minimum necessary to ensure safety and to comply with applicable regulations. Because of the limited area that would have artificial lighting relative to the surrounding areas, and because no underwater lighting is proposed, impacts on EFH would be expected to be negligible.

Presence of structures: The monopile foundations and associated hard structures that would be constructed for the SRWF may displace existing benthic habitat for invertebrates and some fish species, as well as potential EFH species. However, the structures would serve as replacement habitat structure that would create an artificial reef effect for fish and new habitat for colonizing invertebrates. It has been shown in recent studies that offshore wind structures can increase the amount of habitat for invertebrates that colonize hard structure or complex benthic habitats (Hutchison et al. 2020a). Biological productivity may increase and create diverse invertebrate communities which was seen years after the construction of the Block Island Wind Farm (Hutchison et al. 2020a). There was a shift in community structure from aggregations of mussels and barnacles to more dense colonization by corals, hydroids, anemones, crabs, sea stars, and snails (Causon and Gill 2018). Studies from The Block Island Wind Farm reported an increase of mussel beds, tunicate, and the indigenous coral. This was followed by an increase of multiple abundant predators associated with the mussel communities included moon snails, crabs, and sea stars (Hutchison et al. 2020a). The Block Island Wind Farm is in close proximity to the SRWF so similar changes would most likely be seen there. These changes can lead to localized increases in fish abundance and changes in community structure.

In a meta-analysis of studies on windfarm reef effects, McCandless et al. (2014) observed an almost universal increase in the abundance of epibenthic and demersal fish species. Effects on pelagic fish species are less clear (Floeter et al. 2017; McCandless et al. 2014). On balance, and due to the relatively localized spatial extent of the Project, the reef effect of offshore windfarms is likely to produce a neutral effect on EFH. Any potential beneficial effects could be offset if the colonizable habitats provided by offshore wind energy structures aggregate predators and prey, increasing predation risk, or provide steppingstones for non-native species invasions (Gill 2005; Raoux et al. 2017). The net effect of WTGs on pelagic EFH is likely to be neutral to adverse depending on species-specific responses, with the recognition that beneficial effects could be negated should these structures inadvertently promote the establishment of invasive species. In addition to reef effects, the WTGs are likely to create localized hydrodynamic effects that could have localized effects on food web productivity and pelagic eggs and larvae. Hydrodynamic effects on EFH are described further below. Over time, the attractive effects of the structures and complex habitats formed by the maturing reef effect are also expected to alter food web dynamics in ways that may be difficult to predict. Colonization of the new hard surface habitat typically begins with suspension feeders and progresses through intermediate and climax stages (6+ years) characterized by the codominance of plumose anemones and blue mussels (Degraer et al. 2020; Kerckhof et al. 2019). Suspension feeders can act as biofilters, transferring pelagic nutrient resources to the benthic community and decreasing pelagic primary productivity (Slavik et al. 2018). The trophic resources used by suspension feeders could include pelagic eggs or larvae of EFH species, as well as ichthyoplankton prey resources. This could result in a local decrease of eggs and larvae but is unlikely to impact the reproductive success of the affected species as a whole or have more than a localized effect on prey availability for EFH species

As noted above, the colonization of the WTGs could also attract fish due to the increase in resource availability and shelter. This aggregation and change in resource availability could lead to shifts in food web dynamics. While localized effects are possible, ecosystem modeling studies of a European windfarm showed little difference in key food web indicators before and after construction (Raoux et al. 2017). Even though the biomass of certain taxa increased in proximity to the wind farm, trophic group structure was functionally similar between the before and after scenarios. Thus, large-scale food web shifts are not expected due to the installation of WTGs and conversion of pelagic habitat to hard surface. EFH and life stages likely to experience adverse to neutral impacts from the long-term alteration of pelagic habitats by the WTG and OCS foundations include gadid eggs and larvae, flatfish eggs and larvae, pelagic juvenile and adult fishes, all life stages of various shark species, and squid juveniles and adults. This habitat shift may not benefit all species that utilized the habitat prior to construction of the wind farm and may serve to attract biomass as opposed to increase ecosystem productivity. A Fisheries and Benthic Monitoring Plan (Appendix AA1 in the COP) is proposed that can provide insights on how these communities develop following the SRWF development, if the Project is approved.

Demersal fish communities are likely to increase once structures associated with the WTGs are in place and benefit from the increased biological productivity. Longer-term population and habitat effects from these structures and the associated biological changes are unknown. Maintenance impacts from Project monitoring vessel traffic, including the potential for increased vessel strikes on fish and other species would be low. Any sampling that utilizes gear could be potentially hazardous to species vulnerable to the gear such as trawls, traps, and nets.

Monopile foundations that are affixed to the bottom and their associated scour protection have the potential to impact the local hydrodynamics. As currents flow by the structures, there would be some turbulence occurring that can leave wind wakes in the immediate area depending on the conditions. These wind wake changes can increase the potential mixing of the bottom and surface layers of the water column with the potential to impact stratification, nutrient circulation, and possible larval dispersal (van Berkel et al. 2020, Schultze et al. 2020).

Hydrodynamic disturbance or wind wakes resulting from the broad-scale development of large offshore wind farms is a topic of emerging concern because of potential indirect effects on local and regional oceanic responses (e.g., currents, temperature stratification) and related larval transport under typical seasonal conditions. The placement of monopiles and WTGs in the SRWF has the potential to influence hydrodynamic conditions at both local and broader regional scales. These effects fall into two categories, changes in wind field down current of the wind farm, affecting surface currents and wave formation, and turbulent mixing caused by the presence of the structures in the water column. The extent of these effects and resulting significance on biological processes are likely to vary considerably between different oceanographic environments (van Berkel et al. 2020).

A growing body of research has demonstrated that atmospheric effects offshore windfarms, specifically changes in the near surface wind field, could lead to observable effects on oceanographic conditions at scales ranging to tens of miles down field from windfarm sites (e.g., Christiansen et al. 2022; Raghukumar et al. 2022). Changes in the surface wind can in turn influence mixing and circulation patterns and associated biological processes which may have notable impacts (e.g., Daewel et al. 2022; Dorrell et al. 2022; Floeter et al. 2022; Raghukumar et al. 2022). Monopile wind wakes have been observed and modeled at the kilometer scale (Cazenave et al. 2016; Vanhellemont and Ruddick 2014). Foundations disrupt current flow, creating wind wakes and a turbulent mixing effect extending downcurrent from the structures. The presence of monopiles in the water column can introduce small-scale mixing and turbulence that can affect water column stratification under some circumstances (Carpenter et al. 2016; Floeter et al. 2017; Li et al. 2014; Schultze et al. 2020). This effect is muted in oceanographic environments that display strong seasonal stratification (Schultze et al. 2020), but the introduction of nutrients from depth into the surface mixed layer can lead to a local increase in primary production (Floeter et al. 2017). While impacts to current speed and direction decrease rapidly, there is evidence of hydrodynamic effects out to a kilometer away from a monopile including localized changes in circulation and stratification patterns, with potential implications for primary and secondary productivity and fish distribution (van Berkel et al. 2020).

Hydrodynamic disturbance is an emerging topic of concern because of potential effects on the Mid-Atlantic Bight cold pool, a seasonal oceanographic feature that influences regional biological oceanography. Changes in the size and seasonal duration of the cold pool over the past five decades have been associated with shifts in the fish community composition of the Mid-Atlantic Bight. The cold pool is a mass of relatively cool water that forms in the spring and is maintained through the summer by stratification. It supports a diversity of fish and other marine species that are usually farther north but thrive in the cooler waters it provides (Chen et al. 2018; Lentz 2017). Structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016). During summer, when water is more stratified, increased mixing could increase pelagic primary productivity near the structure, increasing the algal food source for zooplankton and filter feeders. Increased mixing may also result in warmer bottom temperatures, increasing stress on some shellfish and fish at the southern or inshore extent of the range of suitable temperatures. Changes in cold pool dynamics resulting from future activities, should they occur, could conceivably result in changes in habitat suitability and fish community structure, but the extent and significance of these potential effects are unknown.

Van Berkel et al. (2020) and Schultze et al. (2020) note that environments characterized by strong seasonal stratification are likely to be less sensitive to wind field and turbulent mixing effects on oceanographic processes. The SRWF and surroundings are characterized by strong seasonal stratification in summer and fall, within increased mixing and deterioration of stratification driven by storms and changes in upwelling in late fall into winter (Chen et al. 2018; Lentz 2017). On the Mid-Atlantic Bight, increased mixing could influence the strength and persistence of the cold pool, a band of cold, near-bottom water that exists at depth from the spring to fall. However, the turbulence introduced by monopile foundations is not expected to significantly affect the cold pool due to the strength of the stratification (temperature differences between the surface and the cold pool reach 50°F [10°C] [Lentz 2017]). Temperature anomalies created by mixing at each monopile would likely resolve quickly due to strong forcing towards stabilization (Schultze et al. 2020).

BOEM has conducted a modeling study to predict how planned offshore wind development in the area could affect hydrodynamic conditions northern Mid-Atlantic Bight. Johnson et al. (2021) considered a range of development scenarios, including full buildout of both WEAs with a total of 1,063 WTG and OSS foundations. They determined that all scenarios would lead to small but measurable changes in current speed, wave height, and sediment transport in the northern Mid-Atlantic Bight. The resulting changes in current speed and wave height could influence larval transport and settlement and reduce bed shear stress thereby affecting sediment transport. Particle tracking, which integrates the overall effect of objects subjected to the effects of currents, showed variations on the order of ± 10 percent between the baseline condition (no offshore wind farms) and the 12 MW full build-out scenario (1,063 WTG and OSS foundations). This is in line with the observed order of magnitude change in the depth averaged currents (Johnson et al. 2021). In addition, small changes in stratification could occur, leading to prolonged retention of cold water near the seabed within the area during spring and summer.

Johnson et al. (2021) used an agent-based model to evaluate how these environmental changes could affect planktonic larval dispersal and settlement for three EFH species, summer flounder, silver hake, and Atlantic sea scallop. They determined that offshore wind development could affect larval dispersal patterns, leading to increases in larval settlement density in some areas and decreases in others, but would be unlikely to negatively impact population productivity for these species. Johnson et al. (2021) concluded that changes in larval distribution patterns on the order of miles or tens of miles are therefore unlikely to result in biologically significant effects on larval survival and recruitment. For example, in the case of sea scallops, larval dispersal to waters southwest of Block Island is predicted to increase while dispersal to waters south of Martha's Vineyard would decrease under all modeled scenarios (Johnson et al. 2021). These localized effects are unlikely to have a measurable population-level effect on this species because sea scallop larvae originate in both local and distant spawning areas and become dispersed regionally over along a southwesterly gradient (Johnson et al. 2021). These dispersal patterns are driven by regional circulation patterns, which are generally consistent but vary annually (Chen et al. 2021; Munroe et al. 2018; Roarty et al. 2020; Zhang et al. 2015). In this context, localized shifts in larval transport and settlement density on the scale of miles to tens of miles are unlikely to lead to the development of significant population sinks. Even where they occur, localized changes of larval recruitment may not necessarily translate to negative effects on adult biomass. For example, Atlantic sea scallops are prone to overcrowding and reduced growth rates in areas with high larval recruitment (Bethoney and Stokesbury 2019); therefore, changes in dispersal that reduce overcrowding could lead to increased growth and abundance in specific areas. However, adverse impacts could occur due to the overcrowding of scallop larvae in the new area or deposition in unsuitable areas.

While findings for these species are instructive, they are not necessarily representative of potential effects on all species that rely on planktonic dispersal of eggs and larvae. The BOEM modeling results determined that small but measurable changes in current speed, wave height, and sediment transport would occur across the northern Mid-Atlantic Bight. As stated, hydrodynamic effects could change how the planktonic eggs and larvae of many marine species are dispersed across the region. Changing larval dispersal pathways can disrupt connectivity between populations and the processes of larval settlement and recruitment (Sinclair 1988). Unfavorable changes can create a condition where population may be negatively affected by a prolonged reduction in larval survival (Sinclair 1988). This could result in negative impacts on species like Atlantic cod that return to the same spawning habitats year after year and rely on relatively consistent oceanographic conditions to disperse planktonic eggs to areas favorable for larval and juvenile survival (Dean et al. 2022). However, insufficient information is available to determine the source populations of Atlantic cod larvae and juveniles occurring in Southern New England waters and it is uncertain if the area is fully supported by self-recruitment (NEFMC 2022). As such, hydrodynamic effects on these species could be more significant, but the available information does not suggest that such effects are likely. Atlantic cod spawning appears to occur throughout the Southern New England region (DeCelles et al. 2017; BOEM *pers. comm.* 2022), which could help buffer against any potential impacts to planktonic eggs and larval transport. While hydrodynamic effects on these species could potentially be more significant, the available information does not suggest that such effects are likely."

Installation of up to 94 WTGs would likely to create individual localized hydrodynamic wind wake effects that could have localized effects on food web productivity and pelagic eggs and larvae. Given their planktonic nature, altered circulation patterns could transport pelagic eggs and larvae out of suitable habitat, altering their survivability. These effects would apply to EFH-designated species that have or prey upon pelagic eggs and larvae. These localized hydrodynamic effects would persist throughout the life of the Project until monopiles are decommissioned and removed. EFH-designated species with pelagic eggs and larvae that are known to likely occur within the SRWF footprint.

Pelagic juveniles and adults with EFH-designated species utilizing water column habitat could experience localized hydrodynamic effects down current of each SRWF monopile. These effects may be limited to decreased current speeds but could also include minor changes to seasonal stratification regimes. Adults and juveniles would be expected to elicit an avoidance behavioral response away from potential unsuitable habitat due to hydrodynamic effects from monopiles. These localized effects would persist throughout the life of the project. finfish species with pelagic juvenile and adult life stages that would likely to occur within the SRWF area.

No future activities were specifically identified within the GAA specific to entanglement and gear loss and damage; however, it is reasonable to assume that fishing activities (both commercial and recreational) may increase over time in the vicinity of structures due to the likelihood of fish and crustacean aggregation. Damaged and lost fishing gear caught on structures may result in entrapment, entanglement, or mortality of marine life in discarded, lost, or abandoned fishing gear, or other disturbances, potentially leading to finfish mortality. Impacts from fishing gear would be localized; however, the risk of occurrence would remain as long as the structures are present. The presence of structures in an otherwise primarily sandy benthic environment would provide a more complex environment, likely to attract finfish and invertebrates such as mobile crustaceans of commercial value. As such, entanglement and gear loss may cause increased impacts on finfish, including mortality and alteration of habitats. These impacts would be localized and short-term; however, they would likely persist intermittently as long as structures remain in place.

In general, fish and invertebrate impacts due to longer-term habitat alteration are likely to be beneficial to some species and cause alteration and loss of habitat for others. The amount of overall habitat that is small in comparison to the abundant habitat available in the area and therefore the impacts are expected to be minor.

Continuing environmental trends from climate change causing any further degradation to available habitat may further inhibit the recovery time for some species after decommissioning. Overall, the decommissioning process could result in both short- and long-term adverse impacts that would most likely range from minor to moderate.

BOEM anticipates that the impacts associated with the presence of structures may be negligible to moderate and long-term. The impacts on finfish, invertebrates, and EFH resulting from the presence of structures would persist for the duration for which the structures remain.

Noise: Impacts on EFH from ship and aircraft noise during O&M of the Sunrise Wind Project are expected to be similar to those discussed for the construction phase, though much lesser in intensity and spatial extent. The underwater noise generated by vessel and aircrafts would be similar to the range of noise from existing vessel and aircraft traffic in the region and are not expected to substantially affect the existing underwater noise environment.

Offshore WTGs produce continuous, non-impulsive underwater noise during operation, mostly in lower-frequency bands below 8 kilohertz. There are several recent studies that present sound properties of similar turbines in environments comparable to that of the proposed Project. These are presented in detail in the Underwater Acoustic and Exposure Modeling Survey (Küsel et al. 2021). A recent compilation of operational noise from several wind farms, with turbines up to 6.15 MW in size, showed that operational noise generally attenuates rapidly with distance from the turbines (falling below normal ocean ambient noise within approximately 0.6 mi (1 km) from the source), and the combined noise levels from multiple turbines is lower or comparable to that generated by a small cargo ship (Tougaard et al. 2020). Larger turbines do produce higher levels of operational noise, and the least squares fit[22] of that dataset would predict that an SPL measured 100 m from a hypothetical 15 MW turbine in operation in 10 m/s (19 kt or 22 mph) wind would be 125 dB re 1 µPa. Using a direct drive is expected to lower noise levels significantly; by approximately 10 dB quieter than other equivalently sized jacket pile turbines.; There is also reason to believe, based on the Tougaard et al. 2020 dataset, that operational noise from jacket piles could be louder than from monopiles due to there being more surface area for the foundation to interact with the water, however the paper does point out that received level differences among different pile types could be confounded by differences in water depth and turbine size. In any case, additional data is needed to fully understand the effects of size, foundation type, and drive type on the amount of sound produced during turbine operation.

Fish communication in the low-frequency (less than 1000 hertz [Hz]) range (Ladich and Myrberg 2006; Myrberg and Lugli 2006) is a particular concern because many fish species have unique vocalizations that

[22] Least square fit is a mathematical procedure for finding the best-fitting curve to a given set of points by minimizing the sum of the squares of the offsets ("the residuals") of the points from the curve. In this context the least square fit was used to demonstrate that varying wind speed results in a variation of underwater noise levels.

allow for inter- and intra-species identification, and because fish vocalizations are generally not loud, typically about 120 decibels (dB) SPL with the loudest sounds reaching 160 dB SPL (Normandeau Associates 2012). As such, anthropogenic sound sources that occur in lower frequency ranges could result in auditory masking effects. Behavioral responses in fishes differ depending on species and life stage, with younger, less mobile age classes being the most vulnerable to noise impacts (Popper and Hastings 2009; Gedamke et al. 2016).

Environmental stressors such as noise can cause masking, which could interfere with communication and potentially disrupt spawning activity (Rowe and Hutchings 2006). Underwater noise sufficient to alter behavior could have disruptive effects on Atlantic cod spawning (Dean et al. 2012), especially at night, as Atlantic cod courtship and spawning behaviors occur primarily at night (Dean et al. 2014; Zemeckis et al. 2019). Some degree of habituation to these operational noise and particle motion effects is to be anticipated. Bedjer et al. (2009) argued that habituation of organisms to ongoing low-level disturbance is not necessarily a neutral or benign process. Lindeboom et al. (2011) found no difference in the residency times of juvenile Atlantic cod around monopiles between periods of WTG operation and non-operation. In a similar study, the abundance of Atlantic cod, eel, shorthorn sculpin (*Myoxocephalus scorpius*), and goldsinny wrasse (*Ctenolabrus rupestris*) were found to be higher near WTGs, suggesting that potential noise impacts from operation did not override the attraction of these species to the artificial reef habitat (Bergström et al. 2013). In addition, habituation to particle motion effects could make individual fish or invertebrates less aware of approaching predators, or could cause masking effects that interfere with communication, mating or other important behaviors.

Collectively, these findings suggest that the SRWF operations could have limited adverse effects on habitat suitability for EFH-designated species within a certain distance of each monopile foundation. The extent of these effects is difficult to quantify as they are likely to vary depending on wind speed, water temperature, ambient noise conditions, and other factors. Operational noise from WTGs is low-frequency (60–300 Hz) and at relatively low sound pressure levels near the foundation (100–151 dB re 1 µPa) and decreases to ambient within 0.6 mi (1 km) (Küsel et al. 2022). Underwater sounds emitted by WTGs are audible to fish, and invertebrates but are lower than the regulatory injury and typically lower than the behavioral thresholds for marine fauna, and often are lower than the ambient sound levels that these animals typically experience. It is unlikely that WTG operations would cause injury or behavioral responses to marine fauna, so the risk is of impact is expected to be low (Küsel et al. 2022).

Short-term, localized impacts from geophysical surveys during O&M may occur from the use of multi-beam echosounders, side-scan sonar, shallow penetration sub-bottom profilers, medium penetration sub-bottom profilers and marine magnetometers. The survey equipment to be employed would be equivalent to the equipment utilized during survey campaigns associated with Lease Area OCS-A 0500 conducted in 2016, 2017, 2018, 2019, and 2020 and with Lease Area OCS-A 0487 conducted in 2019 and 2020 (CSA Ocean Sciences Inc. 2020) and are not expected to result in measurable impacts on EFH. The overall impacts of construction noise impacts on finfish and invertebrates would likely be moderate.

EMF: During operation, powered transmission cables would produce EMF (Taormina et al. 2018). To minimize EMF generated by cables, all cabling under the Proposed Action would include electric shielding (Sunrise Wind 2023). The strength of the EMF rapidly decreases with distance from the cable (Taormina et al. 2018). Sunrise Wind proposes to bury cables to a target burial depth of up to 4 to 6 ft (1.2 to 1.8 m) below the surface, well below the aerobic sediment layer where most benthic infauna live.

The scientific literature provides some evidence of responses to EMF by fish and mobile invertebrate species (Hutchison et al. 2018; Taormina et al. 2018; Normandeau et al. 2011). A recent study of impacts of offshore wind EMF on crabs and lobster (Harsanyi et al. 2022) found that chronic exposure to 2.8-millitesla EMF throughout embryonic development may affect larval mortality, recruitment, and dispersal. Jakubowska-Lehrmann et al. 2022 found that bivalve filtration rate and energy available for individual production were significantly lower when exposed to EMF from DC cables compared to the control treatment. No changes in the respiration of bivalves were noted but ammonia excretion rate was significantly lower after exposure to EMF. Changes in the activities of antioxidant enzymes and the lipid peroxidation were not observed; however, exposure to both AC and DC fields resulted in increased protein carbonylation in bivalves. Effects of EMF may include interference with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Taormina et al. 2018).

Recent reviews (CSA Ocean Sciences, Inc. and Exponent 2019; Gill and Desender 2020; Albert et al. 2020) indicate the relatively low intensity of EMF associated with marine renewable projects would not result in large impacts. CSA Ocean Sciences, Inc. and Exponent (2019) found that offshore wind energy development as currently proposed would have negligible effects, if any, on bottom-dwelling finfish and invertebrates residing within the southern New England area. Although demersal biota would be most likely to be exposed to EMF from power cables, potential exposure would be minimized because EMF quickly decays with distance from the cable source (CSA Ocean Sciences, Inc. and Exponent 2019). In the case of mobile species, an individual exposed to EMF would cease to be affected when it leaves the affected area. Migratory fish may be affected by interference with their capacity to orient in relation to the geomagnetic field, potentially disturbing fish migration patterns (Metcalfe et al. 2015). An individual may be affected more than once during long distance movements; however, there is no information on whether previous exposure to EMF would influence the impacts of future exposure. The impacts of induced electromagnetic fields are expected to be greater for cartilaginous fish because they use electromagnetic signals to detect their prey (Bailey et al. 2014; Gill 2005; Gill and Kimber 2005; Bergstrom et al. 2014). For pelagic species within the southern New England area, no negative effects were expected from offshore wind energy development as currently proposed because of their preference for habitats located at a distance from the seabed. Therefore, BOEM expects localized and long-term, though not measurable, impacts on finfish, invertebrates, and EFH from EMF from the Proposed Action. Section 5.1.4.1 of the EFH Assessment provides a detailed discussion of EMF impacts on EFH and EFH-designated species from the Proposed Action.

Studies of swimming activities of Atlantic haddock (*Melanogrammus aeglefinus*) larvae around magnetic field from HVDC cables have recently been published (Cresci et al. 2022). Atlantic haddock is a demersal fish that may be at risk of exposure to HVDC cables. Their larvae drift over the Continental Shelf and use the Earth's magnetic field for orientation during dispersal. Therefore, anthropogenic magnetic fields from HVDC cables could alter their behavior. In the laboratory. Cresci et al. (2022) tested the behavior of 92 haddock larvae using a setup designed to simulate the scenario of larvae drifting past a magnetic field in the intensity range of that produced by a DC subsea cable. Exposure to the magnetic field did not affect the spatial distribution of haddock larvae in the raceway. Larvae were categorized by differences in their exploratory behavior in the raceway. The majority (78 percent) of larvae were nonexploratory, and exposure to the artificial magnetic field reduced their median swimming speed by 60 percent and decreased their median acceleration by 38 percent. There was no effect on swimming of the smaller proportion (22 percent) of exploratory larvae. These observations support the conclusion that the swimming performance of nonexploratory haddock larvae may be temporarily reduced following exposure to magnetic field from exposed HVDC cables; long-term impacts from exposure to a magnetic field have not been investigated (Cresci et al. 2022). However, HVDC cables used in offshore wind projects are required to be buried at least 4-6 ft (1.2-1.8 m) below the surface of the substrate or covered by cable protection if not buried. This would substantially reduce exposure risk of any nearby organism. Impacts would therefore be short-term and localized and would not rise to population-level impacts.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts from ongoing and planned activities including offshore wind. The Proposed Action would slightly increase the impacts of EMF in the GAA beyond those described under the No Action Alternative. The combined impact on finfish, invertebrates, and EFH would likely be negligible and localized though long-term.

Discharges: The location, design, and operation of the cooling water discharge was selected to minimize the thermal plume size to the greatest extent practicable and prevent thermal plume migration to the surface waters or benthos. The OCS-DC would include three openings for intake pipes located approximately 30 ft (10 m) above the pre-installation seafloor grade. The water depth of the intake pipe openings was selected to minimize the potential of biofouling and entrainment of ichthyoplankton and to take advantage of the cooler water temperatures found at depth to maximize cooling potential of water withdrawn. Further details of the OCS-DC are in the NPDES permit application submitted to USEPA in December 2021 (TRC 2023, Appendix N2).

To identify the optimal location for the cooling water discharge, the Cornell Mixing Zone Expert System (CORMIX) was used to evaluate the mixing zone associated with multiple discharge locations in the water column. The assessment considered four different seasons using a 2°F (1°C) temperature differential threshold to delineate the extent of the mixing zone. The optimal location for the dump caisson discharge was determined to be approximately 40 ft (12 m) below local msl. At this optimized location rapid and complete mixing occurs. The thermal plume would be contained to a distance of 87 ft (27 m) from the outfall and occupy a maximum area of 731 ft^2 (66.9 m^2) in a worst-case, slack tide scenario. The overall impacts of discharge on finfish and invertebrates would likely be minor.

Entrainment: The OCS-DC intake was designed to have a maximum through-screen velocity of 0.43 ft/s (0.13 m/s) which is below the USEPA threshold of 0.5 ft/s (0.15 m/s) required for new facilities defined at 40 *CFR* 125.84(c) and therefore is protective against impingement of juvenile and adult fish. Identification of fish species and life stages that would be most susceptible to entrainment from the OCS-DC were evaluated based on their abundance or their significance to commercial and recreational fisheries. The NPDES permit included annual entrainment estimates of ichthyoplankton grouped within the egg and larval stages (NPDES permit number MA0004940). Since no distinction was made between the two life stages within the NPDES permit, entrainment numbers were considered larval estimates only when calculating adult equivalent losses to be conservative.

To evaluate impacts of this entrainment, entrainment estimates for adult equivalent losses (AELs) were completed for eight abundant or commercially important fish species and are listed in as estimates of the number of entrained organisms removed from the population that otherwise would have survived to some future age, or age of equivalence. To estimate AELs for the OCS-DC, the annual estimates of entrained larvae and eggs (x') from Appendix N2 of Sunrise Wind (2022) were multiplied by the survival fraction at a given life stage (Equation (1)):

$$AEL = \sum_{j=1}^{n} S_{i,A} N_i \quad (1)$$

Where N_i is the number of fish lost at stage *i* and $S_{i.A}$ represents the fraction of fish expected to survive from age *i* to the age of equivalence.

Survival rates of early life stages are often expressed on a life stage-specific basis so that the fraction surviving from any life stage to adulthood (or age of equivalence) is expressed as the product of survival fractions for all life stages through which a fish must pass before reaching adulthood (or the age of equivalence):

$$S_{i,A} = \prod_{j=i}^{j_{\max}} S_j \quad (2)$$

The parameters used to estimate the adult equivalence, such as instantaneous natural mortality and instantaneous fishing mortality rates at varying life stages, were acquired from the USEPA Regional Benefits Analysis for the Final Section 316(b) Phase III existing facilities rule (USEPA 2006). Age of adulthood for the eight species of interest were obtained from Fishes of the Gulf of Maine (Collette and Klein-MacPhee 2002). Results of the estimate can be found in Table B-15 of Appendix B (*Supplemental Information and Additional Figures and Tables)*.

A conservative annual estimate of Atlantic cod entrainment Is 34,239 organisms. To put this potential entrainment rates in context, a large female Atlantic cod is capable of producing 3 to 9 million eggs annually. Calculations of equivalent adults is 16 adult Atlantic cod could be impacted annually by the OCS-DC.

A number of mitigation measures included in the design of the OCS-DC would reduce impacts to finfish and EFH and be protective of Atlantic cod. The low screen velocity would prevent impingement of juvenile and adults. The OCS-DC is to be located 3 to 6.2 mi (5 to 10 km) south of Cox Ledge (*see* Figure 2.1-6) while the hydraulic zone of influence of the intake does not extend more than 20 ft (6.1 m) from the intake (*draft* USEPA NPDES Permit No. MA0004940). Aquatic organisms including eggs and larvae finfish and EFH species would have to pass through this relatively small area in order to be exposed to the influence of the intake and to potentially become impinged or entrained.

The OCS-DC would include three openings for intake pipes located approximately 30 ft (10 m) above the pre-installation seafloor grade. The water depth of the intake pipe openings was selected to minimize the potential of biofouling and entrainment of ichthyoplankton and to take advantage of the cooler water temperatures found at depth to maximize cooling potential of water withdrawn. The location of the intake pipes should reduce entrainment of pelagic and benthic egg and larval life stages.

Additionally, the OCS-DC is designed with variable frequency drive (VFD) pumps to enable the Facility to limit the volume of water it withdraws to the amount actually required to meet cooling water needs. During colder winter months when Atlantic cod spawn, less cooling water is needed.

The VFD pumps would allow the intake flow to be throttled back and the actual intake flow would vary between 4.0 and 5.3 mgd as compared to the design flow of 8.1 mgd. The use of VFDs to achieve projected actual intake flows would result in an estimated 47 to 49-percent reduction in entrainment (*draft* USEPA NPDES Permit No. MA0004940).

At the proposed average monthly intake flows (4.0-5.3 mgd) distributed over two intake pipes, the estimated actual through-screen velocity at the intake is expected to be 0.21 – 0.28 fps. This through-screen velocity is lower than the USEPA's threshold described above, which was set at a level that allows juvenile and adult fish to swim away and avoid becoming impinged on the trash racks or entrapped within the intake pipes.

To estimate entrainment at the OCS-DC, Sunrise Wind used ichthyoplankton data collected by NOAA's Marine Resource Monitoring, Assessment, and Prediction (MARMAP) program and NOAA's Ecosystem Monitoring (EcoMon) program, Sunrise Wind used data from tows conducted in the geographic region which encompassed 1,859 individual tows. Because Sunrise Wind's entrainment estimates are based on data collected over a much larger geographic area than the area within the proposed windfarm boundary, USEPA re-examined the data and calculated entrainment estimates based on larval densities in the general area of the windfarm boundary. USEPA compared average larval densities from this smaller geographic area to Sunrise Wind's estimates to determine if there is likely to be any difference in average densities in the vicinity of the OCS-DC. USEPA trimmed the dataset for all species collected within an area bounded by the maximum and minimum latitude and longitude positions of the wind farm. The resulting area includes 197 individual tows, or about 10 percent of the original area in Sunrise Wind's analysis.

When the analysis is repeated using the larval EcoMon and MARMAP data for all species within the general vicinity of the wind farm, the estimated number of larvae entrained per year based on projected average monthly intake flows increases from 5,632,408 larvae to 6,345,726 larvae. The estimated entrainment among the most abundant species is generally the same or higher within the windfarm area as compared to the larger geographic region that Sunrise Wind assessed, with the exception of Atlantic herring, which was substantially more abundant across the larger area than within the wind farm boundary. Densities of Atlantic cod larvae were similar within the SRWF and the larger geographic area.

USEPA determined that the proposed use of VFDs, the proportional intake volume, and the intake location are the best technology available for minimizing entrainment by the OCS-DC's CWIS (*draft* USEPA NPDES Permit No. MA0004940).

Four finfish species listed on the ESA may occur near or in the SRWF:

- Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*);
- Shortnose sturgeon (*Acipenser brevirostrum*);
- Giant manta ray (*Manta birostris*); and
- Oceanic whitetip shark (*Carcharhinus longimanus*).

No critical habitat for these finfish species is present within the SRWF. Although these four federally listed species have ranges that may include the SRWF, the Atlantic sturgeon is the only one of these species whose occurrence is regular or common in the SRWF and thus may be exposed to impacts from the CWIS. The Atlantic sturgeon spawns in the freshwater of large rivers with juveniles migrating seaward at a length of approximately 2 ft (0.8 m). Juvenile and adult sturgeon typically inhabit shallow coastal waters comprised of sand and gravel substrates with water depths of 30 to 150 ft (10 to 50 m) (Stein et al. 2004a). The CWIS was designed to have a velocity below 0.5 fps which is the USEPA designated velocity that prevents impingement of aquatic organisms including Atlantic sturgeon. Based on these life history characteristics, early life stages are not susceptible to entrainment and larger life stages would not be susceptible to impingement during operation of the OCS-DC. The overall impacts of entrainment on finfish and invertebrates would likely be minor.

Seafloor disturbance: Minimal impacts on EFH would be expected from operation of the SRWEC-OCS, as it would be buried beneath the seabed where feasible and protected. Seafloor disturbance during O&M of the SRWEC-OCS would be limited to non-routine maintenance that may require uncovering and reburial of the cables, as well as maintenance of cable protection where present. These maintenance activities and associated vessel anchoring are expected to result in similar direct impacts on EFH as those discussed for construction, although the extent of disturbance would be limited to specific areas along the SRWEC-OCS route.

Cable protection (e.g., concrete mattresses or rock placement) could be placed in select areas along the SRWEC-OCS. The introduction of engineered concrete mattresses or rock to areas of the seafloor can cause local disruptions to circulation, currents, and natural sediment transport patterns, though these impacts would be expected to be insignificant given the miniscule surface area associated with the cable protection compared to the surrounding waters. Under normal circumstances, these segments of the SRWEC-OCS would remain covered as by sediment and associated cable protection (where applicable). In non-routine situations, these segments could be uncovered, and reburial could be required (for buried portions of the SRWEC). The seafloor overlaying the majority of buried SRWEC-OCS (where cable protection would not exist) would be expected to return to pre-construction conditions over time and no long-term changes to sediment mobility or depositional patterns are expected.

Indirect impacts on EFH associated with O&M activities for the SRWEC-OCS would be expected to result in similar impacts as those discussed for the IAC but would be limited in spatial extent. The protection of the cable with concrete mattresses or rock may result in the long-term conversion of soft-bottom habitat to hard bottom habitat. Similar to the foundations, this cable protection may have a long-term impact on EFH species associated with soft-bottom habitats and a long-term beneficial impact on EFH species associated with hard bottom habitats, depending on the quality of the habitat created by the secondary cable protection, and the quality of the benthic community that colonizes that habitat. The overall impacts of seafloor disturbance on finfish and invertebrates would likely be moderate.

Climate change: This IPF would contribute to alterations in ecological relationships, migration patterns, and disease frequency, and to the reduced growth or decline of invertebrates that have calcareous shells through ocean acidification. Because this IPF is a global phenomenon, the impacts through this IPF from the Proposed Action are expected to be the same as those under the No Action Alternative. In context of reasonably foreseeable environmental trends, the incremental impacts of the Proposed Action on invertebrates from climate change relative to ongoing and planned activities are likely to be negligible because this IPF is a global phenomenon. With the exception of reduced growth on calcareous shells, finfish populations would be expected to experience the same impacts, including alterations to ecological relationships, migration patterns, and disease frequency.

Gear utilization: Sunrise Wind has developed a Fisheries and Benthic Monitoring Plan in accordance with recommendations set forth in *Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf* (BOEM 2019). Monitoring would commence in 2022, and continue through 2027, encompassing all three phases of cable installation (before, during, and after installation). Surveys would include otter trawl surveys, acoustic telemetry for highly migratory species (HMS), scallop surveys, and benthic monitoring for soft- and hard bottom habitats. Gear restrictions, closures, and other regulations set forth by take reduction plans would be adhered to as with typical scientific fishing operations to reduce the potential for interaction or injury.

Sunrise Wind has contracted with scientists at the University of Massachusetts Dartmouth School for Marine Science and Technology and the Commercial Fisheries Research Foundation to execute a seasonal (i.e., four sampling events per year, approximately three months apart) trawl survey using an asymmetrical Before-after Control Impact experimental design. The otter trawl survey at SRWF would be carried out synchronously with the trawl survey at the Revolution Wind Farm lease area. An otter trawl survey is an appropriate sampling gear for the Sunrise Wind Lease Area and the nearby control sites because this gear had broad selectivity and would effectively sample for multiple species, including groundfish (e.g., winter flounder, windowpane flounder, yellowtail flounder, Atlantic cod), monkfish, skates (e.g., winter and little skates), red hake, longfin squid, and others. A sample size of 15 trawl tows per area would be targeted per season in each year at the start of the survey.

The acoustic telemetry survey for HMS would cover the Lease Area and adjacent inshore areas. The Acoustic telemetry receivers were deployed in the Lease Area for HMS in the spring of 2022 and tagging begun 2023. This acoustic telemetry monitoring effort would build on baseline studies by including five additional years of data collection, an expansion of the receiver array, and the deployment of an additional 150 acoustic transmitters for HMS. The project would be overseen by Anderson Cabot Center for Ocean Life (ACCOL) at the New England Aquarium, with Dr. Jeff Kneebone serving as the Principal Investigator. ACCOL would partner with INSPIRE Environmental to execute the field work, data analysis, and reporting.

The acoustic telemetry survey for the SRWEC would be established along the route of the SRWEC, and dedicated telemetry tagging would occur to evaluate the potential impacts associated with the operation of the SRWEC on important marine species. Acoustic telemetry receivers were deployed along the SRWEC-NYS in summer 2022; tagging of sharks, elasmobranchs, lobster and horseshoe crab in NYS waters began in summer 2022 and will continue in 2023. The focal species for this study were chosen based on several factors including their known sensitivity to EMF, their ecological significance or importance to regional commercial and recreational fisheries, and their geographic overlap with the SRWEC. Monitoring efforts would focus on species associated with the benthos, given that they would experience the greatest potential impacts from EMF (Snyder et al. 2019). The species selected for telemetry monitoring are American lobsters, horseshoe crabs, winter skates, sandbar sharks, sand tiger sharks, dusky sharks, and smooth dogfish.

Sunrise Wind partnered with researchers at Coonamessett Farm Foundation to carry out Habitat Mapping Camera (HabCam) surveys for scallops and other benthic organisms within the SRWF and a nearby control area, and the survey is executed using a Before-after Control Impact design. A HabCam survey was completed in summer 2022 and another will be completed in 2023. Similar to other fisheries-independent surveys for scallops in the region, the survey would be executed once per year, targeting sampling in summer. The target is to achieve two years of pre-construction monitoring, and the survey would continue during construction, and for at least two years after construction has been completed. This survey would be carried out in collaboration with a local scallop vessel(s). The primary objective of the HabCam survey is to investigate the relative abundance of scallops and other resources in the SRWF area ("SRW impact") and reference area ("control") over time. Using the HabCam survey equipment and protocols would ensure that the data collected as part of this fisheries monitoring plan would be compatible and standardized with fisheries-independent data that are used to inform scallop science, stock assessment, and management. The HabCam survey approach also is well-suited to sampling within the Lease Area following construction. Sunrise Wind is currently working with researchers at Coonamessett Farm Foundation to develop the sampling protocols and statistical analyses associated with this survey, and those details would be included in a future iteration of the monitoring plan once they are available.

Benthic monitoring of hard and soft-bottom habitats as well as bottom habitats in New York waters. Bottom habitat monitoring would focus on measuring changes in percent cover, species composition and volume of macrofaunal attached communities (native and non-native species groups) and physical characteristics (rugosity, boulder density). These parameters would serve as proxies for resulting changes to the complex food web. Soft-bottom habitat monitoring would focus on measuring physical factors and indicators of benthic function (bioturbation and utilization of organic deposits; Simone and Grant 2020), which would serve as proxies for functional changes in the community composition. It is expected that the introduction of fines and organic content sourced from the epibenthic community on the WTG foundations would support increased deposit feeding benthic invertebrate communities in the soft sediments around the structures.

To accomplish the objectives of the novel hard bottom monitoring, high-resolution video imagery captured using a remotely operated vehicle (ROV) would be employed. Video imagery would be used to document epifaunal community characteristics on the novel hard surfaces (WTG foundations and scour protection layers, OCS-DC jacket, cable protection layers). Benthic functioning of the soft-bottom habitats would be captured by documenting physical parameters (grain size major mode) and biological factors (bioturbation and utilization of organic material) with a sediment profiling imaging/plan view (SPI/PV) system. It is expected that the epibenthic community that colonizes the WTG foundations and OCS-DC jacket would supply organic matter to the sediments below through filtration, biodeposition, and general deposition of detrital biomass. This organic material sourced from the biological activity of the epibenthic community on the foundation structures would likely alter the infaunal community activity, increasing sediment oxygen demand and promoting the activity of deep-burrowing infauna. Based on benthic monitoring results in other offshore wind farms, the effects of the WTG foundation on the surrounding soft sediment habitat would be expected to decrease with increasing distance from the WTG. The benthic monitoring plan for state waters includes details of the pre-construction and post-construction surveys of soft sediment habitats along the SRWEC-NYS (Sunrise Wind 2023). A combination of SPI/PV imaging and sediment grab sampling would be used to monitor these benthic environments.

The otter trawls surveys are designed to capture a representative sample of demersal fish species present in the impact and reference areas, emphasizing EFH and other species of commercial and recreational interest. The trawl surveys may begin in summer 2023, after issuance of the NMFS Biological Opinion. This activity would directly affect EFH species and their prey through mortality of most or all of the trawled individuals. In addition to these direct impacts, bottom-disturbing trawls can alter the composition and complexity of soft-bottom benthic habitats. For example, when trawl gear contacts the seabed it can flatten sand ripples, remove epifaunal organisms and biogenic structures like worm tubes, and expose anaerobic sediments. In this case, the survey tracks have been pre-selected by commercial fishermen based on their known suitability for bottom trawling. This indicates that the associated seabed is subjected to regular disturbance by commercial fishing activity, and that this type of disturbance has already and would continue to occur regardless of whether the Fisheries Research Monitoring Plan is implemented. Impacts on EFH species through capture during the trawl survey would not result in population-level impacts. Trawl surveys are not likely to significantly alter the rate and extent of disturbance of soft-bottom benthic habitat relative to the environmental baseline. BOEM therefore concludes that beam trawl surveys would not change the effects determination for EFH for any species in the EFH Assessment. Mitigation measures for species protected under the ESA species that would be enacted during the trawl surveys include a short tow duration of 20 minutes; sampling during daylight only; marine mammal monitoring by the captain or other scientific crew member before, during, and after haul back; trawl operations commencing as soon as possible once the vessel arrives on station; and opening of codend during haul back as quickly and carefully as possible to avoid damaging any protected species that may have been incidentally captured.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the impacts on finfish from ongoing and planned activities including offshore wind, which would likely be negligible, as impacts from fisheries surveys are expected to be localized and finfish are highly mobile and would be expected to experience short-term and localized behavioral impacts where finfish may be displaced or captured by active survey gear. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts (disturbance, displacement, injury, and mortality) on invertebrates and EFH, which would likely be negligible and short-term, as impacts from surveys are expected to be localized and would often occur along transects already included in fisheries surveys. However, the time period for recovery would depend on the mobility and life stage of each species, with sessile organisms less able to avoid impacts and mobile organisms more able to avoid impacts. Because benthic monitoring for the Project would be via remote equipment, the only impact to EFH and EFH species could be short-term, localized disturbance by vessels, lights and automated underwater vehicles which could induce behavioral changes in mobile species that would cause them to leave the area.

3.10.5.3 Conceptual Decommissioning

3.10.5.3.1 Onshore Activities and Facilities

Onshore decommissioning activities associated with the SRWF would likely have negligible impacts on finfish, invertebrates, and EFH.

3.10.5.3.2 Offshore Activities and Facilities

Project conceptual decommissioning would have similar impacts on invertebrates and fish species to those anticipated for the Proposed Action, but the degree and magnitude of these effects would likely be different. The newly introduced surfaces are expected to develop a complex community of benthic invertebrates. The removal of these surfaces would likely injure or cause mortality to invertebrates attached to the hard surfaces or inhabiting the interstitial spaces and permanently alter benthic habitats within the decommissioning area. Any invertebrates that are living among these habitats may or may not survive, depending on whether they are able to find other suitable habitats. The invertebrates associated with softer bottom benthic habitats may be able to recover within a faster time period after conceptual decommissioning is completed. Whereas the invertebrate species associated with complex benthic habitat within the conceptual decommissioning area could take much longer to recover.

Project conceptual decommissioning of offshore components would require the use of construction vessels of similar number and class as used during construction. Decommissioning activities would produce similar short-term effects on finfish and invertebrates to those described above for proposed Project construction. Underwater noise and disturbance levels generated during conceptual decommissioning would be similar to those described above for construction, with the exception that pile driving would not be required. The monopiles would be cut below the bed surface for removal using a cable saw or abrasive waterjet. Noise levels produced by this type of cutting equipment are generally indistinguishable from engine noise generated by the associated construction vessel (Pangerc et al. 2016). Therefore, this decommissioning equipment would have significantly lower potential for noise effects comparted to those already considered for construction vessel noise. The effects of Project conceptual decommissioning on finfish, invertebrates and EFH species would, therefore, range from negligible to minor.

3.10.5.4 Cumulative Impacts of the Proposed Action

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

Accidental releases: The Proposed Action would contribute a noticeable increment to the cumulative impacts of accidental releases, which would likely be negligible and short term. Most of the risk of accidental releases of invasive species come from ongoing activities, and the impacts (mortality, decreased fitness, disease) due to other types of accidental releases are expected to be negligible.

Anchoring: The Proposed Action would contribute an undetectable increment to the cumulative impacts of anchoring on finfish and invertebrates, which would likely be minor and short term, with localized impacts only occurring in the immediate vicinity of anchors. If anchoring occurs in complex habitats and sensitive SAV habitat, impacts would likely be moderate and long term within that specific habitat.

EMF: The Proposed Action would contribute an undetectable increment to the cumulative impacts because the Proposed Action would slightly increase the impacts of EMF in the GAA beyond those described under the No Action Alternative. The cumulative impact on finfish, invertebrates, and EFH would likely be negligible and localized but long term.

Lighting: The Proposed Action would contribute an undetectable to noticeable increment to the cumulative impacts. The Proposed Action would slightly increase the impacts of artificial lighting in the GAA beyond those described under the No Action Alternative. The cumulative impacts on finfish, invertebrates, and EFH would likely be minor and highly localized but long term.

Noise: Cumulative impacts of noise could occur if construction schedules overlap within the GAA of finfish. A schedule of construction activities at the Sunrise Wind, Revolution Wind and South Fork projects for the onshore facilities, export cables, offshore foundations, IAC, WTG installations, and the OSC-DC were compared. There is no overlap between the Sunrise Wind Project and South Fork construction schedules. There is overlap during the construction of the onshore facilities at both the Sunrise Wind and Revolution Wind projects; however, these projects are remote from each other and would produce no overlapping impacts. There is also overlap during the construction of the export cables between the Sunrise Wind Project and Revolution Wind but at their closest point these cables are approximately 16 mi (25.7 km) apart. Proposed construction of the offshore foundations and IAC at both Projects overlap. The timing of the installation of the WTGs or OSC-DC do not coincide between the Projects; however, the installation of offshore foundations and the IAC have similar timing. In some cases, this work could be as close as 2-3 mi (3.2-4.8 km) apart. Results from the sound modeling show that injury from a single strike is limited to 230 ft (70 m) from a pile for both winter and summer seasons and injury from prolonged cumulative exposure (over 24 hours) extends as far as 5.8 mi (9.4 km) from the pile during the winter water profile. Modeling indicates that behavioral effects on fish could occur up to 4.7 mi (7.5 km) from the pile source during the winter and 3.2 mi (5.2 km) from the pile source during the summer. Within this area, it is likely that some level of behavioral reaction is expected and could include startle responses or migration out of areas exposed to underwater noise (Hastings and Popper 2005). Mitigation measures such as the use of ramp up procedures would allow mobile resources to leave the area before full-intensity pile-driving begins. The Project would use bubble curtains, hydro-dampers, and AdBm, Helmholz resonators to reduce noise propagation. The Project is committed to achieving ranges associated with 10 dB of noise attenuation. The Proposed Action would contribute a noticeable increment to the cumulative noise impacts on finfish and invertebrates, which would likely be moderate adverse, localized, and short term.

Presence of structures: The Proposed Action would contribute a noticeable increment to the cumulative impacts on finfish and invertebrates from the presence of structures, which would likely be minor to moderate, potentially beneficial, and long term, given that hard-structure surfaces could provide benefits to finfish and invertebrates while they are in place. A 7-year monitoring study conducted at the Block Island Wind Farm (BIWF), a local 5 WTG wind farm in operation since 2016 characterized artificial reef effects. The greatest benthic changes occurred on or within the footprint of the WTGs. The artificial reef effects were characterized as benefiting fish and shellfish by providing refuge and creating forage, and as attracting abundant and diverse communities (Hutchison et al. 2020a). All submerged parts of the foundation structures studied were dominated by the blue mussels (approximately 50 cm deep). Other epifauna species present including hydroids, algae, sponges, anemones, tunicates, and coral. Predators associates with mussel aggressions and structure such as moon snails, crabs, sea stars, black sea bass, Atlantic cod, striped bass, bluefish, and dogfish sharks are now more abundant. Demersal fish and invertebrate CPUE varied spatially between the BIWF and two reference areas and temporally between baseline and operation time periods, however, interactions indicating no reduced CPUE at the BIWF (Hutchison et al. 2020a). The CPUE of several fish species were higher near the BIWF during the operation time period relative to the reference areas, providing evidence for an artificial reef effect (Hutchison et al. 2020a). Temporal trends in relative abundances of schooling species such as Atlantic herring, scup, and butterfish reflected regional trends and did not indicate an effect of wind farm operation (Hutchison et al. 2020a). Relative decreases in fish and invertebrate abundances during wind farm operation were neither statistically nor substantively evident (Hutchison et al. 2020a).

The cumulative impacts of the Proposed Action considered the impacts of the proposed would impact fish, invertebrates, and EFH on different levels depending on life stages and habitat preferences of each species. Activities that are associated with benthic disturbances are unlikely to impact any species that rely on pelagic habitats. Those species that rely on benthic habitats may suffer variable impacts that are likely to be short-term in duration and not permanent. The longer-term presence of the construction-related structures would impact both pelagic and benthic habitats and may displace some species while construction activities occur. However, the longer-term presence of structures has been shown to provide potentially beneficial impacts to several invertebrate and fish resources due to artificial reef effects (Hutchison et al. 2020a). Therefore, the overall impacts associated from the Proposed Action are anticipated to be minor to moderate on finfish, invertebrates and EFH.

3.10.5.5 Impacts of Alternative B on ESA-Listed Species

Impacts to endangered species associated due to the Proposed Action are likely to be minor. The most sensitive IPF to sturgeon would most likely be the noise associated with construction, including pile driving, however those activities are most likely to occur in from May to December. Atlantic sturgeon utilize more nearshore and riverine water during the summer months, reducing their risk significantly during that time frame (Ingram et al. 2019).

Habitat disturbance: Impacts on the Atlantic sturgeon from cable emplacement and maintenance may include temporary habitat disturbance, turbidity, and loss of prey. Ingram et al. (2019) tagged Atlantic sturgeon off the New York WEA using acoustic tags to track the movement of fish seasonally from November 2016 through February 2018. Their study showed that offshore migrations peaked from November through January and were uncommon or entirely absent during July to September. Sturgeon forage at the sediment (Dadswell 2006). This behavior may increase the susceptibility to habitat disturbance and of capture with a dredge bucket. For entrapment to occur, an individual sturgeon would have to be present directly below the dredge bucket at the time of operation. As such, entrapment of sturgeon during the temporary performance of mechanical dredging operations is unlikely. Due to their bottom foraging and swimming behavior, adult Atlantic sturgeon. Atlantic sturgeon becoming entrained in a mechanical dredge is considered unlikely to occur. Atlantic sturgeon prey upon small, bottom-oriented fish such as the sand lance, mollusks, polychaete worms, amphipods, isopods, and shrimp, with polychaetes and isopods being the primary and important groups consumed in the Project Area (Smith 1985; Johnson et al. 1997; Dadswell 2006). Sand lances could become entrained in a hydraulic dredge due to their bottom orientation and burrowing within sandy sediments that require clearing. It is expected that dredging in sandwaves to allow for cable installation would result in the entrainment and mortality of some sand lances. However, it is expected any impact of the loss of Atlantic sturgeon prey items to be so small that it cannot be meaningfully measured, evaluated, or detected. Vessel anchoring would cause short-term impacts on finfish and invertebrates in the immediate area where anchors and chains meet the seafloor in offshore sandy environments. Impacts would include turbidity affecting finfish and invertebrates, and injury, mortality, and habitat degradation, primarily of invertebrates. All impacts would be localized, turbidity would be temporary, and displacement and mortality from physical contact would be recovered in the short term. Impacts may be higher within sensitive habitats (e.g., eelgrass beds, hard-bottom habitats). Atlantic sturgeon would likely depart or avoid unfavorable water quality conditions they may encounter. Suspended sediment and turbidity could result in some temporary avoidance of turbid areas. Any effects from elevated levels of turbidity from the project on Atlantic sturgeon or their prey are considered small. Effects of displacement of Atlantic sturgeon and their prey from physical disturbance of sediment are anticipated to be negligible and are further addressed in the Biological Assessment.

Vessel traffic: The presence of vessels introduces the risk of vessel collision with marine life, and vessel collisions with marine life are an ongoing threat in the Project Area due to vessels from numerous industries such as trade, tourism, resource development, and offshore wind development. An increase in vessel traffic would be expected due to industries such as aquaculture, fishing, wind farms, power cables, tourism, and oil or gas pipelines, as well as increasing ship traffic in general. Marine species that spend a significant time near the water surface or in areas where vessel routes overlap with migration, feeding, or breeding grounds have the potential to be struck by vessels. Vessel speed reductions and route restrictions have shown to be effective mitigation measures for reducing the probability of injury and mortality related to vessel collisions. Impacts of vessel collisions can result in injury or mortality and may affect Atlantic sturgeon. However, the risk of vessel strikes to sturgeon would be limited to shallower nearshore areas during sturgeon migration into rivers. While Atlantic sturgeon are known to be struck and killed by vessels in rivers and estuaries, there are no reports of vessel strikes in the marine environment, likely due to the space between bottom-oriented sturgeon and the propellers and hulls of vessels.

EMF: During operation, powered transmission cables would produce EMF. The strength of the EMF rapidly decreases with distance from the cable. Sunrise Wind proposes to bury cables to a target burial depth of up to 4 to 6 ft (1.2 to 1.8 m) below the surface, well below the aerobic sediment layer where most benthic infauna live. Atlantic sturgeon are electrosensitive but appear to have relatively low sensitivity to magnetic fields based on studies of other sturgeon species. Magnetic fields associated with the operation of the transmission line could affect benthic organisms that serve as sturgeon prey. Effects on forage fish, jellyfish, and copepods are extremely unlikely to occur given the limited distance into the water column that any magnetic field associated with the transmission line is detectable.

Lighting: Activities associated with the Proposed Action that could cause impacts from lighting on Atlantic sturgeon and their prey include presence of vessels throughout construction, operation, and decommissioning. Transiting and working vessels associated with construction would use artificial lighting during any operations outside of daylight hours. Light is generally considered an attractant to finfish; therefore, it would be expected that areas where artificial light strikes and penetrates the ocean surface would experience increased fish activity. Lighting may result in impacts on normal behavior of fish and pelagic eggs and larvae by altering their movement and potentially causing temporary increases in predation pressure and disruption of normal swimming behavior, where light may be an attractant to finfish. Light sources from the Proposed Action would involve obstruction lights on the nacelle and mid-mast, which are characterized by intermittent flashes of red hues, and marine navigational lights, which are characterized by intermittent flashes of yellow hues, neither of which present a continuous light source. Artificial light would be minimized to the extent practicable through use of BMPs. No impacts on Atlantic sturgeon from lighting are anticipated.

Noise: There is no available information on the hearing capabilities of Atlantic sturgeon specifically, although the hearing of other species of sturgeon have been studied. Meyer et al. (2010) and Lovell et al. (2005) studied the auditory system morphology and hearing ability of lake sturgeon (*Acipenser fulvescens*), a closely related species. The Acipenseridae (sturgeon family) have a well-developed inner ear that is independent of the swim bladder and therefore it appears that sturgeon rely directly on their ears to hear. The results of these studies indicate a generalized hearing range from 50 to approximately 700 Hz, with greatest sensitivity between 100 and 300 Hz. Mooney et al. 2020 examined the potential negative effects of exposure to pile driving on lake sturgeon and showed diverse impacts that indicate physical damage of barotrauma. Hastings and Popper (2005) summarized studies measuring the physiological responses of the ear of European sturgeon (*Acipenser sturio*). These results suggest sturgeon are likely capable of detecting sounds from below 100 Hz to about 1 kilohertz. Noise impacts may occur due to impact pile driving for WTGs and OSS foundations and effects of exposure that may result in physiological injury and behavior disturbance; UXO detonations, which generate high pressure levels that could kill, injure, or disturb Atlantic sturgeon; and non-impulsive noise from vibratory pile driving associated with HRG surveys, vessels, aircraft, cable laying and trenching, dredging, and WTG operations that may result in injury or behavioral changes. The Programmatic Biological Assessment prepared to evaluate impacts from geotechnical and HRG surveys on the OCS (NMFS 2021d) concluded that no impacts on ESA-listed species, including the Atlantic sturgeon, from these activities are likely to occur. In addition to operational noises described above, there is a potential for interactions with UXO as well as the corrosion of UXO in the Project Area. Sunrise Wind may encounter UXOs on the seabed in the Lease Area and 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 kill, injure, or disturb Atlantic sturgeon. However, the APM seasonal restriction of UXO detonations from January through April would effectively eliminate the likelihood of any exposures for Atlantic sturgeon. Should a sturgeon be exposed to noises above behavioral thresholds, the effects would likely be brief (e.g., Atlantic sturgeon may be startled and divert away from the area), and any effects would be so small that they could not be measured, detected, or evaluated.

Accidental releases: Accidental releases may increase as a result of planned non-offshore wind and 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. Accidental releases of hazardous materials mostly consist of fuels, lubricating oils, and other petroleum compounds. Because most of these materials tend to float in seawater, they are unlikely to make contact with benthic resources. The chemicals with potential to sink or dissolve rapidly are predicted to dilute to non-toxic levels before they would reach benthic resources. In most cases, the corresponding impacts on benthic resources are unlikely to be detectable unless there is a catastrophic spill (e.g., an accident involving a tanker ship). Large-scale spills may be accompanied by the use of chemical dispersants during post-spill response. Benthic resources with planktonic larval stages may be susceptible to this toxicity, which may affect subsequent recruitment.

Invasive species can be released accidentally, especially during ballast water and bilge water discharges from marine vessels. Increasing vessel traffic related to the offshore wind industry would increase the risk of accidental releases of invasive species, primarily during construction. Invasive species releases may or may not lead to the establishment and persistence of invasive species. Although the likelihood of invasive species becoming established as a result of offshore wind activities is very low, the impacts of invasive species on benthic resources could be strongly adverse, widespread, and permanent if the species were to become established and out-compete native fauna. Such an outcome, however, is considered highly unlikely. A spill prevention and a response plan would be developed and implemented during all phases of the Proposed Action. The risk of any type of accidental release would be increased, primarily during construction, but also during O&M and decommissioning of offshore wind facilities.

The cumulative impacts of accidental releases on benthic resources are likely to be minor because largescale releases are unlikely and impacts from small-scale releases would be localized and short term, resulting in little change to benthic resources. As such, accidental releases from offshore wind development would not be expected to appreciably contribute to cumulative impacts on benthic resources. Accidental releases of substances such as fuel, hazardous materials, and trash are a risk during the construction, operation, and maintenance of the Proposed Action. Some substances may persist in the environment and result in injury to individual animals but are not expected to have population impacts. Adverse impacts on finfish, including the Atlantic sturgeon, and invertebrates and EFH are expected to be short term and negligible.

Surveys/Monitoring and Fishing: Impacts from gear utilization would likely be negligible because impacts from Project fisheries surveys are expected to be localized. However, sturgeon capture in commercial fishing gear is documented in fisheries that utilize active gear such as trawl nets. Trawl gear has also been employed as a reliable method to capture sturgeon. Capture of Atlantic sturgeon in trawl gear has the potential to result in injury and mortality, reduced fecundity, and delayed or aborted spawning migration (Moser and Ross 1995; Collins et al. 2000; Moser et al. 2000). The time period for recovery would depend on the mobility and life stage of each species, with sessile organisms less able to avoid impacts and mobile organisms more able to avoid impacts. The effects of gear utilization are expected to contribute an undetectable increment to the cumulative impacts (disturbance, displacement, injury, and mortality) on invertebrates and EFH, which would likely be negligible and short term, as impacts from surveys are expected to be localized and would often occur along transects already included in fisheries surveys. In addition, concentration of recreational fishing around the foundations may potentially increase the risk of Atlantic sturgeon entanglement in vertical and horizontal fishing lines and subsequent injury and mortality due to infection and starvation.

The threatened giant manta ray occurs in offshore water near upwelling areas at the edge of the Continental Shelf. Their occurrences in the Mid-Atlantic OCS are very rare, and the impacts of the Proposed Action are expected to be minimal. The other listed species (Atlantic salmon*,* Shortnose sturgeon, and oceanic whitetip shark) also have very rare occurrences in the Project Area, thus it is highly unlikely that these species would suffer any impacts due to construction, installation, operation, and maintenance, or decommissioning of the Project including from the OCS-DC.

3.10.5.6 Conclusions

Impacts of the Proposed Action

BOEM anticipates construction and installation, O&M, and conceptual decommissioning of the Proposed Action would have **moderate** adverse impacts on finfish, invertebrates and EFH. The primary risks would be associated with cable installation, and noise from construction, most prominently associated with pile-driving activities. Although there may be longer-term habitat alteration effects from the cable installation for benthic species, the overall habitat disturbance would be relatively minor in relation to available habitat. Noise-related impacts can be avoided by mobile fish species and are unlikely to be sensed by invertebrates unless in very close proximity to the sound source, and many of the impacts are likely to be short-term, intermittent and minor. Increases in turbidity associated with dredging activities, and water withdrawal from jet plowing and other methods could temporarily impact pelagic egg and larval stages as well as EFH species. The anticipated path and overall footprint of these activities would be relatively small for the Proposed Action and would not have significant impacts on vulnerable life stages relative to the overall habitat available regionally. All construction, installation, operations, maintenance, and decommissioning activities associated with the Project would implement measures to mitigate and reduce the potential of any adverse impacts to aquatic resources. Monitoring and mitigation measures would be followed in consultation with NMFS, and with coordination with federal and state agencies.

Entrainment estimates for egg and larval species regarding the OCS-DC are anticipated to be minor as demonstrated by the calculated equivalent adult losses. Even though over 1 million of the abundant Atlantic herring eggs and larvae are estimated to be entrained at the OCS-DC that only equates to less than 600 adult Atlantic herring. Based on equivalent adult estimates of Atlantic herring, stock level impacts are not expected from entrainment. Other potentially entrained species equates to substantially lower equivalent adults. The location, design, and operation of the cooling water discharge was selected minimize the thermal plume size to the greatest extent practicable and preventing thermal plume migration to the surface waters or benthos. The thermal plume would be contained to a distance of 87 ft (27 m) from the outfall and occupy a maximum area of 731 ft^2 (66.9 m^2) in a worst-case, slack tide scenario. Impacts from the thermal plume are expected to be minor**.**

The overall impacts associated from the Proposed Action are anticipated to be minor to moderate on finfish, invertebrates and EFH. The monopile foundations and associated hard structures that would be constructed for the SRWF may displace existing benthic habitat for invertebrates and some fish species, as well as potential EFH species. However, the structures would serve as replacement habitat structure that would create an artificial reef effect for fish and new habitat for colonizing invertebrates.

Impacts from accidental releases are expected to be negligible. Most of the risk of accidental releases of invasive species come from ongoing activities. All cables under the Proposed Action would be buried 4 to 6 ft (1.2 to 1.8 m) below the surface and include electric shielding to minimize EMF generation. Impacts from EMF generation are expected to be negligible and localized, but long term.

Cumulative Impacts of the Proposed Action

BOEM anticipates that the cumulative impacts on finfish, invertebrates and EFH in the GAA would be **moderate**. Considering all IPFs together, BOEM anticipates that the overall impacts on finfish, invertebrates, and EFH in the GAA associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would be **moderate**.

3.10.6 Alternative C-1 - Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions

Under the Fisheries Habitat Impact Minimization Alternative C-1, the construction, operation, maintenance, and eventual decommissioning of the 11-MW WTGs and an OCS within the proposed Project Area and associated inter-array and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, to reduce impacts to complex fisheries habitats that are the most vulnerable to long-term impacts as compared to the Proposed Action, certain WTG positions would be excluded from development. Under this alternative, the same number of installed WTGs as described for the Proposed Action may be approved by BOEM.

This alternative was determined to be infeasible following additional geotechnical and geophysical surveys that were undertaken by SRW in 2022 on the eastern portion of the lease area. Following the publication of the DEIS and analysis of Alternative C-1, the additional geotechnical and geophysical survey data was analyzed and published, which informed the infeasibility of Alternative C-1 due to glauconite sands (see COP Appendix G-3 Foundation Feasibility Assessment dated June 30, 2023). Under Alternative C-1, 94 WTGs were proposed for installation in 102 positions, excluding 8 positions from Priority Area 1. However, due to glauconite sands, only 72 of the proposed positions are available for installation under this alternative, which would only produce 792 MW (Table 2.1-6). This renders Alternative C-1 infeasible and led to the development of Alternative C-3 (see Section 2.1.3.3).

This alternative considered and prioritized contiguous areas of complex habitat to be excluded from development to avoid and minimize impacts to complex fisheries habitats, while still meeting BOEM's purpose and need for the Project. Areas for prioritization were identified by NMFS based upon on recent detections of Atlantic cod spawning activity in the vicinity of the Project Area, assumed hard bottom complex substrate, and the presence of large boulders (see Figure 2.1-2). Priority Area 1 is considered the highest priority for conservation and includes 18 WTG positions as well as the OCS-DC. With only eight positions to exclude for Alternative C-1, all were eliminated from Priority Area 1. To identify which eight positions to remove, BOEM relied on the locations and densities of boulders, which can be considered a critical element of potential sensitive habitat (Gardline 2021). Gardline (2021) identified boulders as objects that (1) returned a strong backscatter signal indicative of hard substrates; (2) were observed to have a distinct shadow or measurable height; and (3) had diameters greater than 0.5 m. The density of boulders (number of boulders/155 mi^2 [250 km^2]) on the seafloor surrounding each WTG position was calculated using the ESRI ArcGIS Pro Spatial Analyst Density function (Figure 3.7-4, Table B-2.1 in Appendix B). Then, boulder densities within NMFS's Priority Area 1 were ranked and the eight contiguous WTG positions with the highest boulder densities within Priority Area 1 were identified for exclusion in Alternative C-1 (Figure 3.7-5). The positions identified for exclusion within Alternative C-1 were determined to be most optimal for minimizing fisheries habitat impacts (see Section 3.7 *Benthic Resources* and Appendix B [*Supplemental Information and Additional Figures and Tables*] for additional discussion).

3.10.6.1 Construction and Installation

3.10.6.1.1 Onshore Activities and Facilities

Under Alternative C-1, there would be no difference in onshore construction and installation activities or facilities as compared to the Proposed Action. Onshore construction and installation activities associated with Alternative C-1 would likely have negligible impacts on finfish, invertebrates, and EFH. Under Alternative C-1, onshore construction and installation impacts would be the same as described for the Proposed Action.

3.10.6.1.2 Offshore Activities and Facilities

Construction and installation IPFs to finfish, invertebrates and EFH associated with Alternative C-1 would be similar to those described under the Proposed Action. The exclusion of 8 WTG positions within the design of Alternative C-1 was intended to reduce the number of WTG positions located In complex bottom habitat. although there could be decreased impacts to complex bottom habitat if the eight selected WTG positions were not developed. Adverse impacts would be negligible to minor and short-term.

3.10.6.2 Operations and Maintenance

3.10.6.2.1 Onshore Activities and Facilities

Onshore O&M activities associated with Alternative C-1 would likely have negligible impacts on finfish, invertebrates, and EFH. Under Alternative C-1, onshore construction and installation impacts would be the same as described for the Proposed Action.

3.10.6.2.2 Offshore Activities and Facilities

O&M IPFs to finfish, invertebrates and EFH associated with Alternative C-1 would be similar to those described under the Proposed Action. Adverse impacts would be negligible to minor and short-term. Potential beneficial impacts from the installation of structures would include artificial reef effects that can influence benthic habitats and change the abundance and distribution of fish and invertebrate community structures. The relocation of 8 WTGs within the design of Alternative C-1 would reduce the number of WTGs located in Atlantic cod spawning locations and areas with complex bottom habitat.

3.10.6.3 Conceptual Decommissioning

3.10.6.3.1 Onshore Activities and Facilities

Onshore decommissioning activities associated with the SRWF Alternative C-1 would likely have negligible impacts on finfish, invertebrates, and EFH.

3.10.6.3.2 Offshore Activities and Facilities

Offshore activities associated with the decommissioning of the Alternative C-1 would be similar to those described under the Proposed Action.

3.10.6.4 Cumulative Impacts of Alternative C-1

Noise: Cumulative impacts of noise would be similar to those outlined within the analysis of the Proposed Action; however, impacts may be reduced for Atlantic cod due to exclusion of the 8 WTGs in the vicinity of Cox Ledge. Alternative C-1 would contribute a noticeable increment to the cumulative noise impacts on finfish and invertebrates.

The cumulative impacts on finfish, invertebrates and EFH from Alternative C-1 would likely be **moderate** due to a reduced impact on finfish, invertebrates and EFH given that the WTGs would be removed from prioritized contiguous areas of complex habitat to be excluded from development to avoid and minimize impacts to complex fisheries habitats, while still meeting BOEM's purpose and need for the Project. Areas for prioritization were identified by NMFS based upon on recent detections of Atlantic cod spawning activity in the vicinity of the Project Area, assumed hard bottom complex substrate, and the presence of large boulders.

3.10.6.5 Impacts of Alternative C-1 on ESA-Listed Species

The impacts of Alternative C-1 on ESA-listed species would be similar to those described under the Proposed Action.

3.10.6.6 Conclusions

Impacts of Alternative C-1

The impacts of Alternative C-1 on finfish, invertebrates, and EFH would be similar to those described under the Proposed Action. However, Alternative C-1 could potentially result in reduced overall impacts on finfish, invertebrates, and EFH due to the change in layout aimed to reduce the amount of WTGs located in the presumed Atlantic cod spawning locations. Overall, the potential adverse impacts associated from the Alternative C-1 are anticipated to be **moderate**.

Cumulative Impacts of Alternative C-1

The cumulative impacts on finfish, invertebrates and EFH from Alternative C-1 would likely be **moderate** adverse due to a reduced impact on finfish, invertebrates and EFH given that the WTGs would be removed from prioritized contiguous areas of complex habitat to be excluded from development to avoid and minimize impacts to complex fisheries habitats, while still meeting BOEM's purpose and need for the Project.

3.10.7 Alternative C-2 - Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions and Relocation of up to 12 WTG Positions to the Eastern Side of the Lease Area

Under the Fisheries Habitat Impact Minimization Alternative C-2, the construction, operation, maintenance, and eventual decommissioning of the 11-MW WTGs and an OCS within the proposed Project Area and associated inter-array and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, to reduce impacts to complex fisheries habitats that are the most vulnerable to long-term impacts as compared to the Proposed Action, certain WTG positions would be excluded from development. Under this alternative, the same number of installed WTGs as described for the Proposed Action may be approved by BOEM.

This alternative considered and prioritized areas of complex habitat to be excluded from development to avoid and minimize impacts to complex fisheries habitats, while still meeting the purpose and need for the Project. Areas for prioritization were identified by NMFS based on recent detections of Atlantic cod spawning activity in the vicinity of the Project Area, assumed hard bottom complex substrate, and the presence of large boulders (Figure 2.1-7). Priority Area 1 is considered the highest priority for conservation by NMFS and includes 18 WTG positions as well as the OCS-DC. In Alternative C-1, 8 WTG position were identified for removal within this area. For Alternative C-2, this analysis was expanded upon to relocate 12 WTG positions from the Priority Areas to the eastern side of the Lease Area in addition to excluding development of the 8 WTG positions identified in Alternative C-1. This alternative assumes that habitat on the eastern side of the Lease Area is more suitable, but this assumption may change depending on the results of additional surveys conducted in this area during the summer of 2022.

In Alternative C-2, up to 4 WTG position configurations (C-2a, C-2b, C-2c, and C-2d) are considered to address NMFS Priority Areas, provide continuous habitat, and avoiding boulder fields (see Section 3.7.7 *Benthic Resources*). All eight positions identified in Alternative C-1 would remain excluded for development in all Alternative C-2 configurations. Up to an additional 12 WTGs were selected for relocation to the eastern portion of the Lease Area, based on a similar analysis for Alternative C-1. To identify which 12 WTG positions to relocate, BOEM relied on the locations and densities of boulders in NMFS Priority Areas; boulders can be considered a critical element of potential sensitive habitat (Gardline 2021). Gardline (2021) identified boulders as objects that (1) returned a strong backscatter signal indicative of hard substrates; (2) were observed to have a distinct shadow or measurable height; and (3) had diameters greater than 0.5 m. The density of boulders (number of boulders/155 mi^2 [250 km^2]) on the seafloor surrounding each WTG position was calculated using the ESRI ArcGIS Pro Spatial Analyst Density function (Figure 3.7-4, Table B-2.2 in Appendix B). Then, boulder densities within the Priority Areas were ranked and multiple configurations were developed to provide options of ideal WTG position configurations. NMFS's Priority Areas, highest boulder densities, and maintaining contiguous habitat informed how these alternative configurations were developed.

Alternative C-2 was determined to be infeasible following additional geotechnical and geophysical surveys. Following the publication of the DEIS and analysis of Alternative C-2, the additional geotechnical and geophysical survey data was analyzed and published, which informed the infeasibility of Alternative C-2 due to glauconite sands (see COP Appendix G-3 Foundation Feasibility Assessment, June 30, 2023). Under Alternative C-2, 94 WTGs were proposed for installation, with the removal of 8 and relocation of

12 WTGs (see Section 3.7.7 for Alternative C-2a-d layouts). Out of the 12 WTG positions identified for relocation, due to glauconite sands, only 3 are feasible for development. Additionally, 22 positions that were part of the original layout were determined to be infeasible for development, resulting in a total of 31 infeasible WTG positions under this alternative. Therefore, only 63 of the proposed positions are available for installation, resulting in only 693 MW, which does not meet the OREC agreement (Table 2.1-6). This renders Alternative C-2 infeasible and led to the development of Alternative C-3 (see Section 2.1.3.3).

3.10.7.1 Construction and Installation

3.10.7.1.1 Onshore Activities and Facilities

Under Alternative C-2, there would be no difference in onshore construction and installation activities or facilities as compared to the Proposed Action. Impacts due to onshore construction and installation activities associated with Alternative C-2 would be the same as described for the Proposed Action.

3.10.7.1.2 Offshore Activities and Facilities

Construction and installation IPFs to finfish, invertebrates and EFH associated with Alternative C-2 would be similar to those described under the Proposed Action; although there could be decreased impacts to complex bottom habitat if the eight selected WTG positions were not developed and an additional 12 WTG positions were relocated to the eastern portion of the Lease Area. The addition of WTG positions in the eastern portion of the Lease Area would result in additional inter-array cabling, which would increase seafloor disturbance, sediment suspension/deposition, EMF, and noise impacts. Adverse impacts would be negligible to minor and short-term. The design of Alternative C-2 was intended to reduce the number of WTG positions located in complex bottom habitat.

3.10.7.2 Operations and Maintenance

3.10.7.2.1 Onshore Activities and Facilities

Under Alternative C-2, there would be no difference in onshore O&M activities or facilities as compared to the Proposed Action. Impacts due to onshore O&M activities associated with Alternative C-2 would be the same as described for the Proposed Action.

3.10.7.2.2 Offshore Activities and Facilities

O&M IPFs to finfish, invertebrates and EFH associated with Alternative C-2 would be similar to those described under the Proposed Action. The addition of WTG positions in the eastern portion of the Lease Area would result in additional inter-array cabling, which would increase seafloor disturbance, sediment suspension/deposition, EMF, and noise impacts. Adverse impacts would be negligible to minor and short-term. Potential beneficial impacts from the installation of structures would include artificial reef effects that can influence benthic habitats and change the abundance and distribution of fish and invertebrate community structures. The exclusion of up to 8 WTG positions and relocation of up to an additional 12 WTG positions within the design of Alternative C-2 was undertaken to reduce the number of WTGs located in the presumed Atlantic cod spawning locations and areas with complex bottom habitat. However, the same number of WTGs would be operated and maintained as described for the Proposed Action.

3.10.7.3 Conceptual Decommissioning

3.10.7.3.1 Onshore Activities and Facilities

Under Alternative C-2, there would be no difference in onshore decommissioning activities or facilities as compared to the Proposed Action. Impacts due to onshore decommissioning activities associated with Alternative C-2 would be the same as described for the Proposed Action.

3.10.7.3.2 Offshore Activities and Facilities

Offshore activities associated with the decommissioning of the Alternative C-2 would be similar to those described under the Proposed Action.

3.10.7.4 Cumulative Impacts of Alternative C-2

Noise: Cumulative impacts of noise would be similar to those outlined within the analysis of the Proposed Action; however, impacts may be reduced for Atlantic cod due to exclusion of the 8 WTGs located near Cox Ledge and relocation of WTGs to the eastern side of the Lease Area. Alternative C-2 would contribute a noticeable increment to the cumulative noise impacts on finfish and invertebrates.

The cumulative impacts on finfish, invertebrates and EFH from Alternative C-2 would likely **minor** due to a reduced impact on finfish, invertebrates and EFH given that the WTGs would be removed from prioritized contiguous areas of complex habitat to be excluded from development to avoid and minimize impacts to complex fisheries habitats, while still meeting BOEM's purpose and need for the Project. Areas for prioritization were identified by NMFS based upon on recent detections of Atlantic cod spawning activity in the vicinity of the Project Area, assumed hard bottom complex substrate, and the presence of large boulders.

3.10.7.5 Impacts of Alternative C-2 on ESA-Listed Species

The impacts of Alternative C-2 on ESA-listed species would likely be similar to those described under the Proposed Action as the same number of WTGs would be installed, operated and maintained, and decommissioned. The placement of WTGs within the Lease Area.

3.10.7.6 Conclusions

Impacts of Alternative C-2

The impacts of Alternative C-2 on finfish, invertebrates, and EFH would be similar to those described under the Proposed Action. However, Alternative C-2 could potentially result in reduced overall impacts on finfish, invertebrates, and EFH due to the change in layout aimed to reduce the number of WTGs located in the Atlantic cod spawning locations and complex bottom habitat areas. Overall, the potential adverse impacts associated from the Alternative C-2 are anticipated to be **moderate**.

Cumulative Impacts of Alternative C-2

The cumulative adverse impacts on finfish, invertebrates and EFH from Alternative C-2 would likely be **moderate** due to a reduced impact on finfish, invertebrates and EFH given that the WTGs would be removed from prioritized contiguous areas of complex habitat to be excluded from development to avoid and minimize impacts to complex fisheries habitats, while still meeting BOEM’s purpose and need for the Project.

3.10.8 Alternative C-3 - Reduced Layout from Priority Areas Considering Feasibility Due to Glauconite Sands

Under the Fisheries Habitat Impact Minimization Alternative C-3, the construction, O&M, and eventual decommissioning of the 11-MW WTGs and an OCS within the proposed Project Area and associated inter-array and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, Alternative C-3 was developed to address concerns regarding pile refusal due to glauconite sands in the southeastern portion of the Lease Area while still minimizing impacts to benthic and fisheries resources. Alternative C-3a, C-3b, and C-3c described in Section 3.7.8, *Benthic Resources*, consider different WTG configurations to avoid sensitive habitats and engineering constraints while still meeting the NYSERDA OREC. This alternative only considered removal of WTGs from Priority Area 1 based on consultation with NMFS. Areas with high density of boulder, complex habitat, and data suggesting Atlantic cod aggregation and spawning was considered when determining which WTGs to remove.

Alternative C-3a has up to 87 11-MW WTGs would be installed in the 87 potential positions (*see* Figure 3.7-11). The southeastern portion of the Lease Area would not be developed due to presence of glauconite sands which may result in pile refusal. This alternative considers development of the northeastern portion of the Lease Area and WTG No. 154, which are not considered in the Proposed Action of the Draft EIS and Final EIS. The construction and installation, O&M, and eventual decommissioning of a wind energy facility would occur within the design parameters outlined in the Sunrise Wind Project COP (Sunrise Wind 2023) subject to applicable mitigation measures.

Under Alternative C-3b, up to 84 WTGs would be installed in the 87 potential positions. The southeastern portion of the Lease Area would not be developed due to presence of glauconite sands which may result in pile refusal. This alternative considers development of the northeastern portion of the Lease Area and WTG No. 154, which are not considered in the Proposed Action. The construction and installation, O&M, and eventual decommissioning of a wind energy facility would occur within the design parameters outlined in the Sunrise Wind Project COP (Sunrise Wind 2023) subject to applicable mitigation measures.

Under Alternative C-3c, 80 WTGs would be installed in the 87 potential positions. The southeastern portion of the Lease Area would not be developed due to presence of glauconite sands which may result in pile refusal. This alternative considers development of the northeastern portion of the Lease Area and WTG No. 154, which are not considered in the Proposed Action. The construction and installation, O&M, and eventual decommissioning of a wind energy facility would occur within the design parameters outlined in the Sunrise Wind Project COP (Sunrise Wind 2023) subject to applicable mitigation measures. Under Alternative C-3c, WTGs No. 91 to 94 are excluded from development (*see* Figure 3.7-13). These WTGs were excluded due to proximity to Atlantic cod detections and complex habitat.

3.10.8.1 Construction and Installation

3.10.8.1.1 Onshore Activities and Facilities

Under Alternative C-3, there would be no difference in onshore construction and installation activities or facilities as compared to the Proposed Action. Impacts due to onshore construction and installation activities associated with Alternative C-3 would be the same as described for the Proposed Action.

3.10.8.1.2 Offshore Activities and Facilities

As noted above, Alternative C-3 would not change any aspect of the SRWEC alignments described under the Proposed Action; therefore, the discussion of impacts for these alternatives would focus on the SRWF and the Lease Area. Table 3.7-5 summarizes the estimated seafloor disturbance areas for each of the options under Alternative C (C-1, C-2, and three variations of C-3). These estimates are based on assumptions for disturbance areas for Project components presented in Table 4-1 of the COP and Appendix M3 (Inspire 2022c).

Seafloor disturbance: The intent of the WTG arrangements proposed under Alternatives C-3 is to limit seafloor disturbance in areas of higher habitat complexity and relocate those disturbances to less sensitive habitat types where practicable given the limitations imposed by the presence of glauconite sands in portions of the Lease Area. The C-3 alternatives would install fewer WTGs than the 94 included in the Proposed Action, Alternative C-1, and C-2. Alternative C-3a would install 87 WTGs, Alternative C-3b would install up to 84 WTGs, and Alternative C-3c would install 80 WTGs (seven, nine, and 14 fewer than the Proposed Action, respectively). The resulting arrangements would reduce temporary and permanent disturbance due to WTG foundations and the total miles of cable needed for the IAC layouts. The IAC layouts for Alternative C-3a, b, and c would completely avoid the southeastern portion of the Lease Area. This would remove the potential for seafloor disturbance for finfish, invertebrates and EFH species in this portion of the Lease Area. Alternative C-3a would install the 8 WTG positions excluded from Alternative C-2 in Priority Area 1 and 6 WTGs on the eastern side of the Lease Area. Alternative C-3b would install the 8 WTG positions excluded from Alternative C-2 in Priority Area 1 and 3 WTGs on the eastern side of the Lease Area. Alternative C-3c would install 3 WTGs on the eastern side of the Lease Area and exclude WTG Nos. 91, 92, 93, and 94 in Priority Area 1.

Sediment suspension and deposition: The proposed WTG arrangements under Alternative C-3a and Alternative C-3b would have similar areas of seafloor disturbance in priority habitat areas as the Proposed Action because all locations in Priority Area 1 would be installed. Alternative C-3c removes 4 WTGs from Priority Area 1 and would each reduce the level of sediment suspension and deposition near where Atlantic cod spawning has been documented. Therefore, there would be some reduction in the level or duration of impacts to finfish, invertebrates and EFH species from sediment suspension or deposition from Alternative C-3c as compared to that described under the Proposed Action.

Noise and vibration: Changing the location of the WTGs for the SRWF is not likely to appreciably affect the noise or vibration generated during the construction phase of the proposed Project as compared to the Proposed Action. The areas of soft bottom habitat that would be avoided due to the presence of the glauconite sands would experience less noise and vibration, but otherwise the mechanisms and levels of impact would be expected to be the same as the Proposed Action.

EMF: The IAC layouts for Alternative C-3a, b, and c would completely avoid the southeastern portion of the Lease Area. This would remove the potential for EMF exposure for bottom orientated finfish, invertebrates and EFH species in this portion of the Lease Area. This would constitute a reduction in the potential for impacts to bottom orientated finfish, invertebrates and EFH species from EMFs under Alternative C-3, but only for this portion of the Lease Area as compared to the Proposed Action.

Discharges and releases: There would be no substantive difference in the potential for impacts to bottom orientated finfish, invertebrates and EFH species from discharges or releases under Alternative C-3 as compared to the Proposed Action.

Trash and debris: There would be no substantive difference in the potential for impacts bottom orientated finfish, invertebrates and EFH species from trash or debris under Alternative C-3 as compared to the Proposed Action.

3.10.8.2 Operations and Maintenance

3.10.8.2.1 Onshore Activities and Facilities

Under Alternative C-3, there would be no difference in onshore O&M activities or facilities as compared to the Proposed Action. Impacts due to onshore O&M activities associated with Alternative C-2 would be the same as described for the Proposed Action.

3.10.8.2.2 Offshore Activities and Facilities

Seafloor disturbance: The Alternative C-3 WTG layouts in Priority Area 1 are very similar to those under the Proposed Action. Alternative C-3 adds up to 6 WTGs on the eastern edge of the Lease Area. The WTGs and associated IAC in the higher priority habitat areas on the northwestern portion of the Lease Area would introduce hard bottom habitats and convert some natural boulder habitat to constructed hard surfaces through boulder relocation. These impacts would be similar to the Proposed Action. The expected changes from introducing hard bottom habitat to areas of homogenous soft-bottom habitats across the Lease Area would be similar to those described under the Proposed Action.

Sediment suspension and deposition: The proposed WTG arrangements under Alternative C-3 would shift some of the seafloor disturbance impacts during O&M from Priority Area 3 in the southeastern areas to Priority Area 1 in the northwestern portion of the Lease Area. It is unlikely that this would cause a substantive difference in the level or duration of impacts to bottom orientated finfish, invertebrates and EFH species from sediment suspension or deposition as compared to that described under the Proposed Action.

Noise and vibration: Changing the location of the WTGs for the SRWF is not likely to appreciably affect the noise or vibration generated during the O&M phase of the Project as compared to the Proposed Action. The areas of soft bottom habitat that would be avoided would experience less noise and vibration, but otherwise the mechanisms and levels of impact would be expected to be the same as the Proposed Action.

EMF: The IAC layouts for Alternative C-3a, b, and c would completely avoid the southeastern portion of the Lease Area). This would remove the potential for EMF exposure for bottom orientated finfish, invertebrates and EFH species in this portion of the Lease Area. This would constitute a reduction in the potential for impacts bottom orientated finfish, invertebrates and EFH species from EMFs under Alternative C-3, but only for the southeastern portion of the Lease Area as compared to the Proposed Action.

Discharges and releases: There would be no substantive difference in the potential for impacts to bottom orientated finfish, invertebrates and EFH species from discharges or releases during O&M under Alternative C-3 as compared to the Proposed Action.

Trash and debris: There would be no substantive difference in the potential for impacts to bottom orientated finfish, invertebrates and EFH species from trash or debris during O&M under Alternative C-3 as compared to the Proposed Action.

3.10.8.3 Conceptual Decommissioning

3.10.8.3.1 Onshore Activities and Facilities

Under Alternative C-3, there would be no difference in onshore decommissioning activities or facilities as compared to the Proposed Action. Impacts due to onshore decommissioning activities associated with Alternative C-3 would be the same as described for the Proposed Action.

3.10.8.3.2 Offshore Activities and Facilities

Seafloor disturbance: The shift of WTGs out of the soft bottom habitat areas on the southeastern portion of the Lease Area would remove impacts to those areas. Otherwise, the expected changes from removing hard bottom habitat associated with the WTG foundations and support structures and returning those areas to their original habitat characteristics would be similar to those described under the Proposed Action.

Sediment suspension and deposition: The proposed WTG arrangement under Alternative C-3 would shift some of the seafloor disturbance during decommissioning away from soft bottom habitat areas. Other than this shift in location, there would be no substantive difference in the level or duration of impacts to bottom orientated finfish, invertebrates and EFH species from sediment suspension or deposition during decommissioning as compared to that described under the Proposed Action.

Noise and vibration: Changing the location of the WTGs for the SRWF is not likely to appreciably affect the noise or vibration generated during the decommissioning phase of the proposed Project as compared to the Proposed Action. The areas of soft bottom habitat that would be avoided would experience less noise and vibration, but otherwise the mechanisms and levels of impact would be expected to be that same as the Proposed Action.

EMF: During the decommissioning phase, turbines would cease to be operated and EMFs effects associated with the IAC and SRWEC would be eliminated; therefore, there is the potential for minor beneficial impacts due to the elimination of EMF impacts as a result of decommissioning.

Discharges and releases: There would be no substantive difference in the potential for impacts to bottom orientated finfish, invertebrates and EFH species from discharges or releases during decommissioning under Alternative C-3 as compared to the Proposed Action.

Trash and debris: There would be no substantive difference in the potential for impacts to bottom orientated finfish, invertebrates and EFH species from trash or debris during decommissioning under Alternative C-3 as compared to the Proposed Action.

3.10.8.4 Cumulative Impacts of Alternative C-3

The cumulative impacts of the variations proposed under Alternative C-3 considered the impacts of this alternative in combination with other ongoing and planned wind 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 bottom orientated finfish, invertebrates and EFH species through the primary IPFs of seafloor disturbance, presence of structures, and changes to noise and EMF. The proliferation of offshore wind farms and their associated offshore infrastructure have the potential to change attributes of the seafloor environment within the multiple lease areas.

Climate change: There would be no substantive difference in the potential for cumulative impacts to finfish, invertebrates, and EFH from climate change under Alternative C-3 as compared to the Proposed Action.

3.10.8.5 Impacts of Alternative C-3 on ESA-Listed Species

Reducing the total WTGs proposed for the Lease Area from 94 to between 80 and 87 locations would have a commensurate reduction in the total area disturbed for construction as well as the total acres of habitat that would be converted from native habitat conditions to engineered hard surface and armored areas. The largest reductions in disturbance and impacts would be seen in soft bottom habitats, stemming from the need to avoid the southeastern portion of the Lease Area due to the glauconite sands. Relocating up to 6 WTG positions from areas of higher complexity habitat to areas of soft-bottom, homogeneous habitat on the eastern edge of the Lease Area could reduce the overall adverse impacts of the WTG array on finfish, invertebrates and EFH species resources. The magnitude of this reduction would likely be moderate, but in the context of the overall offshore wind development planned in this region, incremental decreases in impacts may have minor beneficial impacts to the OCS habitat overall. BOEM expects the overall impacts to be similar to the Proposed Action.

3.10.8.6 Conclusions

Impacts of Alternative C-3

Reducing the total WTGs proposed for the Lease Area from up to 94 to between 80 and 87 locations would have a commensurate reduction in the total area disturbed for construction as well as the total acres of habitat that would be converted from native habitat conditions to engineered hard surface and armored areas. The largest reductions in disturbance and impacts would occur in soft bottom habitats, stemming from the need to avoid the southeastern portion of the Lease Area due to the glauconite sands. Relocating up to 6 WTG positions from areas of higher complexity habitat to areas of soft-bottom, homogeneous habitat on the eastern edge of the Lease Area could reduce the overall adverse impacts of the WTG array. The magnitude of this reduction would likely be moderate, but in the context of the overall offshore wind development planned in this region, incremental decreases in impacts may have beneficial impacts to the OCS habitat overall. BOEM expects the overall impacts to be **moderate** adverse for Alternative C-3.

Cumulative Impacts of Alternative C-3

Alternative C-3 reduces the total number of WTGs by as much as 14 locations; however, the reduction does not differ from the Proposed Action substantially in size or extent of impacts to the more complex habitats in the northwestern corner of the SRWF where Atlantic cod spawn. The SRWF is limited in scale compared to some of the offshore renewable energy projects planned in the GAA. Depending on how they are located and distributed, the development of multiple large-scale projects could have broader scale cumulative effects on biological communities than an individual project considered in isolation. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with Alternative C-3 and future offshore wind activities in the GAA combined with ongoing activities, reasonably foreseeable environmental trends, including climate change, and reasonably foreseeable activities would result in **moderate** adverse cumulative impacts on bottom orientated finish, invertebrates and EFH.

3.10.9 Comparison of Alternatives

The four action alternatives alone are similar in terms of the level of impact on finfish, invertebrates and EFH resources, differing primarily in the numbers and locations of the WTGs. The relocation of WTG positions associated with Alternatives C-1 and C-2 could have fewer adverse impacts to certain habitats that are present and species that utilize those portions of the Lease Area. In addition, Alternative C-3 includes a reduction of 7 to 14 WTGs that would be installed and operated, which would have an additional reduction in adverse impacts to certain finfish and invertebrate species, as well as EFH. Despite these slightly varied impacts across alternatives and sub-alternatives, BOEM anticipates that impacts to finfish, invertebrates, and EFH would be **moderate** adverse. Table 3.10-4 provides a summary comparison for each alternative.

Table 3.10-4. Comparison of Alternative Impacts on Finfish, Invertebrates, and Essential Fish Habitats

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
No Action Alternative: Finfish, invertebrates, and EFH would likely continue to be affected by existing environmental trends in the region. Ongoing activities are expected to have continuing short-term and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on finfish, invertebrates, and EFH. Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on finfish, invertebrates, and EFH. *Cumulative Impacts of the No Action Alternative:* Cumulative impacts due to reasonably foreseeable activities, such as increased vessel traffic, any new submarine cable installations or pipelines, onshore construction activities, marine survey or	*Proposed Action:* BOEM anticipates construction and installation, O&M, and conceptual decommissioning of the Proposed Action would have **moderate** adverse impacts on finfish, invertebrates and EFH. The primary risks would be associated with cable installation, and noise from construction, most prominently associated with pile-driving activities Entrainment estimates for egg and larval species regarding the OCS-DC are anticipated to be minor as demonstrated by the calculated equivalent adult losses. *Cumulative Impacts of the Proposed Action:* BOEM anticipates that the cumulative impacts on finfish, invertebrates and EFH in the GAA would be **moderate** adverse. Considering all IPFs together, BOEM anticipates that the overall impacts on finfish,	*Alternative C-1:* Alternative C-1 could potentially result in reduced overall impacts on finfish, invertebrates, and EFH due to the change in layout aimed to reduce the amount of WTGs located in the presumed Atlantic cod spawning locations and complex bottom habitat areas. Overall, the potential adverse impacts associated from the Alternative C-1 would be less than the Proposed Action, although still anticipated to be **moderate** on bottom orientated finish, invertebrates and EFH. *Cumulative Impacts of Alternative C-1:* The cumulative impacts on finfish, invertebrates and EFH from Alternative C-1 would likely remain **moderate**.	*Alternative C-2:* Alternative C-2 could potentially result in reduced overall impacts on finfish, invertebrates, and EFH due to the change in layout aimed to reduce the number of WTGs located in the presumed Atlantic cod spawning locations and complex bottom habitat areas. Overall, the potential impacts associated from the Alternative C-2 would be less than the Proposed Action, although still anticipated to be **moderate** on bottom orientated finish, invertebrates and EFH. *Cumulative Impacts of Alternative C-2:* The cumulative impacts on finfish, invertebrates and EFH from Alternative C-2 would likely be **moderate**.	*Alternative C-3:* Alternative C-3 would result in reduced overall impacts on finfish, invertebrates, and EFH due to the change in layout that would reduce the number of WTGs. However, the reduction would be located in Priority Area 3 and not in Priority Area 1 where Atlantic cod spawning locations and complex bottom habitat areas are located. Overall, the potential impacts associated from the Alternative C-3 would be less than the Proposed Action, although still anticipated to be **moderate** on bottom orientated finish, invertebrates and EFH. *Cumulative Impacts of Alternative C-3:* Considering all the IPFs together, BOEM anticipates that the overall cumulative impacts associated with Alternative C-3 and future offshore wind activities in the GAA combined with ongoing activities,

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
explorations, mineral extractions, port expansions, channel dredging activities, and the installation of any new offshore structures, buoys, or piers, are anticipated to be **moderate**.	invertebrates, and EFH in the GAA associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would be **moderate** adverse on bottom orientated finish, invertebrates and EFH species due to the artificial reef effect.			reasonably foreseeable environmental trends, including climate change, and reasonably foreseeable activities would result in **moderate** adverse impacts on bottom orientated finish, invertebrates and EFH.

3.10.10 Summary of Impacts of the Preferred Alternative

BOEM has identified Alternative C-3b as the Preferred Alternative as depicted in Figure 2.1-10. Alternative C-3b would include installation of up to 84 WTGs, which is 10 fewer WTGs than the maximum WTGs proposed under the PDE of the Proposed Action. Alternative C-3b would result in reduced overall impacts on finfish, invertebrates, and EFH due to the change in layout that would reduce the number of WTGs. However, the reduction would be located in Priority Area 3 and not in Priority Area 1 where Atlantic cod spawning locations and complex bottom habitat areas are located. Overall, the potential adverse impacts for the Preferred Alternative would be **moderate** and cumulative impacts are anticipated to be **moderate.**

Proposed Mitigation Measures

The mitigation measures listed in Table 3.10-5 are recommended for inclusion in the Preferred Alternative.

Table 3.10-5. Proposed Mitigation Measures: Finfish, Invertebrates, and Essential Fish Habitat

Measure	Description	Effect
Impingement Mortality and Entrainment	Sunrise Wind would upgrade and/or retrofit the CWIS to a closed-cycle cooling system if the technology becomes available during Project operations and it is feasible to do so.	Reduce impacts of impingement mortality and entrainment on Finfish and Invertebrates
Impingement Mortality and Entrainment	The through-screen velocity of the CWIS would be reduced to below 0.5 ft/second, which is the threshold required for new facilities defined at 40 CFR 125.84(c).	Reduce impacts of impingement mortality and entrainment on Finfish and Invertebrates
Impingement Mortality and Entrainment	Sunrise Wind would reduce the CWIS water withdrawal, when feasible, during periods of peak egg and larval abundance within the area affected by the OCS-DC.	Reduce impacts of impingement mortality and entrainment on Finfish and Invertebrates
Marine Debris Awareness Training	The Lessee must 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 shall 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 will 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 must submit to DOI an annual report that describes its marine trash and debris awareness training process, number of people trained, estimated related costs, and certifies that the training process has been followed for the previous calendar year. The Lessee	Reduce impacts of contamination on Finfish and Invertebrates

Measure	Description	Effect
	would send the reports via email to BOEM (at renewable_reporting@boem.gov) and to BSEE (at marinedebris@bsee.gov).	
Sound field verification	BOEM, BSEE, and USACE shall 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 shall 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.	Reduce impacts of noise on hearing Species
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 (via TIMSWeb) 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.	Reduce impacts of entanglement on Finfish and Invertebrates
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 Sunrise 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 surveys. This requirement is in place for any trips where gear is hauled.	Reduce impacts of handling on Finfish and Invertebrates
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/dam-migration/sea_turtle_handling_and_resuscitation_measures.pdf). These handling and resuscitation procedures would be carried out any time a sea turtle is incidentally	Reduce impacts on ESA-listed Finfish

Measure	Description	Effect
	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/dam-migration-miss/Resuscitation-Cards-120513.pdf). 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.	
Take notification	The Greater Atlantic Regional Fisheries Office (GARFO) Protected Resources Division 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 Protected Resources Division 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	Reduce impacts on ESA-listed finfish

Measure	Description	Effect
	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.	
Monthly/annual reporting requirements	BOEM and BSEE would ensure that Sunrise 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 Sunrise Wind, NMFS, BOEM and BSEE. All reports would be sent to: nmfs.gar.incidental-take@noaa.gov and BSEE via TIMSWeb.	Reduce impacts on ESA-listed finfish
Data Collection and BMPs	BOEM and BSEE 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 Sunrise Wind Project as applicable.	Reduce impacts on ESA-listed finfish

3.10.10.1 Effect of Measures Incorporated into the Preferred Alternative

Mitigation measures listed in Table 3.10-5 and Table H-3 in Appendix H (*Mitigation and Monitoring*) are incorporated into Alternative C-3b (Preferred Alternative). As specified in Table 3.10-5, BOEM is considering the reasonable and prudent measures (RPMs) and terms and conditions (T&Cs) identified in the draft NMFS Biological Opinion to avoid and minimize take of ESA-listed Atlantic sturgeon. These measures are described in Appendix H, Table H-3. BOEM would require compliance with the negotiated RPMs and T&Cs in the final Biological Opinion. Implementation of the mitigation measures in Table 3.10-5 would ensure the effectiveness of, and compliance with, the APMs analyzed as part of the Preferred Alternative. This would ensure that impacts to finfish and EFH are limited to the levels described in this Final EIS.

In addition to the mitigation listed above, NMFS issued EFH conservation recommendations for the Sunrise Wind Project on September 14, 2023, in support of BOEM's consultation with NMFS under the Magnuson-Stevens Fishery Conservation and Management Act (see Table H-3 in Appendix H). BOEM is reviewing the conservation recommendations and will provide a written response to NMFS that identifies the conservation recommendations that have been adopted or partially adopted. If the Sunrise Wind COP is approved, conservation recommendations that have been adopted or partially adopted will be reflected in the ROD.

NMFS has also identified terms and conditions in the Biological Opinion for the Sunrise Wind Project in support of BOEM's ESA consultation with NMFS. These terms and conditions are included in Appendix H, Table H-2 and the final terms and conditions would be incorporated into the ROD as conditions of COP approval.

3.11 Marine Mammals

This section discusses potential impacts on marine mammals from the proposed Project, alternatives, and future offshore wind activities in the GAA (Appendix D, Figure D-8). The marine mammal GAA as described in Appendix D, includes the Scotian Shelf, Northeast Shelf, and Southeast Shelf large marine ecosystems.

3.11.1 Description of the Affected Environment and Future Baseline Conditions

Of the 40 marine mammal species with occurrence records off the northeastern coast of the United States (DoN 2005), 17 species are expected to occur in the proposed Project Area (Table 3.11-1). These species may occur near the onshore facilities (SRWEC landfall location at Smith Point on Long Island, New York) and the in-water areas which range from state waters (SRWEC-NYS from the shoreline to a maximum depth of 95 ft [29 m]) to federal waters (SRWEC-OCS with maximum depth of 223 ft [68 m] and SRWF which ranges from 114.8 to 203.4 ft [35 to 62 m] in depth) (COP Appendix G1, Sunrise Wind 2022b). Expected marine mammal occurrence in these areas is summarized in (Table 3.11-1) and is based on known habitat associations, habitat modeling, confirmed sightings and acoustic detections in the proposed Project Area and general region, and the potential for occurrence based on these factors regardless of how frequent that occurrence may be. Ongoing threats to these species in this region include vessel strikes, entanglement in fishing gear, fisheries bycatch, contaminants, disease, climate change, and noise (i.e., marine construction activities, vessel traffic, seismic surveys, sonar, and other military training activities) (Grieve et al. 2017; Hayes et al. 2021; MacLeod 2009; Record et al. 2019).

Brief descriptions of the regional and proposed Project Area occurrence of the cetacean (whales, dolphins, and porpoises) and pinniped species (seals) expected to occur in the proposed Project Area are provided below. Cetaceans include mysticetes (baleen whales) and odontocetes (toothed whales). The ESA-listed species include four endangered mysticetes - the North Atlantic right whale (NARW; *Eubalaena glacialis*), fin whale (*Balaenoptera physalus*), blue whale (*B. musculus*), and sei whale (*B. borealis*) - and one endangered odontocete - the sperm whale (*Physeter macrocephalus*). Of these ESA species, critical habitat has only been designated for the NARW. Non-ESA-listed species include two pinniped species (harbor seal [*Phoca vitulina*] and gray seal [*Halichoerus grypus*]), two mysticetes (humpback whale [*Megaptera novaeangliae*] and common minke whale [*B. acutorostrata*]), and eight odontocetes (common bottlenose dolphin [*Tursiops truncatus*], Atlantic spotted dolphin [*Stenella frontalis*], common dolphin [*Delphinus delphis*], Atlantic white-sided dolphin [*Lagenorhynchus acutus*], Risso’s dolphin [*Grampus griseus*], long-finned pilot whale [*Globicephala melas*], short-finned pilot whale [*G. macrorhynchus*], and harbor porpoise [*Phocoena phocoena*]).

Striped dolphins (*S. coeruleoalba*) are not expected to occur in the proposed Project Area due to this species’ known association with deeper waters and the lack of sightings recorded near the proposed Project Area. Striped dolphins were included in the habitat-based density models that NMFS generated for the Rhode Island/Massachusetts WEA using Atlantic Marine Assessment Program for Protected Species (AMAPPS) 2010-2017 data (Palka et al. 2021c). Average seasonal abundance estimates ranged from 0.5 individuals in the fall to 1.3 individuals in the summer (Palka et al. 2021c). Sightings recorded during these surveys (Palka et al. 2021a) were consistent with the known distribution of this species along the Continental Shelf edge and farther offshore (CETAP 1982). No striped dolphin sightings were recorded in or near the Rhode Island/Massachusetts WEA (Palka et al. 2021a) during these recent surveys or previous AMAPPS surveys (Hayes et al. 2020), and no sightings of this species were recorded in the proposed Project Area during recent geophysical surveys (Gardline 2021a; 2021b; Smultea Sciences 2020a; 2020b). In the NYB, no striped dolphins were sighted during the monthly NYSDEC surveys (March 2017 - February 2020) (Tetra Tech and LGL 2020), and sightings recorded during the NYSERDA digital aerial survey were primarily in deep waters (along the shelf break and farther offshore) (NYSERDA 2020).

Table 3.11-1. **Marine Mammals Expected to Occur in the Proposed Project Area**

Species [1]	Stock	ESA|MMPA Status [2, 3]	Stock Abundance	Annual M&SI[4]	Expected to Occur in SRWF, SRWEC-OCS, and SRWEC-NYS	Expected to Occur in Onshore Facilities
Blue whale (*Balaenoptera musculus*)	Western North Atlantic	E|S	402	0	Yes	No
North Atlantic right whale (*Eubalaena glacialis*)	Western North Atlantic	E|S	356; 338[5]	7.7	Yes	No
Humpback whale (*Megaptera novaeangliae*)	Gulf of Maine	None	1,396	12.15	Yes	No
Common minke whale (*Balaenoptera acutorostrata*)	Canadian east coast	None	21,968	10.6	Yes	No
Sei whale (*Balaenoptera borealis*)	Nova Scotia	E|S	6,292	0.8	Yes	No
Fin whale (*Balaenoptera physalus*)	Western North Atlantic	E|S	6,802	1.8	Yes	No
Sperm whale (*Physeter macrocephalus*)	North Atlantic	E|S	4,349	0	Yes	No
Common bottlenose dolphin (*Tursiops truncatus*)	Western North Atlantic Offshore	None	62,851	28	Yes	No
	Western North Atlantic Northern Migratory Coastal	S[6]	6,639	12.2–21.5	Yes	No
Atlantic spotted dolphin (*Stenella frontalis*)	Western North Atlantic	None	39,921	0	Yes	No
Common dolphin (*Delphinus delphis*)	Western North Atlantic	None	172,974	390	Yes	No
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	Western North Atlantic	None	93,233	27	Yes	No
Risso's dolphin (*Grampus griseus*)	Western North Atlantic	None	35,215	34	Yes	No
Long-finned pilot whale (*Globicephala melas*)	Western North Atlantic	None	39,215	9	Yes	No

Species [1]	Stock	ESA|MMPA Status [2, 3]	Stock Abundance	Annual M&SI[4]	Expected to Occur in SRWF, SRWEC-OCS, and SRWEC-NYS	Expected to Occur in Onshore Facilities
Short-finned pilot whale (*Globicephala macrorhynchus*)	Western North Atlantic	None	28,924	136	Yes	No
Harbor porpoise (*Phocoena phocoena*)	Gulf of Maine, Bay of Fundy	None	95,543	164	Yes	No
Harbor seal (*Phoca vitulina*)	Western North Atlantic	None	61,336	339	Yes	Yes
Gray seal (*Halichoerus grypus*)	Western North Atlantic	None	27,300	4,453	Yes	Yes

Notes: All stock information is based on the most recently available data included in the NOAA stock assessment report for 2022 (Hayes et al. 2023) and the last stock assessment report update for each stock (Hayes et al. 2022; Hayes et al. 2021; Hayes et al. 2020). Expected occurrence is based on known habitat associations, confirmed sightings, and the potential for occurrence regardless of how abundant or common.

[1] Naming convention follows the Society for Marine Mammalogy list of marine mammal species and subspecies (Committee on Taxonomy 2021).

[2] ESA Status: E = Endangered

[3] MMPA Status: S = Strategic

[4] M&SI = Total annual observed human-caused mortality and serious injury are mean annual figures for the period 2015–2019 derived from incidental fishery entanglement records and vessel strike records.

[5] The best estimate of abundance in the 2022 stock assessment report is 338 whales which is based on data through 30 November 2021 (Hayes et al. 2023). Based on data through December 2022, the most recent population estimate is 356 whales with a 95% credible interval range of 346 to 363 whales (Linden 2023).

[6] This stock is also designated as depleted under the MMPA due to the unusual mortality event (UME) in 1988-1989 which affected the western North Atlantic Coastal Stock of common bottlenose dolphins. The Northern Migratory Coastal Stock retains the depleted designation as a result of its origin from the western North Atlantic Coastal Stock (Hayes et al. 2021).

Table 3.11-2. **Abundance Estimates[1] of Marine Mammals Expected to Occur in the Proposed Project Area**

Species/Group	Annual SRWF	Winter SRWF	Spring SRWF	Summer SRWF	Fall SRWF
Blue whale[2]	0	0	0	0	0
North Atlantic right whale	2.71	4.64	5.29	0.33	0.59
Humpback whale	1.81	0.56	1.99	2.32	2.36
Common minke whale	7.81	1.54	13.59	12.04	4.07
Sei whale	0.74	0.58	1.55	0.26	0.59
Fin whale	3.08	2.69	2.71	5.42	1.48
Sperm whale	0.32	0.20	0.11	0.49	0.47
Common bottlenose dolphin	13.81	8.79	4.89	23.00	18.57
Atlantic spotted dolphin	0.80	0.09	0.03	0.27	2.80
Common dolphin	119.75	94.90	44.43	136.33	203.33
Atlantic white-sided dolphin	21.85	22.20	22.43	19.82	22.97
Risso's dolphin	0.81	1.33	0.34	0.55	1.02
Long-finned pilot whale[3]	2.94	N/A	N/A	N/A	N/A
Short-finned pilot whale[3]	2.94	N/A	N/A	N/A	N/A
Harbor porpoise	57.48	112.00	109.13	3.91	4.87
Seals (*Phocidae*)	144.05	290.00	217.67	23.91	44.63

1 The seasonal and annual abundance estimates provided in this table are average absolute estimates corrected for perception and availability bias. Seasons are defined as follows: spring (March through May), summer (June through August), fall (September through November), and winter (December through February). The estimates for the SRWF were derived from Duke University's Habitat-based Marine Mammal Density Models for the U.S. Atlantic (Roberts et al. 2016; Roberts et al. 2023) and include OCS Lease Area 0487 with a 10-km (6.2 mi) buffer. These models were updated in June 2022 and include survey effort data collected between 1992-2020 and the version 12 model the NARW.

2 Blue whale densities are not repeated in table through the rest of the document because the densities are so low, they appear as zero. Subsequent analysis is based on the assumption in the National Marine Fisheries Service proposed rule that blue whales may potentially occur in the proposed Project Area, albeit at extremely low numbers.

3 The estimates for pilot whales are based on the group pilot whales (*Globicephala* spp.) because the individual species were not modeled separately.

3.11.1.1 ESA-listed Species

Blue Whale: In the North Atlantic Ocean, the range of blue whales extends from the subtropics to the Greenland Sea. Blue whales have been detected and tracked acoustically in much of the North Atlantic, with most of the acoustic detections around the Grand Banks area of Newfoundland and west of the British Isles (Hayes et al. 2021). The blue whale is considered an occasional visitor to the U.S. EEZ (Hayes et al. 2020), which may represent the limits of its feeding range (CETAP 1982; Wenzel et al. 1988). This species is included for consistency with the determinations made in NOAA's proposed Letter of Authorization under the Marine Mammal Protection Act for the Sunrise Wind Project (88 *FR* 8997). Sightings on the Continental Shelf in southern New England are limited and include three sightings of probably the same blue whale southeast of Montauk Point during summer 1990 (Kenney and Vigness-Raposa 2010). Five blue whale sightings were recorded during the recent aerial surveys in the NYB for the NYSDEC and NYSERDA (NYSERDA 2020; Tetra Tech and LGL 2020). All sightings were in waters deeper than 203.4 ft (62 m) (NYSERDA 2020; Zoidis et al. 2021). Blue whales were not observed in the proposed Project Area during the recent Northeast Large Pelagic Survey Collaborative (NLPSC) aerial surveys which covered the Rhode Island and Massachusetts WEAs (Rhode Island/Massachusetts WEAs) (Kraus et al. 2016; O'Brien et al. 2021a; O'Brien et al. 2021b; Quintana et al. 2019; Stone et al. 2017). Blue whale vocalizations were sparsely detected from acoustic devices during winter (Kraus et al. 2016); however, due to the far detection range of a blue whale vocalization (more than 108 nm [more than 200 km]) (Kraus et al. 2016) and the lack of blue whale sightings during these recent surveys, these vocalizing blue whales were likely not within the proposed Project Area. During the recent AMAPPS studies, blue whales were sighted (Palka et al. 2021b) and acoustically detected along the shelf break as opposed to the shelf (Palka et al. 2021d) which supports the occurrence of blue whales in waters farther offshore than the proposed Project Area.

NARW: The NARW remains one of the most endangered large whales in the world with an estimated population size of 356 whales based on data through December 2022 (Linden 2023). Despite decades of protection, a combination of anthropogenic impacts and low calving rates continue to impede recovery of this species. Currently, the most significant threats to NARW survival include entanglement in fishing gear and collisions with vessels (Knowlton and Kraus 2001). Between 2003 and 2018, 43 mortalities documented between Florida and the Gulf of St. Lawrence were due to entanglement and vessel strikes (Sharp et al. 2019). NOAA declared an unusual mortality event (UME) for this species in 2017 (NOAA Fisheries 2023a). As of November 16, 2023, a total of 121 mortalities, serious injuries, and morbidities (sublethal injury and illness) of NARWs were documented. The UME is ongoing, and the primary cause appears to be human interactions, specifically vessel strikes or rope entanglements (NOAA Fisheries 2023a).

Ten seasonal management areas (SMAs) are designated along the United States east coast to protect NARWs from vessel strikes. Most vessels equal to or greater than 65 ft (19.8 m) in length are required to transit at speeds of 10 knots (11.5 mph) or less in these SMAs during certain times of the year (NMFS 2008). The SMA in Block Island Sound overlaps with the proposed Project Area; the mandatory speed restriction for this area is in effect from November 1 through April 30. In addition, speed restrictions are encouraged in Dynamic Management Areas (DMAs) and NARW Slow Zones which are triggered by the presence of NARWs.

This species ranges widely across the Northwest Atlantic Ocean mostly along the United States and Canadian coasts. Generally, NARWs travel along the coast annually moving between the northern portions of the range where they feed and the southern portions, which support calving and breeding (Brown 1986; Jefferson et al. 2015; Winn et al. 1986). Critical habitat is designated in NARW foraging areas in the Gulf of Maine and Georges Bank region and calving areas off the southeast U.S. coast (NMFS 2016a) (Figure 3.11-1). NARW occurrence is concentrated in these areas in February through June and November through March, respectively (Hamilton and Mayo 1990; Kenney et al. 1995; Nichols et al. 2008; Winn et al. 1986); however, not all individuals in the population complete this migration, and the seasonal distribution of many whales is unknown. NARWs are often detected in these well-known habitat areas outside of the 'typical' time periods (Kenney 2001; Patrician et al. 2009; Winn et al. 1986). NARWs have been recorded in the Mid-Atlantic year-round (e.g., Estabrook et al. 2021; O'Brien et al. 2021a; Quintana et al. 2019; Whitt et al. 2013). Some individuals have been sighted throughout the fall and winter on the northern feeding grounds, and a large portion of the population may spend the winter in several northern areas, such as the Gulf of Maine and Cape Cod Bay (Clark et al. 2010; Cole et al. 2013; Mussoline et al. 2012). Results from a recent study using long-term acoustics data (2004-2014) confirmed the year-round presence of NARWs across their entire range, an increase in NARW presence in the Mid-Atlantic region since 2010, and a simultaneous decrease in presence in the northern Gulf of Maine (Davis et al. 2017).

The proposed Project Area is part of the NMFS-designated migratory corridor biologically important area for the NARW(LaBrecque et al. 2015). NARW high-use areas have recently been identified in the Gulf of St. Lawrence and south of Cape Cod (Figure 3.11-1; Table 3.11-2), which includes the proposed Project Area. Based on survey and acoustics data collected during the NLPSC study in the Rhode Island/Massachusetts WEAs, NARWs were recorded in the WEAs year-round, and hot spots of NARW occurrence were identified within the WEAs and nearby on Nantucket Shoals (Kraus et al. 2016; O'Brien et al. 2021a; O'Brien et al. 2021b; Quintana et al. 2019; Stone et al. 2017). This study confirmed the use of this area by adults, juveniles, and mom-calf pairs with multiple whales resighted across months and years (Kraus et al. 2016; O'Brien et al. 2021a; Stone et al. 2017). As many as 137 individual whales have been identified based on preliminary photo analyses (O'Brien et al. 2021a). Both feeding and courtship behaviors (Surface Active Groups) were observed (Kraus et al. 2016; Stone et al. 2017). Oceanographic survey results indicate that the zooplankton community composition in the Massachusetts WEA is similar to that of Cape Cod Bay (Quintana et al. 2019), a well-known feeding, socializing, and nursery area for NARWs (Mayo et al. 2018). Based on survey data, higher abundances are expected in the proposed Project Area during winter and spring compared to the other seasons (Table 3.11-2). This estimated abundance is consistent with mean monthly acoustic detections in this region which have been higher during January through March and lower during July through September (Kraus et al. 2016; Stone et al. 2017) and the peak abundance recorded in the NYB during April and December (Zoidis et al. 2021).

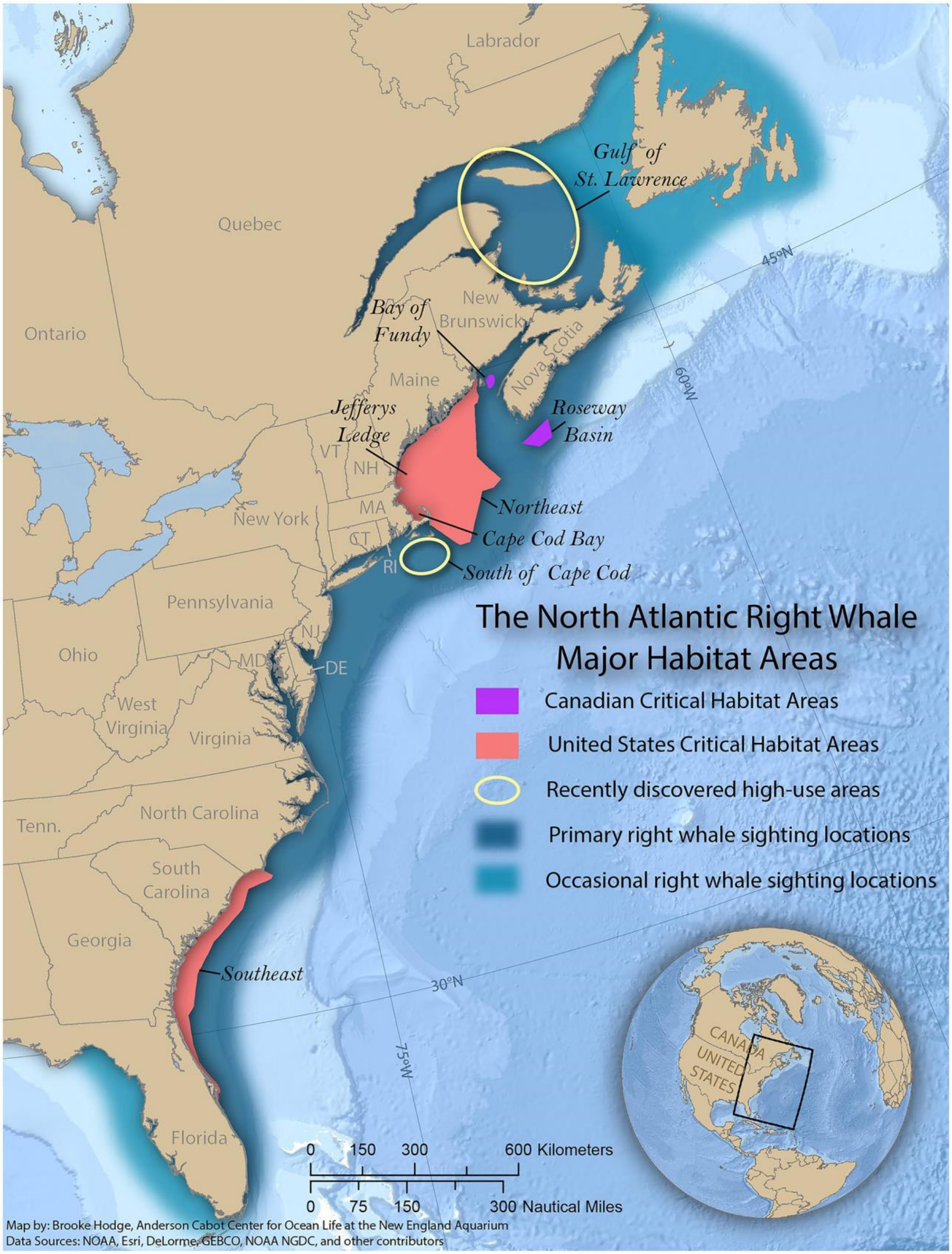


Figure 3.11-1. Critical Habitats and Other High-use Areas of the North Atlantic Right Whale Map

Sei Whale: Sei whales are often found in oceanic waters but do occur on the Continental Shelf (Horwood 1987; Hayes et al. 2022). In the western North Atlantic Ocean, sei whales range primarily from Georges Bank north to Davis Strait (northeast Canada, between Greenland and Baffin Island) (Perry et al. 1999). During the spring, sei whale abundance in United States waters increases, and sightings are concentrated along the eastern margin of Georges Bank, into the Northeast Channel area, south of Nantucket, and along the southwestern edge of Georges Bank (CETAP 1982; Palka et al. 2021c; Roberts et al. 2016). Peak abundance in the proposed Project Area is estimated to be during spring (Table 3.11-2) although sei whales may occur in this region throughout the year. AMAPPS 2010-2017 surveys recorded sei whales in or near the Rhode Island/Massachusetts WEAs during spring and summer (Palka et al. 2021a). The sei whale was the least common baleen whale species recorded during the NYSDEC and NLPSC studies. In the NYB, this species was sighted during spring (Tetra Tech and LGL 2020) and acoustically detected primarily during March, April, and May (Estabrook et al. 2021). The NYSERDA surveys recorded sei whales during August, February/March, and April/May; individuals were observed as close as 11.5 mi to 23 mi (10 nm to 20 nm) from Long Island (NYSERDA 2020). In the Rhode Island/Massachusetts WEAs, sei whales, including calves, were sighted in spring and summer (March through June) (Kraus et al. 2016; O'Brien et al. 2021a; Quintana et al. 2019; Stone et al. 2017), and feeding behavior was observed (Kraus et al. 2016; Stone et al. 2017).

Fin Whale: Fin whales are common year-round in United States Atlantic EEZ waters, particularly north of Cape Hatteras (Davis et al. 2020; Edwards 2015). Fin whales may occur in the proposed Project Area during any time of the year. Peak abundance in the proposed Project Area is estimated to be during summer (Table 3.11-2) which coincides with peak abundance of this species in the NYB (Zoidis et al. 2021). AMAPPS 2010-2017 surveys recorded fin whales in or near the Rhode Island/Massachusetts WEAs during spring and summer (Palka et al. 2021a). Fin whales were commonly detected year-round during recent NYB studies (Estabrook et al. 2021; NYSERDA 2020; Tetra Tech and LGL 2020). Although visual surveys recorded some seasonal variations in occurrence, acoustic detections were nearly continuous throughout the year (Estabrook et al. 2021). Fin whales are known to feed in this region; a feeding biologically important area for fin whales is designated March to October east of Montauk Point (LaBrecque et al. 2015). Feeding behavior has been observed in/near the proposed Project Area (Kraus et al. 2016; Stone et al. 2017). During the Rhode Island/Massachusetts WEA studies, fin whales were sighted and acoustically detected year-round with peak sightings recorded between April and August (Kraus et al. 2016; O'Brien et al. 2021a; O'Brien et al. 2021b; Quintana et al. 2019; Stone et al. 2017). At least three sightings of fin whale calves have been recorded in this region (Kraus et al. 2016; Stone et al. 2017).

Sperm Whale: Sperm whales are frequently sighted seaward of the Continental Shelf off the eastern United States (CETAP 1982; Kenney and Winn 1987; Waring et al. 1993). Although females are rarely sighted in shallow waters over the Continental Shelf (Whitehead 2003), adult males are known to inhabit shallow waters of 328 ft (100 m) or less in portions of their range (Croll et al. 1999; Garrigue and Greaves 2001; Scott and Sadove 1997; Whitehead et al. 1992). Regular sightings of sperm whales are well documented in shallow shelf waters (average water depth of 55 m) southeast of Montauk Point during spring, summer, and fall (Scott and Sadove 1997). It is thought that sperm whales may use this area as foraging habitat since sightings are concentrated in the channel between Block Island Sound and Block Canyon where there is a localized abundance of squid (Scott and Sadove 1997).

Sperm whales may occur in the proposed Project Area during any time of the year; however, peak abundance is estimated to be during summer and fall (Table 3.11-2). Sperm whales have been recorded year-round in the NYB (Estabrook et al. 2021; NYSERDA 2020; Tetra Tech and LGL 2020) with peak abundance during summer (Zoidis et al. 2021). During the AMAPPS 2010-2017 and NLPSC surveys, sperm whales were sighted in or near the Rhode Island/Massachusetts WEAs during summer and fall (Kraus et al. 2016; O'Brien et al. 2021a; Palka et al. 2021a; Stone et al. 2017) Sleeping behaviors were observed in relatively shallow waters during the NLPSC studies (O'Brien et al. 2021a).

3.11.1.2 Non-ESA-Listed Species

Humpback Whale: In the western North Atlantic, humpback whales feed during spring, summer and fall over a geographic range encompassing the eastern coast of the United States including the Gulf of Maine, the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland (Katona and Beard 1990). Feeding also occurs in the Mid-Atlantic (Aschettino et al. 2020; Barco et al. 2002; Brown et al. 2018). During the winter, most of the North Atlantic population of humpback whales is believed to migrate south to calving grounds in the West Indies region (Smith et al. 1999; Stevick et al. 2003; Whitehead and Moore 1982); however, not all humpbacks migrate to the calving grounds every winter. Winter sightings of humpbacks are common in coastal waters of the southeastern United States and Mid-Atlantic (Aschettino et al. 2020; Brown et al. 2018; Zeh et al. 2021; Zoodsma et al. 2016). Since January 2016, NOAA has investigated a UME for humpback whales due to elevated numbers of strandings along the United States Atlantic coast (NOAA Fisheries 2022a). From Maine to Florida, 156 humpback whale strandings were recorded thus far. Results of necropsy examinations on approximately half of the whales reveal human interactions such as ship strike or entanglement (NOAA Fisheries 2022a).

Humpback whales may occur in the proposed Project Area during any time of the year; lowest abundance in the proposed Project Area is estimated to be during winter (Table 3.11-2). Humpback whales were recorded year-round throughout the NYB (NYSERDA 2020; Tetra Tech and LGL 2020), including as close to shore as 5.75 mi (5 nm) from Long Island (NYSERDA 2020). Acoustic presence was highest during the fall and summer (Estabrook et al. 2021), and abundance based on visual detections was highest during spring (Zoidis et al. 2021). In the NYB, probable foraging included bubble-net feeding and was the most common behavior observed and occurred during spring (May) and summer (June and July) (Tetra Tech and LGL 2020). AMAPPS 2010-2017 surveys recorded humpback whales in or near the Rhode Island/Massachusetts WEAs during all seasons except winter (Palka et al. 2021a). Humpbacks were sighted in the proposed Project Area in all seasons during recent geophysical surveys (Gardline 2021a; 2021b; Smultea Sciences 2020a; 2020b). Feeding and courtship behaviors were observed during the NLPSC surveys in the Rhode Island/Massachusetts WEAs (Kraus et al. 2016; O'Brien et al. 2021b; Stone et al. 2017). During these surveys, humpback whales were visually and acoustically detected year-round with peak sightings in spring and summer and high monthly acoustic presence December through June (Kraus et al. 2016; O'Brien et al. 2021a; O'Brien et al. 2021b; Quintana et al. 2019; Stone et al. 2017). Calves were observed in this area during spring and summer months (Kraus et al. 2016; Stone et al. 2017).

Common Minke Whale: Common minke whales (hereafter referred to as minke whales in this document) are widely distributed in the United States Atlantic EEZ (CETAP 1982). Since January 2017, NOAA has investigated a UME for minke whales due to elevated numbers of strandings along the United States Atlantic coast from Maine through South Carolina (NOAA Fisheries 2022b). A total of 122 minke whale strandings were recorded thus far. Preliminary examinations reveal evidence of human interactions or infectious diseases (NOAA Fisheries 2022b).

Minke whales may occur in the proposed Project Area during any time of the year; highest abundance in the proposed Project Area is estimated to be during spring and summer (Table 3.11-2). In the NYB, sightings have been recorded on the Continental Shelf year-round (NYSERDA 2020; Tetra Tech and LGL 2020). Sighting rates for minke whales were highest in the summer (Tetra Tech and LGL 2020). AMAPPS 2010-2017 surveys recorded minke whales in or near the Rhode Island/Massachusetts WEAs during all seasons except winter (Palka et al. 2021a). Feeding behaviors were observed during the NLPSC surveys in the Rhode Island/Massachusetts WEAs (Kraus et al. 2016; Stone et al. 2017). During these surveys, minke whales were visually and acoustically detected year-round and were widely dispersed throughout the study area (Kraus et al. 2016; O'Brien et al. 2021a; O'Brien et al. 2021b; Quintana et al. 2019; Stone et al. 2017). Calves were sighted during spring/summer (Kraus et al. 2016; Stone et al. 2017).

Common Bottlenose Dolphin: Common bottlenose dolphins (hereafter referred to as bottlenose dolphins) from the Western North Atlantic offshore stock and Western North Atlantic northern migratory coastal stock may occur in the proposed Project Area. Although individuals were sighted as close to shore as 4.5 mi (7.3 km) in water depths of 55 ft (16.8 m) (Garrison et al. 2003), the offshore stock is primarily distributed along the OCS and continental slope from Florida to Georges Bank with confirmed sightings as far north as the Scotian Shelf (CETAP 1982; Hayes et al. 2020; Kenney 1990). The northern coastal migratory stock occurs in estuarine, coastal, and shelf waters from Cape Lookout, North Carolina to Long Island, New York (Hayes et al. 2018) with possible extralimital occurrences as far north as Cape Cod Bay (Wiley et al. 1994). Based on the known ranges of these two stocks, bottlenose dolphins sighted in or near the proposed Project Area are most likely to be part of the offshore stock; however, sightings of the migratory coastal stock are possible given the location of the proposed Project Area in relatively shallow, nearshore waters, the probable sightings as far north as Cape Cod Bay, and the potential for range shifts due to climate change.

Bottlenose dolphins may occur in the proposed Project Area during any time of the year; highest abundance in the proposed Project Area is estimated to be during summer and fall (Table 3.11-2). This species has been sighted year-round in the NYB (NYSERDA 2020). AMAPPS 2010-2017 surveys recorded bottlenose dolphins in the Rhode Island/Massachusetts WEAs during all seasons except winter when sightings were mostly south of Long Island (Palka et al. 2021a), which coincides with the more southernly distribution of the migratory coastal stock during this time of year (Hayes et al. 2018). During the NLPSC surveys in the Rhode Island/Massachusetts WEAs, bottlenose dolphins were sighted year-round (Kraus et al. 2016; Quintana et al. 2019; Stone et al. 2017) and calves and mating behaviors were observed (Kraus et al. 2016; Stone et al. 2017).

Atlantic Spotted Dolphin: In the western North Atlantic, Atlantic spotted dolphins range from northern New England to Venezuela, including the Gulf of Mexico and the Caribbean Sea (Perrin et al. 1987). They are observed in Continental Shelf and slope waters (Hayes et al. 2020; Mullin and Fulling 2003; Payne et al. 1984). This species has been sighted in the NYB in waters deeper than 229.6 ft (70 m) in November, May, and April/May (NYSERDA 2020). Peak abundance in the proposed Project Area is estimated to be during summer and fall (Table 3.11-2). Atlantic spotted dolphins were not recorded in the AMAPPS 2010-

2017 surveys in or near the Rhode Island/Massachusetts WEAs; the closest sightings were recorded offshore of the WEAs during summer (Palka et al. 2021a). Atlantic spotted dolphins were not recorded during the NLPSC surveys in 2011-2015 or 2017-2019 (Kraus et al. 2016; O'Brien et al. 2021a; O'Brien et al. 2021b; Quintana et al. 2019; Stone et al. 2017). During geophysical surveys, a sighting of four dolphins was recorded as "possible Atlantic spotted dolphins" in the proposed Project Area in December 2019 (Smultea Sciences 2020b).

Common Dolphin: Off the United States and Canadian east coasts, common dolphins range from the Georgia/South Carolina border to Newfoundland (Jefferson et al. 2009). Along the United States Atlantic coast, common dolphins typically occur in temperate waters on the Continental Shelf between the 328 and 656 ft (100 and 200 m) isobaths but also associate with the Gulf Stream (CETAP 1982; Selzer and Payne 1988; Waring and Palka 2002). This species is sighted year-round throughout the NYB (NYSERDA 2020; Tetra Tech and LGL 2020). The AMAPPS 2010-2017 surveys recorded common dolphins in or near the Rhode Island/Massachusetts WEAs throughout the year (Palka et al. 2021a). This species was sighted in all seasons during Project-specific geophysical surveys (Gardline 2021a; 2021b; Smultea Sciences 2020a; 2020b). The common dolphin was the most frequently sighted dolphin species during the NLPSC surveys in the Rhode Island/Massachusetts WEAs (Kraus et al. 2016; Stone et al. 2017). Sightings were year-round and scattered throughout the WEAs (O'Brien et al. 2021a; Quintana et al. 2019). Calves, feeding behaviors, and mating behaviors were observed (Kraus et al. 2016; O'Brien et al. 2021b; Stone et al. 2017). The lowest abundance of common dolphins in the proposed Project Area is estimated to be during spring (Table 3.11-2), which coincides with the lower number of nearshore sightings recorded in the NYB during April and May (NYSERDA 2020).

Atlantic White-sided Dolphin: Off the east coast of the United States, Atlantic white-sided dolphins are most common over the Continental Shelf from Hudson Canyon north to the Gulf of Maine (Palka et al. 1997). Virginia and North Carolina appear to represent the southern edge of their range, and peak occurrence in the Mid-Atlantic is thought to be during spring and summer (Testaverde and Mead 1980). This species is found primarily in Continental Shelf waters up to 328-ft- (100-m) deep (CETAP 1982; Mate et al. 1994; Selzer and Payne 1988). Sightings in the NYB were recorded in shelf waters deeper than 229.6 ft (70 m) during fall (November) and winter (February/March/April) (NYSERDA 2020). Atlantic white-sided dolphins may occur in the proposed Project Area throughout the year (Table 3.11-2). This species was recorded in the proposed Project Area in June during geophysical surveys (Gardline 2021a). The AMAPPS 2010-2017 surveys recorded Atlantic white-sided dolphins in or near the Rhode Island/Massachusetts WEAs during spring and fall (Palka et al. 2021a). During the NLPSC surveys in or near the Rhode Island/Massachusetts WEAs, this species was sighted during all seasons except winter (Kraus et al. 2016; O'Brien et al. 2021a; O'Brien et al. 2021b; Quintana et al. 2019).

Pilot Whales: Pilot whales are typically distributed along the Continental Shelf break; however, movements over the Continental Shelf are commonly observed in the northeastern United States (CETAP 1982; Hayes et al. 2022; Payne and Heinemann 1993). The exact latitudinal ranges of the two species of pilot whales, short-finned pilot whales and long-finned pilot whales, remain uncertain (Hayes et al. 2022). In general, pilot whales sighted south of Cape Hatteras are expected to be short-finned pilot whales, while those sighted north of approximately 42 degrees north are expected to be long-finned pilot whales (Garrison and Rosel 2017); however, long-finned pilot whales are known to strand as far south as Florida, and short-finned pilot whales have stranded as far north as Massachusetts (Pugliares et al. 2016). The apparent ranges of the two pilot whale species overlap along the Mid-Atlantic shelf break between Delaware and the southern flank of Georges Bank (Payne and Heinemann 1993; Rone et al. 2012). Tagged short-finned pilot whales ranged along the shelf break as far north as Nantucket Shoals and Georges Bank (Thorne et al. 2017). Distinguishing between the two species of pilot whales during visual surveys is difficult; sightings often cannot be confidently identified to the species level and are recorded as “pilot whale spp.” or “*Globicephala* spp.”

Due to the uncertainty of the exact ranges of these species, the potential for range shifts due to climate change, and the difficulty distinguishing between these species in the field, both species are included as expected to occur in the proposed Project Area. Pilot whales may occur during all seasons based on historical occurrence records in this region (see DoN 2005; Kenney and Vigness-Raposa 2010). Peak abundance in the Rhode Island/Massachusetts WEAs is during the summer (Palka et al. 2021c). During the NLPSC surveys in and near the Rhode Island/Massachusetts WEAs, pilot whales, including calves, were sighted during spring and summer (Kraus et al. 2016; O’Brien et al. 2021a; Quintana et al. 2019). During recent surveys in the nearby NYB, pilot whales were sighted during all seasons except winter (NYSERDA 2020; Tetra Tech and LGL 2020), however, short-finned pilot whales were sighted in August (NYSERDA 2020).

Risso’s Dolphin: Risso’s dolphins are primarily distributed along the Continental Shelf edge from Cape Hatteras, North Carolina, northward to Georges Bank during the spring, summer, and fall (CETAP 1982; Payne et al. 1984). During winter, their range begins at the Mid-Atlantic Bight and extends into oceanic waters (Payne et al. 1984). In the NYB, Risso’s dolphins were observed year-round. The NYSDEC surveys recorded sightings on the shelf and seaward of the shelf break (Tetra Tech and LGL 2020). Sightings recorded during the NYSERDA surveys were in waters deeper than the 295-ft (90-m) isobath (NYSERDA 2020). Peak abundance in the proposed Project Area is estimated to be during winter and fall (Table 3.11-2). The AMAPPS 2010-2017 surveys recorded Risso’s dolphins in or near the Rhode Island/Massachusetts WEAs during summer and fall (Palka et al. 2021a). During NLPSC surveys in the WEAs, three sightings of Risso’s dolphins were recorded in April 2012 just east of the proposed Project Area in the northern portion of the Massachusetts WEA (Kraus et al. 2013). Risso’s dolphins were not sighted during the other NLPSC aerial surveys in 2011, remaining of 2012, 2013-2015 (Kraus et al. 2016; O’Brien et al. 2021a; O’Brien et al. 2021b; Quintana et al. 2019; Stone et al. 2017).

Harbor Porpoise: Off the United States east coast, harbor porpoises primarily range from Maine to North Carolina (CETAP 1982; Hayes et al. 2021; Northridge 1996). They occur most frequently over the Continental Shelf (Jefferson et al. 2015; Read 1999). Harbor porpoises have been sighted year-round in the NYB, primarily on the shelf and during winter and spring (NYSERDA 2020; Tetra Tech and LGL 2020). The AMAPPS 2010-2017 surveys recorded harbor porpoises in or near the Rhode Island/Massachusetts WEAs during all seasons except summer (Palka et al. 2021a). The NLPSC surveys in these WEAs recorded harbor porpoise sightings year-round (Kraus et al. 2016; Quintana et al. 2019; Stone et al. 2017). Abundance in the proposed Project Area is estimated to be lowest during summer and fall (Table 3.11-2). From July through September, harbor porpoises are known to concentrate in the northern Gulf of Maine and southern Bay of Fundy (Palka 1995) with a few sightings in the upper Bay of Fundy and on the northern edge of Georges Bank (Palka 2000); however, sighting trends have shown more frequent sightings during summer in some years. Between October 2011 and June 2015, most harbor porpoise sightings were recorded from November through May (Kraus et al. 2016; Stone et al. 2017). Between February 2017 and July 2018, the highest number of sightings were during August 2017 (Quintana et al.

2019), and between March 2020 and October 2020, only two harbor porpoises were sighted, and they were seen during summer (O'Brien et al. 2021b).

Harbor Seal: In the western North Atlantic, harbor seals occur year-round along the coasts of eastern Canada and Maine (Baird 2001; Boulva 1973; Gilbert and Guldager 1998; Katona et al. 1993; Zoidis et al. 2022) and seasonally along the coasts of southern New England to Virgina from September through late May (Jones and Rees 2021; Schneider and Payne 1983; Schroeder 2000; Toth et al. 2018). Between July 2018 and March 2020, the Northeast Pinniped UME included 3,152 seal strandings from Maine to Virginia; 172 of these seals stranded off New York (NOAA Fisheries 2022d). Although most mortalities were of harbor and gray seals, some harp and hooded seal strandings were also added to this UME. The pathogen phocine distemper virus was found in the majority of deceased seals and, based on this finding, has been identified as the cause of the UME. This 2018–2022 UME is non-active with closure pending (NOAA Fisheries 2022d). Since June 2022, another UME for harbor, gray, and harp seals has been declared by NMFS off the southern and central coast of Maine, with 492 seal strandings between 1 June 2022 and 16 July 2023 (NOAA Fisheries 2023b). Preliminary testing has found some of the harbor and gray seals affected by this UME to be positive for highly pathogenic avian influenza H5N1 (NOAA Fisheries 2023b).

Haul-out sites near the proposed Project Area are on Block Island and Long Island (Kenney and Vigness-Raposa 2010; Schroeder 2000). Recent aerial surveys of pinniped haul-out sites in this region identified over 900 harbor and gray seals in Moriches Bay, Shinnecock Bay, Montauk, Fisher's Island, Little Gull Island, Block Island, and Narragansett Bay (Atlantic Marine Conservation Society 2016). Harbor seals have been sighted during recent surveys in the NYB in winter 2016/2017 (February/March), winter 2017/2018 (March/April), and spring 2019 (April/May) (NYSERDA 2020). Unidentified seals, likely harbor or gray seals based on known distributions, were also sighted during spring and summer surveys (NYSERDA 2020; Tetra Tech and LGL 2020). The AMAPPS 2010-2017 surveys recorded harbor seals in and near the Rhode Island/Massachusetts WEAs (Palka et al. 2021b). During the NLPSC 2011-2015 aerial surveys of the Rhode Island/Massachusetts WEAs, harbor seals were sighted in August 2013 and February 2014 (Kraus et al. 2014). Harbor seals may occur in the proposed Project Area year-round based on the known seasonal occurrence of this species in southern New England during fall, winter, and spring; sightings in the Rhode Island/Massachusetts WEAs during summer (Kraus et al. 2014); and sightings in or near the proposed Project Area during winter, spring, and fall (Gardline 2021a; Smultea Sciences 2020a; 2020b). Peak abundance of seals in the proposed Project Area is estimated to be during winter and spring (Table 3.11-2).

Gray Seal: Along the east coast of the United States, gray seals range from Maine to North Carolina (Hammill et al. 1998; Harry et al. 2005; Hayes et al. 2021; Katona et al. 1993; Lesage and Hammill 2001). As mentioned previously, gray seals were part of the Northeast Pinniped UME which included 3,152 seal strandings from Maine to Virginia between July 2018 and March 2020 (NOAA Fisheries 2022d). Of these strandings, 172 were off New York (NOAA Fisheries 2022d). Although most mortalities were of harbor and gray seals, some harp and hooded seal strandings were also added to this UME. The pathogen phocine distemper virus was found in the majority of deceased seals and, based on this finding, has been identified as the cause of the UME. This 2018–2022 UME is non-active with closure pending (NOAA Fisheries 2022d). Since June 2022, another UME for harbor, gray, and harp seals has been declared by NMFS off the southern and central coast of Maine, with 492 seal strandings between 1 June 2022 and 16

July 2023 (NOAA Fisheries 2023b). Preliminary testing has found some of the harbor and gray seals affected by this UME to be positive for highly pathogenic avian influenza H5N1 (NOAA Fisheries 2023b).

Pupping sites in the United States are in Maine and Massachusetts; the closest site to the proposed Project Area is Noman's Land southwest of Martha's Vineyard (Wood et al. 2020). Recent aerial surveys of pinniped haul-out sites in this region identified over 900 harbor and gray seals in Moriches Bay, Shinnecock Bay, Montauk, Fisher's Island, Little Gull Island, Block Island, and Narragansett Bay (Atlantic Marine Conservation Society 2016). In the NYB, gray seals were recorded during winter and spring, and unidentified seals, likely harbor or gray seals based on known distributions, were sighted during spring and summer (NYSERDA 2020; Tetra Tech and LGL 2020). Gray seals may occur in the proposed Project Area during all seasons; peak abundance of seals in the proposed Project Area is estimated to be during winter and spring (Table 3.11-2). The AMAPPS 2010-2017 surveys recorded gray seals in and near the Rhode Island/Massachusetts WEAs (Palka et al. 2021b). The NLPSC surveys in these WEAs recorded gray seals during winter and spring (Kraus et al. 2014). Project-specific geophysical surveys recorded gray seals in or near the proposed Project Area during every season (Gardline 2021a; 2021b; Smultea Sciences 2020a; 2020b).

3.11.2 Impact Level Definitions for Marine Mammals

This Final EIS uses a four-level classification scheme to analyze potential impact levels on marine mammals from the alternatives, including the Proposed Action. Table 3.11-3 lists the definitions for both the potential adverse impact levels and potential beneficial impact levels for marine mammals. Table G-10 in Appendix G identifies potential IPFs, issues, and indicators to assess impacts to marine mammals. Impacts are categorized as beneficial or adverse and may be short-term or long-term in duration. Short-term impacts may occur over a period of a year or less. Long-term impacts may occur throughout the duration of a project.

Table 3.11-3. Definition of Potential Adverse and Beneficial Impacts for Marine Mammals

Impact Level	Definition of Potential Adverse Impact Levels	Definition of Potential Beneficial Impact Levels
Negligible	The impacts on individual marine mammals and/or their habitat, if any, would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or the population.	Impacts on individual marine mammals and/or their habitat would be beneficial but at the lowest levels of detection and barely measurable.
Minor	Impacts on individual marine mammals and/or their habitat are detectable and measurable; however, they are of low intensity, short-term, and localized. Impacts on individuals and/or their habitat do not lead to population-level effects.	Impacts on individual marine mammals and/or their habitat are detectable and measurable. The effects are likely to benefit individuals, be localized, and/or be short-term and are unlikely to lead to population-level effects.
Moderate	Impacts on individual marine mammals and/or their habitat are detectable and measurable; they are of medium intensity, can be short-term or long-term, and can	Impacts on individual marine mammals and/or their habitat are detectable and measurable. These benefits may affect large areas of habitat, be long-term, and/or affect

Impact Level	Definition of Potential Adverse Impact Levels	Definition of Potential Beneficial Impact Levels
	be localized or extensive. Impacts on individuals and/or their habitat could have population-level effects, but the population can sufficiently recover from the impacts or enough habitat still is functional to maintain the viability of the species both locally and throughout their range.	a large number of individuals and may lead to a detectable increase in populations but is not expected to improve the overall viability or recovery of affected species or population.
Major	Impacts on individual marine mammals and/or their habitat are detectable and measurable; they are of severe intensity, can be long-lasting or permanent, and are extensive. Impacts to individuals and/or their habitat would have severe population-level effects and compromise the viability of the species.	Impacts on individual marine mammals and/or their habitat are detectable and measurable. These impacts on habitat may be short-term, long-term, or permanent and would promote the viability of the affected species/population and/or increase the affected species/population levels.

3.11.3 Impacts of Alternative A - No Action on Marine Mammals

When analyzing the impacts of the No Action Alternative on marine mammals, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for marine mammals. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E.

3.11.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for marine mammals would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Marine mammals in the GAA are currently subject to a variety of ongoing human-caused IPFs. The main known contributors to mortality events include collisions with vessels (ship strikes), entanglement with fishing gear, and fisheries bycatch. Other important IPFs considered include underwater noise from anthropogenic sources, pollution (accidental spills and waste discharge), and climate change. Many marine mammal migrations cover long distances, and these factors can have impacts on individuals over broad geographic and temporal scales. Climate change represents a persistent and ongoing issue that dominates environmental trends. Impacts associated with climate change have the potential to reduce reproductive success and increase individual mortality and disease occurrence, which could have population-level effects for all marine mammals.

Ongoing offshore wind activities within the GAA that contribute to impacts on marine mammals include:

- Continued O&M of the Block Island project (5 WTGs) installed in State waters,
- Continued O&M of the CVOW project (2 WTGs) installed in OCS-A 0497, and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of Block Island and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect marine mammals 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 the following section for planned offshore wind activities, but the impacts would be of lower intensity.

Traffic (vessel strikes): Studies indicate that maritime activities can have adverse effects on marine mammals due to vessel strikes (Laist et al. 2001; Moore and Clarke 2002). Almost all sizes and classes of vessels have been involved in collisions with marine mammals around the world, including large container ships, ferries, cruise ships, military vessels, recreational vessels, commercial fishing boats, whale-watch vessels, research vessels, and even jet-skis (Dolman et al. 2006). Research into vessel strikes and marine mammals focused largely on baleen whales given their higher susceptibility to a strike because of their larger size, slower maneuverability, larger proportion of time spent at the surface foraging, and inability to actively detect vessels using sound (i.e., echolocation). Focused research on vessels strikes on toothed whales is lacking. Factors that affect the probability of a marine mammal vessel strike and its severity include number, species, age, size, speed, health, and behavior of animal(s) (Martin et al. 2016; Vanderlaan and Taggart 2007); number, speed, and size of vessel(s) (Martin et al.

2016; Vanderlaan and Taggart 2007); habitat type characteristics (Vanderlaan and Taggart 2007); operator's ability to avoid collisions (Martin et al. 2016); vessel path (Martin et al. 2016; Vanderlaan and Taggart 2007); and the ability of a marine mammal to detect and locate the sound of an approaching vessel.

Vessel speed and size are important factors for determining the probability and severity of vessel strikes. The size and bulk of the large vessels inhibit the ability for the crew to detect and react to marine mammals along the vessel's transit route. In 93 percent of marine mammal collisions with large vessels reported in Laist et al. (2001), whales were either not seen beforehand or were seen too late to be avoided. Laist et al. (2001) reported that most lethal or severe injuries are caused by ships 262-ft-long (80-m) or longer traveling at speeds greater than 15 mph (13 knots). A more recent analysis conducted by Conn and Silber (2013) built upon collision data collected by Vanderlaan and Taggart (2007) included new observations of serious injury to marine mammals as a result of vessel strikes at lower speeds (e.g., 2.3 mph and 6.3 mph (2 knots and 5.5 knots). The relationship between lethality and strike speed was still evident; however, the speeds at which 50 percent probability of lethality occurred was approximately 10 mph (9 knots).

Smaller vessels have been involved in marine mammal collisions. Minke, humpback, and fin whales have been killed or fatally wounded by whale-watching vessels around the world (Jensen et al. 2003). Strikes occurred when whale-watching boats were actively watching whales as well as when they were transiting through an area, with the majority of reported incidences occurring during active whale-watching activities (Jensen et al. 2003; Laist et al. 2001).

In general, large baleen whales are more susceptible to a vessel strike than smaller cetaceans and pinnipeds. While there are rare reports of toothed whales being struck by ships (Van Waerebeek et al. 2007; Wells and Scott 1997), these animals are at relatively low risk due to their speed and agility (Richardson et al. 1995). Pinnipeds are also fast and maneuverable in the water and have sensitive underwater hearing, enabling them to avoid being struck by approaching vessels (Jensen et al. 2003; Laist et al. 2001). There are very few documented cases of seal or sea lion mortalities because of vessel strikes in the literature (Richardson et al. 1995). Large whales are more susceptible to vessel strikes than other marine mammals due to their large size, slower travel and maneuvering speeds, lower avoidance capability, and increased proportion of time they spend near the surface (Laist et al. 2001; Vanderlaan and Taggart 2007). In the marine mammal GAA, baleen whales at risk of collision include humpback whales, fin whales, blue whales, sei whales, sperm whales, and, to a lesser extent, minke whales due to their smaller size (Hayes et al. 2020; Hayes et al. 2021).

In 2017, vessel strikes were thought to be a leading cause of a UME for the NARW. A total of 34 individuals died during this time. As a result, in 2008, NMFS implemented a seasonal, mandatory vessel speed rule in certain areas along the United States East Coast to reduce the risk of vessel collisions with NARWs. These SMAs require vessel operators to maintain speeds of 11.5 mph (10 knots) or less and to avoid SMAs when possible. Effectiveness of the program was reviewed by NMFS in 2020. Results indicated that while it was not possible to determine a direct causal link, the mortality and serious injury incidents on a per-capita basis suggest a downward trend in recent years (NMFS 2020).

The impacts of traffic (vessel strikes) on mysticetes, with the exception of NARWs, from ongoing activities (from any vessel) would be moderate because it is likely to result in long-term consequences to individuals or populations that are detectable and measurable. Impacts of traffic (vessel strikes) on individual mysticetes could have population-level effects, but the population should sufficiently recover. BOEM notes that not all populations (e.g., minke whales, fin whales) are experiencing population-level consequences from vessel strikes; however, vessel strikes are a threat for all whales. The impacts of traffic (vessel strikes) on NARW from ongoing activities would be major and long term because vessel strikes have had and continue to have population level effects that compromise the viability of the species. The impacts of traffic (vessel strikes) on odontocetes and pinnipeds from ongoing activities would be minor to moderate because population-level effects are unlikely although consequences to individuals would be detectable and measurable.

Gear utilization – entanglement and bycatch: Fisheries interactions can have adverse effects on marine mammal species, with estimated global mortality exceeding hundreds of thousands of individuals each year (Read et al. 2006). Marine mammals can ingest or become entangled in marine debris (e.g., ropes, plastic) that is lost from fishing vessels and other offshore activities. Most recorded marine megafauna entanglements are directly or indirectly attributable to ropes and lines associated with fishing gear (Benjamins et al. 2014). Large baleen whales are at greatest risk for entanglement due to their large body size and slow maneuverability. Of the species considered in this assessment, entanglement is listed as a threat to humpback whales, NARWs, fin whales, blue whales, sei whales, common bottlenose dolphins, and gray seals (Hayes et al. 2020; Hayes et al. 2021). There is limited information regarding entanglements of fin, sei, and minke whales; however, evidence of fishery interactions causing injury or mortality has been noted for each of these species in the Greater Atlantic Regional Fisheries Office (GARFO)/NMFS entanglement/stranding database (Hayes et al. 2021). Of the available information, there are considerable data on the potential for entanglement of humpback whales and NARWs. A study of 134 individual humpback whales in the Gulf of Maine suggested that between 48 and 65 percent of the whales experienced entanglements (Robbins and Mattila 2001) and that 12 to 16 percent encounter gear annually (Robbins and Mattila 2001). Along with vessel collisions (discussed above), entanglement of humpback whales could be limiting the recovery of the population (Hayes et al. 2020). Entanglement in fishing gear was also identified as one of the leading causes of mortality in NARWs and may be a limiting factor in the species' recovery (Knowlton et al. 2012). Gray seals are at risk for entanglements (Hayes et al. 2020; Hayes et al. 2021). However, observed serious injury rates are lower than would be expected from the anecdotally observed numbers of gray seals living with ongoing entanglements, as gray seals entangled in netting are common at haul-out sites in the Gulf of Maine and southeastern Massachusetts. This may be because the majority of observed animals are dead when they come aboard the vessel at bycatch (Josephson et al. 2021); therefore, rates do not reflect the number of live animals that may have broken free of the gear and are living with entanglements.

Bycatch occurs in various commercial, recreational, and subsistence fisheries with hotspots driven by marine mammal density and fishing intensity (Lewison et al. 2014). Small cetaceans and seals are at most risk of being caught as bycatch due to their small body size that allows them to be taken up in fishing gear. Of the species considered in this assessment, Risso's dolphins, short-beaked common dolphins, short-finned pilot whales, harbor porpoises, white-sided dolphins, harbor seals, harp seals, gray seals, and hooded seals have been documented in several fisheries' bycatch data. Several commercial fisheries have documented bycatch. The ones that most commonly report bycatch are pelagic longlining, bottom trawling, and sink gillnetting (Hayes et al. 2020; Hayes et al. 2021). Purse seine fisheries, Atlantic blue crab trap/pot, North Carolina roe mullet stop net, and hook and line (rod and reel) have also noted instances of marine mammal bycatch.

Ongoing offshore-wind projects include fisheries surveys and monitoring. These efforts will comply with the Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf (BOEM 2019). The slow speed of mobile gear and the short tow times further reduce the potential for entanglements or other interactions for all mammals. The proposed trawl effort and tow times (20 minutes) for the proposed fisheries monitoring surveys, and there have been no reports of bycatch or entanglement of marine mammals with similar scientific surveys that have been carried out over many years (NMFS 2016c). Consequently, the likelihood of interactions with listed species of marine mammals is considered extremely unlikely. Based on the above analysis, the likelihood of any potential impacts to is extremely unlikely to occur and the potential for impacts to NARW and all other marine mammals is negligible.

Stranding data indicate that other marine mammal species may be affected by entanglements or bycatch; however, the contribution of fishery-related mortalities and serious injuries to these strandings is often difficult to determine. This is because not all of the marine mammals that die or are seriously injured wash ashore, and not all show signs of entanglement or other fishery interaction (Hayes et al. 2020; Hayes et al. 2021). As a result, the contribution of fisheries interactions to the annual mortality and injury of marine mammal species in the GAA and beyond is likely underestimated (Hayes et al. 2020; Hayes et al. 2021).

Effects from entanglement and bycatch associated with commercial and recreational fishing would have a range of impacts depending on the species: major impacts for NARWs, negligible to minor impacts for other mysticetes, odontocetes, and pinnipeds.

Noise: Underwater sound is a pervasive issue throughout the world's oceans and can adversely affect marine mammals. Vessel traffic, seismic surveys, and active naval sonars are the main anthropogenic contributors to low and mid-frequency noises in oceanic waters (NMFS 2018), with vessel traffic the dominant contributor to ambient sound levels in frequencies below 200 Hz (Veirs et al. 2016). In the marine mammal GAA, underwater noise from anthropogenic sources includes offshore marine construction activities (including pile driving), vessel traffic, seismic surveys, sonar and other military training activities, and turbine operations. The long-term effects of multiple anthropogenic underwater noise stressors on marine mammals across their large geographical range are difficult to determine and relatively unknown. The potential for these stressors to have population-level consequences likely varies by species, among individuals, across situational contexts, and by geographic and temporal scales (Southall 2021).

Noise generated from ongoing non-offshore wind and ongoing offshore wind activities includes impulsive (e.g., impact pile driving, seismic surveys, sonar, military training [sonar and munitions training]) and non-impulsive (e.g., vibratory pile driving, vessels, aircraft, dredging) sources. Impact pile driving, seismic exploration, and sonar surveys can lead to PTS/injury-level effects in marine mammals. In addition, high-intensity tactical sonar activities have been linked to stranding events (Fernandez et al. 2005; Cox et al. 2006; Balcomb and Claridge 2001; Jepson et al. 2003; Wang and Yang 2006; Parsons et al. 2008; D'Amico et al. 2009; Dolman et al. 2010). All noise sources that are audible by a given species have the potential to cause behavioral effects and some may also cause PTS and TTS when in closer proximity to the sound source. The frequency and number of noise-generating anthropogenic activities in the marine mammal geographic analysis area are relatively unknown. If marine mammal populations are subjected to multiple anthropogenic noise stressors throughout their lifetimes that disrupt critical life stages (e.g., feeding, breeding, calving) and throughout their ranges, then impacts from noise from ongoing non-offshore wind and offshore wind activities could be major, particularly for listed species such as NARWs, and have the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species. Thus, underwater noise impacts from ongoing non-offshore wind and ongoing offshore wind actions would result in major impacts to NARWs, and moderate impacts to all other marine mammal species.

Accidental releases and discharges: Marine mammals are particularly susceptible to the effects of contaminants from pollution and discharges as they accumulate through the food chain or are ingested with garbage. PCBs and chlorinated pesticides (e.g., dichlorodiphenyltrichloroethane [DDE], dieldrin) are of most concern and can cause long-term chronic impacts. These contaminants can lead to issues in reproduction and survivorship, and other health concerns (e.g., Jepson et al. 2016; Pierce et al. 2008) however, the population-level effects of these and other contaminants are unknown. Research on contaminant levels for many marine mammal species is lacking. Some information has been gathered from necropsies conducted from bycatch and therefore focus on smaller whale species and seals. Moderate levels of these contaminants have been found in pilot whale blubber (Muir et al. 1988) (Weisbrod et al. 2000). Weisbrod et al. (2000) examined PCBs and chlorinated pesticide concentrations in bycaught and stranded pilot whales in the western North Atlantic. Contaminant levels were similar to or lower than levels found in other toothed whales in the western North Atlantic, perhaps because they are feeding farther offshore than other species (Weisbrod et al. 2000). Also, high levels of toxic metals (e.g., mercury, lead, cadmium) and selenium were measured in pilot whales harvested in the Faroe Islands drive fishery (Nielsen et al. 2000).

Impacts from accidental releases and discharges associated with the ongoing construction and operation of offshore wind projects have been previously analyzed and were anticipated to result in negligible impacts (BOEM 2021a, 2021b). Offshore wind projects would comply with their Oil Spill Response Plan and USCG requirements for the prevention and control of oil and fuel spills. However, impacts from accidental releases and discharges from ongoing non-offshore wind activities would likely be minor for mysticetes, odontocetes, and pinnipeds and are unlikely to result in population-level effects, although consequences to individuals would be detectable and measurable, except for the NARW. Impacts from accidental releases and discharges from ongoing non-offshore wind activities would likely be moderate to major and long term for NARWs and have the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species.

EMF: There are eight telecommunication cables present in the offshore export cable corridor and in the vicinity of the Project Area, five of which are still in service (current Sunrise Wind Citation). The five in-service cables would presumably continue to operate and generate EMF effects under the No Action Alternative. While the type and capacity of those cables is not specified, the associated baseline EMF effects can be inferred from available literature. Fiber-optic communications cables with optical repeaters would not produce EMF effects. Impacts from EMF from ongoing non-offshore wind activities would likely be negligible for mysticetes, odontocetes, and pinnipeds, of the lowest level of detection, and barely measurable, with no perceptible consequences to individuals or the population.

Exponent Engineering, P.C. (2018) modeled EMF levels that could be generated by the South Fork Wind Farm export cable and inter-array cable. The model estimated induced magnetic field levels ranging from 13.7 to 76.6 milligauss on the bed surface above the buried and exposed South Fork Wind Farm export cable and 9.1 to 65.3 milligauss above the inter-array cable, respectively. Induced field strength would decrease effectively to 0 milligauss within 25 ft (7.6 meters) of each cable. By comparison, Earth's natural magnetic field produces more than five times the maximum potential EMF effect from projects similar to the Project (BOEM 2021b, Appendix F, Figure F-8). Background magnetic field conditions would fluctuate by 1 to 10 milligauss from the natural field effects produced by waves and currents. The maximum induced electrical field experienced by any organism close to the exposed cable would be no greater than 0.48 millivolt per meter (Exponent Engineering, P.C. 2018). EMF effects on marine mammals from offshore wind activities would vary in extent and magnitude depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or HVDC, transmission voltage). However, measurable EMF effects are generally limited to within tens of feet of cable corridors. BOEM would require these future submarine cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation. Impacts from EMF from the ongoing construction and operation of offshore wind projects have been previously analyzed and were anticipated to be negligible for NARWs and all other marine mammals due to estimate low EMF levels, the localized nature of EMF along the cables near the seafloor, and appropriate shielding and burial depth (BOEM 2021a, 2021b).

Presence of structures: There are more than 130 artificial reefs in the Mid-Atlantic region, six of which are offshore New York. Artificial reefs are made of a variety of materials including cars, trucks, subway cars, bridge rubble, barges, boats, and large cables (MAFMC 2023). Artificial reefs 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, if present where artificial reefs are located. Ongoing offshore wind projects would add a total of 74 WTGs and 2 OSS to the offshore environment. Hard bottom from scour and cable protection and vertical structures such as WTG foundations in a soft-bottom habitat can create artificial reefs, thus inducing the "reef" effect. The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans, providing a potential increase in available forage items and shelter for seals and small odontocetes compared to the surrounding soft bottoms (Arnould et al. 2015; Lindeboom et al. 2011; Mikkelsen et al. 2013; Russell et al. 2014). Increased prey abundance would be localized at foundation and cable protection locations, and a substantial increase in use offshore wind project areas by foraging whales is not anticipated (NMFS 2021b). Impacts from the presence of structures from the ongoing construction and operation of offshore wind projects have been previously analyzed and were anticipated to be negligible for NARWs and mysticetes and negligible to minor adverse for odontocetes and pinnipeds as a result of the potential for increased interaction with active or ghost fishing gear for odontocetes and pinnipeds. Minor beneficial impacts on pinniped and odontocete foraging and sheltering occur as a result of the monopiles and scour protection creating an artificial reef effect (BOEM 2021a, 2021b; Russell et al. 2016). These beneficial effects have the potential to be offset by risk of entanglement for derelict fishing gear or reduced feeding potential (prey concentrations) for some marine mammal species. Because of the uncertainty of the relative contribution of beneficial and adverse impacts to odontocetes and pinnipeds, the overall impact level determination is minor adverse.

Cable emplacement and maintenance: Emplacement and maintenance of submarine cables and pipelines associated with non-offshore wind activities, and cable emplacement and maintenance for ongoing offshore wind activities, would disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances would 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. (2015) suggest that because some marine mammals often live in turbid waters and some species of mysticetes employ feeding methods that create sediment plumes, some species of marine mammals have a tolerance for increased turbidity. 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. Impacts from emplacement and maintenance of submarine cables and pipelines are anticipated to be negligible for NARWs and all other marine mammals. Sediment resuspension during cable and pipeline emplacement and maintenance would be short term and localized and individual marine mammals, if present, would be expected to successfully forage in nearby areas not affected by increased turbidity.

Port utilization: Vineyard Wind 1 would use port facilities in Connecticut, Massachusetts, Rhode Island, and Canada during construction and O&M, and BOEM found that no changes to port utilization would occur (BOEM 2021a). South Fork would use existing port facilities in New York, Rhode Island, Massachusetts, Connecticut, New Jersey, Maryland, Virginia, or Nova Scotia for offshore construction, staging, fabrication, crew transfer, and logistics support, and BOEM found that although dredging or in-water work could be required for the Port of Montauk, these actions would occur within heavily modified habitats (BOEM 2021b). Impacts from port utilization from ongoing construction and operation of offshore wind projects are anticipated to be negligible for all marine mammals. 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. The impacts on water quality from sediment suspension during port expansion activities is temporary and short term, and would be similar to those described under the cable emplacement and maintenance IPF above, and are anticipated to be negligible for NARWs and all other marine mammals.

Lighting: The addition of 74 WTGs and 2 OSS to the geographic analysis area with aviation and marine navigation lighting, as well as lighting associated with construction vessels, would increase artificial lighting in the offshore environment. Orr et al. (2013) concluded that the operational lighting effects from wind farm facilities on marine mammal distribution, behavior, and habitat use were uncertain but likely negligible if recommended design and operating practices are implemented. BOEM requires wind farm developers to comply with the current design guidance for avoiding and minimizing artificial lighting effects; however, artificial light could aggregate prey species at night. Impacts from lighting from ongoing offshore wind activities would likely be negligible for NARWs, other mysticetes, odontocetes, and pinnipeds and are likely to be of the lowest level of detection and barely measurable, with no perceptible consequences to individuals or the population (BOEM 2021a, 2021b).

Climate change: Global climate change is an ongoing risk to marine mammals although the associated impact mechanisms are complex, not fully understood, and difficult to predict with certainty. NMFS lists the long-term changes in climate change as a threat for almost all marine mammal species (Hayes et al. 2020, Hayes et al. 2021). Climate change is known to increase temperatures, erosion and sediment deposition, disease frequency, ocean acidification, and storm severity and frequency; raise sea levels; and alter altered habitat, ecology, and migration patterns (Albouy et al. 2020; USEPA 2016; Record et al. 2019). Increased temperatures can alter habitat, modify species' use of existing habitats, change precipitation patterns, and increase storm intensity. Over time, climate change and coastal development would alter existing habitats, rendering some areas unsuitable for certain species and more suitable for others. Increase of the ocean's acidity has numerous effects on ecosystems including reducing available carbon that organisms use to build shells and causing a shift in food webs offshore (USEPA 2016). This has the potential to affect the distribution and abundance of marine mammal prey. For example, between 1982 and 2018 the average center of biomass for 140 marine fish and invertebrate species along United States' coasts shifted approximately 20 mi (32 km) north. These species migrated an average of 21 ft (6.4 m) deeper (USEPA 2016). Shifts in abundance of their zooplankton prey will affect baleen whales who travel over large distances to feed (Hayes et al. 2020). Impacts of climate change would likely be moderate for mysticetes, odontocetes, and pinnipeds and are likely to result in long-term consequences to individuals or populations that are detectable and measurable, except for NARWs. Impacts from climate change would likely be major for NARWs and have the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species.

Ongoing offshore wind is expected to combat the effects from climate change over the long term by providing clean energy and reducing use of fossil fuels. Minor beneficial impacts on mysticetes, odontocetes, and pinnipeds are anticipated because planned offshore wind activities may reduce the ongoing and predicted rate of climate change. Therefore, impacts on marine mammals from climate change may be reduced.

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 non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

This section provides a general description of potential impacts that could conceivably occur in the GAA from ongoing and future planned offshore wind activities, recognizing that the extent and significance of potential impacts cannot be fully quantified for projects that are in early phases and have not been fully designed. Should any or all ongoing and future activities described in Appendix E proceed, each would be subject to independent NEPA analyses and regulatory approvals, and their environmental effects would be fully considered therein.

Other future non-Project activities other than offshore wind development activities that may affect marine mammals include new submarine cables and pipelines, tidal energy projects, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar, ship strikes), marine transportation, NMFS research initiatives, and installation of new structures on the United States Continental Shelf (refer to Appendix E for a description of ongoing and planned activities). These activities could result in short-term or permanent displacement and injury to or mortality of individual marine mammals, but population-level effects would not be expected. The exception to this is the NARW, due to the small size of its population and frequent occurrence in shallow coastal zones.

The paragraphs below provide an overview of what is known regarding the IPFs described above.

Seafloor disturbance: Future offshore wind projects could disturb seabed while installing associated undersea cables. Trenching activities to place transmission cables would create areas of short-term seafloor disturbance. Installation of WTGs, support equipment, scour protection, and other related equipment would result in the long-term alteration of substrates. These structures are likely to alter prey composition and distribution for some marine mammals, potentially resulting in beneficial effects to odontocetes. The potential impacts of the long-term shift in prey species in the SRWF area are discussed in further detail below under *Visible Infrastructure.* Alterations to the seafloor are not expected to negatively impact prey resources for marine mammals, and the overall impact to marine mammals is expected to be negligible.

Sediment suspension and deposition: Future offshore wind projects could disturb seabed while installing associated undersea cables, causing an increase in suspended sediment. This disturbance would result in short-term plumes of suspended sediments in the immediate construction areas. Elliott et al. (2017) monitored TSS levels during construction of the BIWF. The observed TSS levels were far lower than levels predicted by the reference model, dissipating to baseline levels less than 50 ft (15.2 m) from the disturbance. Both the modeled TSS effects, which are conservatively high, and the observed TSS effects were short-term and within the range of baseline variability; however, these effects would be short-term (lasting only a few tide cycles) due to the low mobility of sediments (primarily sand) in cable and foundation installation areas (Stantec 2020).

These disturbances would be localized in extent, limited in magnitude, and short-term. Data describing behavioral responses of marine mammals to localized turbidity plumes are limited, but available information suggests that most species would be insensitive to the associated changes in visibility (NOAA 2022). For example, visual impairment does not appear to impair the ability of gray seals or harbor seals to forage and move effectively (McConnell et al. 1999; Todd et al. 2015). Research on the TSS sensitivity of other marine mammal species, such as dolphins and large whales, is generally lacking; however, these species have developed echolocation for communicating, foraging, and navigating by evolving in an environment with variable and often low visibility (Tyack and Miller 2002). This suggests that a short-term reduction in visibility would not significantly impair behavior. Even if marine mammals were to alter their behavior in response to elevated TSS (e.g., by avoiding the disturbance and/or interrupting foraging), any potential exposures would be localized in extent, limited in magnitude, short-term and, therefore, unlikely to result in biologically significant effects to any individual marine mammal. Therefore, the anticipated effects of construction-related seabed disturbance on NARWs and all other marine mammals would be short-term and negligible.

Noise: Under the No Action Alternative, human activities would continue to generate underwater noise potentially affecting marine mammals. Existing and future sources of anthropogenic underwater noise include commercial, government and military, research, and recreational vessel activity, and the development and operation of other wind energy projects on the OCS. Several offshore wind project construction periods would overlap during the 2022 to 2030 period (Appendix E). Construction from these projects, most notably pile driving, would create airborne and underwater noise with moderate potential to affect marine mammals. These effects range from low-level behavioral effects and interference with communication, foraging, mating, predator avoidance, and navigation to short-term or permanent hearing impairment (Madsen et al. 2006; Weilgart 2007). Other sources of noise from wind projects include helicopters and aircraft used for transportation and facility monitoring, pre- and post-construction environmental surveys, G&G surveys, WTG operation, and vessel traffic associated with these activities.

The noise associated with offshore wind project construction and operation generally falls into two categories: (1) impulsive noise sources, such as G&G surveys and impact pile driving, which generate sharp instantaneous changes in sound pressure and (2) non-impulsive noise sources, such as vessel engine noise, vibratory pile driving, and WTG operation, which remain relatively constant and stable over a given time period. Impulsive and non-impulsive noise sources associated with offshore wind projects and other activities likely to occur on the OCS in the future are discussed below.

Geophysical & geotechnical survey noise: Without mitigation, certain types of G&G surveys could result in long-term, high-intensity impacts on marine mammals (Ruppel et al. 2022). These effects may include behavioral avoidance of the ensonified area and increased stress; short-term loss of hearing sensitivity; and permanent auditory injury depending on the type of sound source, distance from the source, and duration of exposure; however, G&G noise resulting from offshore wind site characterization surveys is of less intensity than the acoustic energy characterized by seismic air guns and affects a much smaller area than G&G noise from seismic air gun surveys typically associated with oil and gas exploration. Although seismic air guns are not used for offshore wind site characterization surveys, sub-bottom profiler technologies that are hull-mounted on survey vessels may incidentally harass marine mammals and would require mitigation and monitoring measures (Ruppel et al. 2022). Typically, mitigation and monitoring measures are required by BOEM through requirements of lease stipulations and required by Incidental Take Authorizations from NMFS pursuant to Section 101(a)(5) of the MMPA. Similarly, the requirement to comply with avoidance and minimization measures for these surveys would avoid any effects on individuals that could result in population-level effects to threatened and endangered populations listed under the ESA. These measures are project-specific, with many required through the federal permitting process, and may include protected species observers (PSOs), PAM, pre-survey monitoring, and the establishment of exclusion zones in which sound sources would be shut down when marine mammals are present. Because of the reasonably foreseeable mitigation measures required by federal permits and reviews, including Incidental Harassment Authorization or Letters of Authorization under the MMPA, G&G surveys from future offshore wind activities would be short-term and minor for NARWs and all other marine mammals, and no population-level effects are expected.

UXO detonation and deflagration noise: Planned offshore wind activities may encounter UXO on the seabed in their offshore wind lease areas or along export cable routes. While non-explosive methods may be employed to lift and move these objects (i.e., lift-and-shift), 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 marine mammals. A physical description of UXO detonation and deflagration can be found in the Petition for Incidental Take Regulations (Sunrise Wind 2022a). The number and location of detonations that may be required for other offshore wind projects can be extrapolated based on information contained within COPs submitted to date. For example, Revolution Wind (OCS-A 0486) (Revolution Wind 2022), Sunrise Wind (OCS-A 0487) (Sunrise Wind 2023a), and New England Wind (OCS-A 0534) (JASCO Applied Sciences 2022a) off the coast of Massachusetts and Rhode Island have proposed up to 13 UXO, 3 UXO, and 10 UXO detonations, respectively. Atlantic Shores South Offshore Wind (OCS-A 0499) (JASCO Applied Sciences 2022b) off the coast of New Jersey and CVOW-C (OCS-A 0483) (Tetra Tech 2022) off the coast of Virginia are not proposing UXO detonation. Alternative strategies, such as avoidance, lifting and moving the UXO, low-order detonation, and deflagration, are typically considered prior to in-situ disposal, and only one detonation per day, during daylight only, is being proposed. Therefore, the potential for overlapping UXO detonation zones on the same day from nearby projects is unlikely. Therefore, impacts associated with UXO detonations for other projects would be similar to those described and modeled for the Proposed Action under Section 3.11.5.1.2. Due to the permitting and required monitoring and mitigation for all potential MEX/UXO clearance activities, the level of impacts are anticipated to range from negligible to minor for NARWs and all other marine mammals.

Non-impulsive noise: The majority of anthropogenic underwater noise in the marine environment is continuous noise from large vessel engines, specifically ocean-going cargo, tanker, and container vessels. Other sources of noise like small vessels, wind farm operations, and other activities are likely to account for a small percentage of the total anthropogenic sound energy in the future ocean environment. Virtually all of the long-term noise effects associated with offshore wind energy projects during operations would occur intermittently and be non-impulsive in nature. Non-impulsive noise sources include helicopters and fixed-wing aircraft used for facility monitoring, vibratory pile driving, construction and O&M vessel noise, and operational noise from WTGs.

Aircraft noise: Helicopters and fixed-wing aircraft may be used during initial site surveys, marine mammal monitoring prior to and during construction, and facility monitoring. Noise and disturbance associated with helicopter and/or aircraft use may result in some short-term and short-term behavioral responses. These include reduced surfacing duration, abrupt dives, and alarm reactions such as breaching and tail slapping (Patenaude et al. 2002); however, these effects have only been observed at distances of less than 1,000 ft (300 m). ESA and MMPA Incidental Take Authorizations would require most aircraft associated with future wind farm projects would operate at greater altitudes except when flying low to inspect WTGs or taking off and landing on the service operations vessel. For this reason, aircraft operations are not expected to result in biologically significant effects on NARWs and all other marine mammals, and the impacts would therefore be negligible.

Impact and vibratory pile driving: In the planned activities scenario (see Appendix E), the construction of up to 3,027 new WTG and OSS foundations in the geographic analysis area GAA is expected to occur intermittently over a 7-year period. During the installation of WTG foundations, underwater sound related to pile-driving would likely occur for 4 to 6 hours per day. Offshore wind activities may also require the installation and removal of sheet piles for cofferdams or other structures, which may require the use of a vibratory hammer. The sounds generated during pile-driving will vary depending on the piling method (impact or vibratory), pile material, size, hammer energy, water depth, and substrate type. Pile driving in the nearshore environment (e.g., at export cable landfalls in nearshore areas) is even more spatially dependent (i.e., affected by the shape of the surrounding seabed) than in the offshore environment. A description of the physical qualities of pile-driving noise can be found in the Acoustic Appendix I1 of the SRW COP (Küsel et. al. 2022).

Sounds from pile-driving may affect marine mammal species in the area. The impacts would vary in extent and intensity based on the scale and design of each project, as well as the schedule of project activities. Potential construction scenarios may include concurrent or non-concurrent pile-driving events over one or more years. Concurrent pile-driving scenarios would increase the geographical extent of noise that is introduced into the marine environment on a given day but would decrease the total number of days that the environment is ensonified (assuming that the project can be completed faster) in comparison to a non-concurrent construction scenario. Results from Southall et al. (2021a) showed that concurrent construction of multiple windfarms, if scheduled to avoid critical periods when NARWs are present in higher densities, reduces the overall risk to this species. However, it could increase risk for

PTS or TTS or behavioral effects for species that are present during the construction period. Given the migratory movements and seasonal abundances of marine mammals throughout the offshore wind energy areas, it is likely that some individuals would be exposed to multiple days of construction noise within the same year.

Pile-driving activities from other offshore wind development projects have the potential to affect all marine mammal functional hearing groups around each project site. Depending on the hearing sensitivity of the species, exceedance of PTS thresholds may occur on the scale of several kilometers, whereas exceedance of TTS thresholds and behavioral effects may occur on the order of tens of kilometers from the center of pile-driving activity. However, because marine mammals are mobile, they may move away from a sound before sufficient duration has passed to cause PTS or TTS. In addition, if mitigations are applied (e.g., bubble curtains, exclusion zones, etc.) all of these effects and exposure ranges can be reduced.

The most commonly reported behavioral effect of pile-driving activity on marine mammals has been short-term avoidance or displacement from the pile-driving site. This has been well-documented for harbor porpoises, a species of high concern in European waters. Given that species like harbor porpoise produce echolocation clicks nearly constantly (Osiecka et al. 2020), strategically-placed passive acoustic instruments can allow researchers to derive insights about the animals' presence and behavior around wind farms by listening for their clicks. A 2011 study of harbor porpoise acoustic activity in the North Sea at the Horns Rev II wind farm revealed that porpoise vocal activity was reduced as distant as 17.8 km from the construction site during pile-driving. At the closest measured distance of 2.5 km, vocal activity completely ceased at the start of pile-driving and did not recommence for up to one hour after pile-driving ended, and remained below average levels for 24–72 hours (Brandt et al. 2011). Dahne et al. (2013) visually and acoustically monitored harbor porpoises during construction of the Alpha Ventus wind farm in German waters and found a decline in porpoise detections at distances up to 10.8 km from pile- driving, while an increase in porpoise detections occurred at points 25 and 50 km away, suggesting displacement away from the pile-driving activity. During several construction phases of two Scottish windfarms, an 8–17% decline in porpoise acoustic presence was seen in the 25 km by 25 km block containing pile-driving activity in comparison to a control block. Displacement within the pile-driving monitored area was seen up to 12 km away (Benhemma-Le Gall et al. 2021).

A more recent analysis in the North Sea looked at harbor porpoise density and acoustic occurrence relative to the timing and location of pile-driving activity, as well as the sound levels generated during the development of eight wind farms (Brandt et al. 2016). Using data from passive acoustic monitoring pooled across all projects, changes in porpoise detections across space and time were modeled. Compared to the 25–48-hour pre-piling baseline period, porpoise detections during construction declined by about 25 percent at SELs between 145–150 dB re 1 µPa2s and 90 percent at SELs above 170 dB re 1 µPa2s. Across the eight projects, a graded decline in porpoise detections was observed at different distances from pile-driving activities. The results revealed a 68 percent decline in detections within 5 km of the noise source during construction, 33 percent decline 5-10 km away, 26 percent decline 10–15 km away, and a decline of less than 20 percent at greater distances, up to the 60 km range modeled (Note: the authors' used a 20 percent decline to indicate an adverse effect had occurred). However, within 20–31 hours after pile-driving, porpoise detections increased in the 0 to 5 km range, suggesting no long-term displacement of the animals. Little to no habituation was found, i.e., over the course of installation, porpoises stayed away from pile-driving activities. It is worth noting that there was substantial inter-project variability in the reactions of porpoises that were not all explained by differences in noise level. The authors hypothesized that the varying qualities of prey available across the sites may have led to a difference in motivation for the animals to remain in an area. Temporal patterns were observed as well: porpoise abundance was significantly reduced in advance of construction up to 10 km around the wind farm area, likely due to the increase in vessel traffic activity. This study showed that although harbor porpoises actively avoid pile-driving activities during the construction phase, these short-term effects did not lead to population level declines over the five-year study period (Brandt et al. 2016).

A study conducted during wind farm construction in Cromarty Firth, Scotland compared the effect of impact and vibratory pile-driving on the vocal presence of both bottlenose dolphins and harbor porpoises in and outside the Cromarty Firth area (Graham et al. 2017). There were no statistically significant responses attributable to either type of pile-driving activity in the three metrics considered: daily presence/absence of a species, number of hours in which a species was detected, or duration of daytime (between 06:00-18:00) encounters of a species. The only exception was seen in bottlenose dolphins on days with impact pile driving. The duration of bottlenose dolphin acoustic encounters decreased by an average of approximately four minutes at sites within the Cromarty Firth (closest to pile-driving activity) in comparison to areas outside the Cromarty Firth. The authors hypothesized that the lack of a strong response was because the received levels were very low in this particularly shallow environment (129 dB re 1 µPa2s (1 second of vibratory) and 133 dB re 1 µPa2s (1 strike of impact), both at 812 m from the pile), despite similar size piles and hammer energy to other studies. This study underscores the important influence of environmental conditions on the propagation of sound and its subsequent impacts to marine mammals.

In addition to avoidance behavior, several studies have observed other behavioral responses in marine mammals. A playback study on two harbor porpoises revealed that high-amplitude sounds, like pile driving, may adversely affect foraging behavior in this species by decreasing catch success rate (Kastelein et al. 2019). In another playback study, trained dolphins were asked to perform a target detection exercise during increasing levels of vibratory pile driver playback sounds (up to 140 dB re 1 µPa) (Branstetter et al. 2018). Three of the five dolphins exhibited either a decrease in their ability to detect targets in the water, or a near complete cessation of echolocation activity, suggesting the animals became distracted from the task by the vibratory pile-driving sound.

In addition to bottlenose dolphins and harbor porpoises, the effects of pile driving has been studied on a limited set of additional species. Würsig et al. (2000) studied the response of Indo-Pacific hump-backed dolphins to impact pile driving in the seabed in water depths of 6–8 m. No overt behavioral changes were observed in response to the pile-driving activities, but the animals' speed of travel increased, and some dolphins remained in the vicinity while others temporarily abandoned the area. Once pile-driving ceased, dolphin abundance and behavioral activities returned to pre-pile-driving levels. A study using historical telemetry data collected before and during the construction and operation of a British wind farm showed that harbor seals may temporarily leave an area affected by pile-driving sound beginning at estimated received peak to peak pressure levels between 166 and 178 dB re 1 µPa (Russell et al. 2016). Seal abundance was reduced by 19 to 83 percent during individual piling events (i.e., the installation of a single pile) within 25 km of the center of the pile. Displacement lasted no longer than 2 hours after the cessation of pile-driving activities, and the study found no significant displacement during construction as a whole. Interestingly, the study also showed that seal usage in the wind farm area increased during the operational phase of the wind farm, although this may have been due to another factor, as seal density increased outside the wind farm area as well.

Since there are no studies that have directly examined the behavioral responses of baleen whales to pile-driving, studies using other impulsive sound sources such as seismic airguns serve as the best available proxies. With seismic airguns, the distance at which responses occur depends on many factors, including the volume of the airgun (and consequently source level), as well as the hearing sensitivity, behavioral state, and even life stage of the animal (Southall et al. 2021b). In a 1986 study, researchers observed the responses of feeding gray whales to a 100 in^3 airgun and found that there was a 50 percent probability that the whales would stop feeding and move away from the area when the received levels reached 173 dB re 1 µPa SPL (Malme et al. 1986). Other studies have documented baleen whales initiating avoidance behaviors to full-scale seismic surveys at distances of less than 10 km (Johnson et al. 2007; Ljungblad et al. 1988; McCauley et al. 1998; Richardson et al. 1986) and as far away as 20 km (Richardson et al. 1999). Bowhead whales have exhibited other behavioral changes, including increased calling rates as airgun pulse energies increase from their lowest detectable levels. The increase in rates then leveled off at a received cumulative sound exposure level around 94 dB re 1 microPascal per squared second (μPa^2s) and decreased once the 10-minute cumulative SEL exceeded 127 dB re 1 μPa^2s (Blackwell et al. 2015). A more recent study by Dunlop et al. (2017) compared the migratory behavior of humpback whales exposed to a 3,130 in^3 airgun array with those that were not. There was no gross change in behavior observed (including respiration rates), although whales exposed to the seismic survey made a slower progression southward along their migratory route compared to the control group. This was largely seen in female-calf groups, suggesting there may be differences in vulnerability to underwater sound based on life-stage (Dunlop et al. 2017). The researchers produced a dose-response model which suggested behavioral change was most likely to occur within 4 km of the ship at received sound exposure levels over 135 dB re 1 μPa^2s (Dunlop et al. 2017).

Acoustic masking can occur if the frequencies of the sound source overlap with the frequencies of sound used by marine species. Low-frequency cetaceans and pinnipeds, in particular, are more likely to experience acoustic masking of communication signals from pile-driving than other species due to the overlapping frequency content of their vocalizations with the acoustic energy from pile-driving, which is mostly below 1 kHz. In addition, low frequency sound can propagate greater distances than higher frequencies, meaning masking may occur over larger distances than masking related to higher frequency noise. There is evidence that some marine mammals can avoid acoustic masking by changing their vocalization rates (e.g., bowhead whale [Blackwell et al. 2013], blue whale [Di Iorio and Clark 2010], humpback whale [Cerchio et al. 2014]), increasing call amplitude (e.g., beluga whale [Scheifele et al. 2004], killer whales [Holt et al. 2009]), or shifting dominant frequencies (Lesage et al. 1999; Parks et al. 2007). When masking cannot be avoided, increasing noise could affect the ability to locate and communicate with other individuals. Given that pile-driving occurs intermittently, with some quiet periods between pile-strikes, it is unlikely that complete masking would occur with impact pile driving. For vibratory pile driving, sound levels are lower, but noise is generated nearly continuously. This means that the distance at which masking could occur from vibratory pile driving is smaller than that of impact pile driving, but the proportion of time during active pile driving for which masking might occur would be greater.

Overall, it is reasonable to assume that there would be greater impacts to low-frequency cetaceans (i.e., baleen whales) than other species groups, even though direct research on pile-driving noise on baleen whales is limited. As discussed above, there is evidence suggesting that baleen whales may avoid or change their behavior when exposed to impulsive sounds. Secondly, their primary frequency range for listening to their environment and communicating with others overlaps with the dominant frequency of impact and vibratory pile-driving noise. Finally, since baleen whales have specific feeding and breeding grounds (unlike toothed whales who can perform these life functions over broader spatial scales), disturbance by anthropogenic noise occurring in one of these key geographic areas may come at an increased cost to these species. Planned offshore projects will occur within the migratory corridor for NARW between their foraging and calving areas. The migratory corridor extends from close to shore to the edge of the OCS. In the GAA, the migratory corridor is approximately 100 km in width at its minimum. Planned offshore wind projects may result in behavioral impacts, including avoidance over a large proportion of the width of the migratory corridor, potentially disrupting foraging, increasing energy expenditures, or delaying migrations between foraging and calving areas. However, portions allowing for a continuous migratory pathway are expected to be unaffected by elevated noise impacts at all times. Considering the number and extent of projects planned in the GAA, moderate adverse impacts, such as some individual level fitness effects, are expected to marine mammals from pile-driving activities. These impacts could be reduced with implementation of project-specific avoidance, mitigation, and monitoring measures. For example, noise abatement devices, such as double-bubble curtains, can be used to reduce the overall acoustic energy that is introduced and decrease the geographic extent of noise-related impacts. The implementation of shut-down zones enforced by PSOs and seasonal restrictions based on species presence in an area can reduce the intensity and likelihood of effects to minor, by only allowing activity when animals are not present. Many of these are requirements as conditions of compliance with the ESA, MMPA, and other federal regulations. These measures can reduce the potential for PTS and TTS effects from pile -driving for marine mammals. The likelihood of behavioral avoidance and masking effects are still high, especially for baleen whales.

Based on the above information, impact pile driving is likely to result in moderate impacts to marine mammals through increased risk of PTS and TTS and behavioral impacts. Vibratory pile driving is expected to occur on far fewer days, and, therefore, the total number of days per year at which marine mammals would experience behavioral impacts from vibratory pile driving is very small, and overall impacts would be minor for NARWs and all other marine mammals.

Other noise: Vessel noise is likely the most significant source of non-impulsive noise associated with offshore wind projects. The frequency range for vessel noise falls within the known range of hearing for marine mammals and would be audible. Although vessel noise may have some effect on marine mammal behavior, it would be limited to temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes (Erbe et al. 2018; Erbe et al. 2019; Nowacek et al. 2007). Studies indicate noise from shipping increases stress hormone levels in NARWs (Rolland et al. 2012), and modeling suggests that their communication space has been reduced substantially by anthropogenic noise (Hatch et al. 2012). The authors also suggest that physiological stress may contribute to suppressed immunity and reduced reproductive rates and fecundity in NARWs (Hatch et al. 2012; Rolland et al. 2012). Similar impacts could occur for other marine mammal species.

Other behavioral responses to vessel noise could include animals avoiding the ensonified area, which may have been used as a forage, migratory, or socializing area. Results from studies on acoustic impacts from vessel noise on odontocetes indicate that small vessels at a speed of 5 kts (9 kmh) in shallow coastal water can reduce the communication range for bottlenose dolphins within 164 ft (50 m) of the vessel by 26 percent (Jensen et al. 2009). In a quieter, deepwater habitat, model results suggest that there could be a 58 percent reduction in the communication range of pilot whales from a similar-sized boat and speed (Jensen et al. 2009). Because lower frequencies propagate farther away from the sound source compared to higher frequencies, low-frequency cetaceans (mysticetes [baleen whales]) are at a greater risk of experiencing behavioral noise effects from vessel traffic. BOEM assumes that construction of future offshore wind projects (construction period estimated to last 2 years per project) would begin in earnest in 2021, peak in 2025, and conclude in 2030. Vessel activity could peak in 2025 with as many as 207 vessels involved in construction of reasonably foreseeable projects in the GAA (refer to Section 3.11.3, *Impacts of the No Action Alternative*) although actual vessel numbers and trip numbers would vary based on individual project designs and port locations.

Vessel traffic from future offshore wind activities is not anticipated to measurably increase regional ambient noise levels due to the high ambient noise from the proximity to busy shipping lanes and marginal change to overall vessel traffic for the region. However, this increased offshore wind-related vessel traffic during construction and associated noise impacts could result in repeated localized, intermittent, and short-term impacts on marine mammals resulting in brief behavioral responses that would be expected to dissipate once the vessel or the individual has left the area BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of marine mammals and high levels of ambient noise due to the proximity to busy shipping routes; no stock or population-level effects would be expected. Should multiple project construction activities occur in close spatial and temporal proximity, the implementation of relevant avoidance, minimization, and mitigation measures would further reduce the potential for impact to marine mammals. Increased vessel traffic from planned offshore wind projects is expected to have negligible to minor impacts for NARWs and all other marine mammals.

Noise associated with cable laying would be produced by vessels and equipment during route identification, trenching, jet plow embedment, backfilling, dredging, and cable protection installation. Noise intensity and propagation would depend upon bathymetry, local seafloor characteristics, vessels, and equipment used (Taormina et al. 2018). Modeling estimates that underwater noise would remain above the 120 dB SPL threshold in an area of 98,842 ac (400 km^2) near the source (Bald et al. 2015; Nedwell and Howell 2004; Taormina et al. 2018). Assuming cable laying activities occur 24 hours per day and vessels continually move along the cable route, then estimated ensonified areas would not remain in the same location for more than a few hours (developed using Kirkpatrick et al. 2017). Although this suggests a large area of effect, it is important to place construction vessel noise in context with the existing underwater noise environment. A significant proportion of cable-laying activities would cross through high vessel traffic areas (see COP, Appendix X, DNV-GL 2022) where ambient underwater noise levels are likely to exceed the 120 SPL behavioral threshold. Although anthropogenic noise effects, particularly from vessel noise, would continue to adversely affect marine mammals into the future, construction vessel noise is unlikely to substantially alter this baseline condition and therefore would not substantially change existing levels of adverse effects on marine mammals. Ongoing non-impulsive noise from vessel traffic and the operation of WTGs is persistent and expected to continue indefinitely. Because of this, non-impulsive noise would have moderate effects on NARWs and all other marine mammals over the long term. Based on existing conditions, the potential impacts from cable laying noise are expected to be negligible to minor for NARWs and all other marine mammal species.

WTG operation is another source of continuous noise but is not expected to result in biologically significant effects on marine mammals. According to measurements at the Block Island Wind Farm, low-frequency noise generated by turbines reach ambient levels at 164 ft (50 m) (Miller and Potty 2017). Other studies observed SPL levels ranging from 109 to 127 decibels (dB) at 46 and 65.6 ft (14 and 20 m), respectively, at operational wind farms (Tougaard et al. 2009).

Further, Tougaard et al. (2020) summarized available monitoring data on wind farm operational noise, including both older generation geared turbine designs and quieter modern direct drive systems like those proposed for the SRWF. In their review, they evaluated approximately 40 wind projects with turbines ranging from 0.2 to 6.15 megawatts (MW). Tougaard further determined that operating turbines produce underwater SPL on the order of 105-128 dB in the 1025-Hz to 81-kHz range as measured at 164 ft (50 m); however, the turbines evaluated were smaller capacity, and the total number of turbines in the projects evaluated was less than what is proposed at SRWF. Tougaard's levels were consistent with the noise levels observed at the BIWF (110 to 125 dB SPL; Elliot et al. 2019). However, these studies and models demonstrated that noise generated by wind turbines attenuates rapidly with distance from the turbine (falling below normal ocean ambient noise within approximately 0.6 mi [1 km] from the source), and the combined noise levels from multiple turbines is lower or comparable to that generated by a small cargo ship. Operational noise and ambient noise both increase in conjunction with wind speed, meaning that WTG noise is only audible within a short distance from the source even in increased wind conditions (Kraus et al. 2016; Thomsen et al. 2015), and are unlikely to be detectable to marine mammals outside the respective wind farm footprints. Therefore, operational noise from regional wind farm development have negligible impacts on NARWs and all other marine mammals.

Although anthropogenic noise effects, particularly from vessel noise, would continue to adversely affect marine mammals into the future, construction vessel noise is unlikely to substantially alter this baseline condition and, therefore, would not substantially change existing levels of adverse effects on marine mammals. Ongoing non-impulsive noise from vessel traffic and the operation of WTGs is persistent and expected to continue indefinitely. Because of this, non-impulsive noise would have moderate adverse impacts on NARWs and all other marine mammals over the long term.

EMF: Under the No Action Alternative, several thousand miles of new submarine electrical transmission cables would be added in the geographic area for marine mammals. Submarine power cables emit anthropogenic electric and magnetic fields that can interact with natural geomagnetic EMF, potentially affecting the behavior of electromagnetic sensitive species by disrupting cues. EMF are generated by current flow passing through power cables during operation and can be divided into EMFs (Taormina et al. 2018). Magnetic fields have a second induced component, a weak electric field, or an induced electric field. Both EMFs rapidly diminish in strength with increasing distance from the source.

Marine mammals appear to have a detection threshold for magnetic intensity gradients (i.e., changes in magnetic field levels with distance) of 0.1 percent of the earth's magnetic field or approximately 0.05 microtesla (µT) (Kirschvink 1990). Assuming a 50-mG (5-µT) sensitivity threshold (Normandeau et al. 2011), marine mammals could theoretically detect EMF effects from the inter-array and South Fork Export Cables but only in close proximity to cable segments lying on the bed surface. Individual marine mammals would have to be within 3 ft (0.9 m) or less of those cable segments to encounter EMF above the 50-mG detection threshold.

As marine mammals in the area would be transiting and/or foraging and would not spend significant time on the seafloor in proximity to the cables, no species- or population-level impacts to marine mammals are expected. The mobile nature and surfacing behavior in marine mammals likely limit time spent near the cables, reducing potential for EMF exposure. Data are limited but only minor responses, such as lingering near or being attraction to cables, have been noted in electrosensitive species (e.g., elasmobranchs, benthic species), and no interactions with anthropogenic EMF from submarine cables have been recorded for marine mammals. Therefore, potential effects to NARWs and all other marine mammals from EMF exposure associated with the No Action Alternative, if present, are expected to be transient and negligible. Further discussion of potential EMF effects on marine mammals is available in the COP, Appendix J1 (Exponent Engineering P.C. 2022).

Accidental releases - contaminants: Vessels associated with future offshore activities could generate exhaust and could be a source of potential accidental spills of petroleum-based toxics. Marine mammals that occur in the analysis area could be exposed to these contaminants. Inhalation of fumes from oil spills can result in mortality or sublethal effects on individual fitness, including adrenal effects, hematological effects, liver effects, lung disease, poor body condition, skin lesions, and several other health effects (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008; Smith et al. 2017; Sullivan et al. 2019; Takeshita et al. 2017). Although these effects are acknowledged, the likelihood of adverse population-level impacts on marine mammals from accidental releases of debris or contaminants from future activities on the OCS is low. Current regulations and requirements imposed on federally approved activities prohibit vessels from dumping potentially harmful debris, require measures to avoid and minimize spills of toxic materials, and provide mechanisms for spill reporting and response.

Planned offshore wind activities are expected to result in a low risk of fuel, fluid, and hazardous materials leaks from any of the approximately 3,027 WTGs (Table E2-1 in Appendix E) anticipated in the GAA (including ongoing and planned projects but not including the Proposed Action). The total volume of WTG fuels, fluids, and hazardous materials in the geographic analysis area is estimated at 21.9 million gallons (Table E2-3 in Appendix F). OSS and ESPs are expected to hold an additional 10.8 million gallons of fuels, fluids, and hazardous materials (Table E2-3 in Appendix E). BOEM has modeled the risk of spills associated with WTGs and determined that a release of 128,000 gallons, which represents all available oils and fluids from 130 WTGs and an OSS, is likely to occur no more frequently than once every 1,000 years and a release of 2,000 gallons or less is likely to occur every 5 to 20 years (Bejarano et al. 2013). 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 these factors, accidental releases and discharges from federally approved activities on the OCS are not expected to appreciably contribute to adverse impacts to NARWs and all other marine mammals. However, based on ongoing non-offshore wind and offshore wind projects, the cumulative impact potential is moderate to major for NARWs, and minor for all other marine mammals.

Accidental releases - trash and debris: Future activities in the offshore components of the OCS could result in the accidental release of trash or contaminants associated primarily with vessel activity during Project construction. The inadvertent releases would contribute to the existing hazard posed by chronic marine pollution and debris. Entanglement in or ingestion of marine debris is a significant source of human-caused mortality in marine mammals. For example, ingested debris was documented in up to 22 percent of beached marine mammal carcasses. Autopsies identified blockage of the digestive tract, injury, and malnutrition caused by ingested debris as the likely cause of mortality (Baulch and Perry 2014). Approximately 50 percent of marine mammal species worldwide have been documented ingesting marine litter (Werner et al. 2016). Although these effects are acknowledged, the likelihood of adverse population-level impacts on marine mammals from accidental releases of debris or contaminants from future activities on the OCS is low. Current regulations and requirements imposed on federally approved activities prohibit vessels from dumping potentially harmful debris in United States waters. Based on these factors, accidental releases of trash and debris from federally approved activities on the OCS are not expected to appreciably contribute to adverse marine mammal impacts. However, based on ongoing non-offshore wind and offshore wind projects, the cumulative impact potential is moderate to major for NARWs, and minor for all other marine mammals.

Traffic (vessel strikes): Vessel traffic associated with future offshore wind development poses a collision risk to marine mammals, especially NARWs, other baleen whales, and calves that spend more time at and near the ocean surface. Vessel strike is relatively common with cetaceans and one of the primary causes of death to NARWs (Kraus et al. 2005). The minimum rate of human-caused mortality and serious injury to NARWs between 2013 and 2017 was estimated at 6.85 per year, with vessel strikes accounting for 1.3 mortalities per year (Hayes et al. 2020). Marine mammals are more vulnerable to vessel strike when they are within the draft of the vessel, vessels are larger or faster, and when they are beneath the surface and not detectable by visual observers (Vanderlaan and Taggart 2007). Weather conditions (e.g., fog, rain, and wave height) and nighttime operations also reduce marine mammal detection. The probability of vessel strike for NARWs decreased substantially as vessel speed fell below 17.3 mph (15 knots) (Vanderlaan and Taggart 2007); serious injury may rarely occur at speeds below 11.5 mph (10 knots) (Laist et al. 2001).

At the peak of projected offshore wind farm development in 2025, up to 207 construction vessels may be operating in the GAA. Although this is a large number, the overall increase in vessel activity is small relative to the baseline level and year to year variability of vessel traffic in the analysis area. In addition, the risk of marine mammal collisions is extremely low for most wind farm construction activities. Vessels working in the WEAs either remain stationary during turbine placement or are traveling slowly (i.e., at less than 11.5 mph [10 knots]) between turbine locations. Vessel speeds may increase when traveling between the WEAs and area ports unless voluntary or mandatory speed restrictions are in effect. Timing restrictions, use of PSOs, and other mitigation measures required by BOEM and NMFS would further minimize the potential for fatal vessel interactions. These measures would effectively minimize but not completely avoid collision risk. Any incremental increase in risk must be considered relative to the baseline level of risk associated with existing vessel traffic. Project O&M of wind farms would involve fewer vessels that are smaller in size, and the level of vessel activity would be far lower than during construction. Smaller vessels (i.e., less than 260 ft [79.2 m] in length) pose a lower risk of fatal collisions than larger vessels (Laist et al. 2001).

Offshore wind development could also alter commercial and recreation fishing vessel activity, which may lead to increased interactions with marine mammals that are also temporarily displaced out of lease areas during construction (refer to Sections 3.14 *Commercial Fisheries and For-Hire Recreational Fishing* and 3.6.6 *Navigation and Vessel Traffic* for details). Overall, existing vessel traffic conditions and increased vessel traffic from future offshore wind activities and potentially increased commercial and recreational fishing activity over the long-term may result in major impacts to NARWs and minor to moderate impacts to all other marine mammals due to rare injurious or fatal collisions with vessels.

Gear utilization – entanglement and bycatch: Fisheries interactions can have adverse effects on marine mammal species, with estimated global mortality exceeding hundreds of thousands of individuals each year (Read et al. 2006). Marine mammals can ingest or become entangled in marine debris (e.g., ropes, plastic) that is lost from fishing vessels and other offshore activities. Most recorded marine megafauna entanglements are directly or indirectly attributable to ropes and lines associated with fishing gear (Benjamins et al. 2014). Large baleen whales are at greatest risk for entanglement due to their large body size and slow maneuverability. Of the species considered in this assessment, entanglement is listed as a threat to humpback whales, NARWs, fin whales, blue whales, sei whales, common bottlenose dolphins, and gray seals (Hayes et al. 2020; Hayes et al. 2021). There is limited information regarding entanglements of fin, sei, and minke whales; however, evidence of fishery interactions causing injury or mortality has been noted for each of these species in the GARFO/NMFS entanglement/stranding database (Hayes et al. 2021). Of the available information, there are considerable data on the potential for entanglement of humpback whales and NARWs. A study of 134 individual humpback whales in the Gulf of Maine suggested that between 48 and 65 percent of the whales experienced entanglements (Robbins and Mattila 2001) and that 12 to 16 percent encounter gear annually (Robbins and Mattila 2001). Along with vessel collisions (discussed above), entanglement of humpback whales could be limiting the recovery of the population (Hayes et al. 2020). Entanglement in fishing gear was also identified as one of the leading causes of mortality in NARWs and may be a limiting factor in the species' recovery (Knowlton et al. 2012). Gray seals are at risk for entanglements (Hayes et al. 2020; Hayes et al. 2021). However, observed serious injury rates are lower than would be expected from the anecdotally observed numbers of gray seals living with ongoing entanglements, as gray seals entangled in netting are common at haul-out sites in the Gulf of Maine and southeastern Massachusetts. This may be because the majority of observed animals are dead when they come aboard the vessel at bycatch (Josephson et al. 2021); therefore, rates do not reflect the number of live animals that may have broken free of the gear and are living with entanglements.

Bycatch occurs in various commercial, recreational, and subsistence fisheries with hotspots driven by marine mammal density and fishing intensity (Lewison et al. 2014). Small cetaceans and seals are at most risk of being caught as bycatch due to their small body size that allows them to be taken up in fishing gear. Of the species considered in this assessment, Risso's dolphins, short-beaked common dolphins, short-finned pilot whales, harbor porpoises, white-sided dolphins, harbor seals, harp seals, gray seals, and hooded seals have been documented in several fisheries' bycatch data. Several commercial fisheries have documented bycatch. The ones that most commonly report bycatch are pelagic longlining, bottom trawling, and sink gillnetting (Hayes et al. 2020; Hayes et al. 2021). Purse seine fisheries, Atlantic blue crab trap/pot, North Carolina roe mullet stop net, and hook and line (rod and reel) have also noted instances of marine mammal bycatch.

Stranding data indicate that other marine mammal species may be affected by entanglements or bycatch; however, the contribution of fishery-related mortalities and serious injuries to these strandings is often difficult to determine. This is because not all of the marine mammals that die or are seriously injured wash ashore, and not all show signs of entanglement or other fishery interaction (Hayes et al. 2020; Hayes et al. 2021). As a result, the contribution of fisheries interactions to the annual mortality and injury of marine mammal species in the GAA and beyond is likely underestimated (Hayes et al. 2020; Hayes et al. 2021). Effects from entanglement and bycatch associated with commercial and recreational fishing would have a range of impacts depending on the species: major impacts for NARWs, negligible to minor impacts for other mysticetes, odontocetes, and pinnipeds.

Ongoing and proposed wind farm projects are likely to engage in various surveys for monitoring the impacts of those projects. All of this associated monitoring work is anticipated to require coordination and/or permitting with the appropriate federal agencies and follow the recommendations set forth in the Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf (BOEM 2019; NMFS 2016b). For fisheries-associated monitoring using trawls, the slow speed of mobile gear and the short tow times further reduce the potential for entanglements or other interactions for all mammals. Observations during mobile gear use have shown that entanglement or capture of large whale species is extremely rare and unlikely (NMFS 2016c). Although the trawl methods analyzed in commercial fisheries are comparable to the fishery monitoring methods proposed, the proposed trawl effort and tow times (20 minutes) for the proposed fisheries monitoring surveys are less than that previously considered by NMFS for commercial trawling activities. Consequently, the likelihood of interactions with listed species of marine mammals is much lower than commercial fishing activities. The potential for impacts to NARWs, mysticetes, and large odontocetes is anticipated to be negligible, while the potential for impacts to small odontocetes and pinnipeds is negligible to minor. These monitoring methods are designed to not have measurable impacts on surveyed resources, and the potential for impacts to prey species for NARWs and all other marine mammals would be negligible.

Lighting: The addition of up to 2,050 new offshore structures in the GAA with long-term hazard and aviation lighting, as well as lighting associated with construction vessels, would increase artificial lighting. Orr et al. (2013) concluded that the operational lighting effects from wind farm facilities to marine mammal distribution, behavior, and habitat use were uncertain but likely negligible if recommended design and operating practices are implemented. The cumulative impact of artificial lighting from future wind farm development and other offshore activities is anticipated to be negligible for NARWs and all other marine mammals.

Presence of structures: The addition of additional new offshore structures in the GAA could increase marine mammal prey availability through creating new hard-bottom habitat, increasing pelagic productivity in local areas, or promoting fish aggregations at foundations (Bailey et al. 2014; English et al. 2017). The presence of WTGs can alter circulation and stratification down current from the structures, potentially altering oceanographic conditions at the local scale; however, the presence of additional structures could have broader effects on oceanographic conditions with the potential to influence the distribution marine mammals prey species at broader spatial scales.

Hydrodynamic disturbance resulting from the broadscale development of large offshore wind farms is a topic of emerging concern because of potential effects on the Mid-Atlantic Bight cold pool. The cold pool is a mass of relatively cool water that forms in the spring and is maintained through the summer by stratification. The cold pool supports a diversity of fish and other marine species that are usually found farther north but thrive in the cooler waters it provides (Chen et al. 2018; Lentz 2017). Changes in the size and seasonal duration of the cold pool over the past five decades are associated with shifts in the fish community composition of the Mid-Atlantic Bight (Chen et al. 2018; Kohut and Brodie 2019). Several lease areas within the Rhode Island/Massachusetts WEAs are located on the approximate northern boundary of the cold pool. The potential effects of extensive wind farm development on features like the cold pool is a topic of emerging interest and ongoing research (Chen et al. 2016). The placement of monopiles and WTGs in the SRWF has the potential to influence hydrodynamic conditions at both local and broader regional scales. These effects fall into two categories: changes in wind field down current of the wind farm, affecting surface currents and wave formation, and turbulent mixing caused by the presence of the structures in the water column. The extent of these effects and resulting significance on biological processes are likely to vary considerably between different oceanographic environments (van Berkel et al. 2020). The presence of WTGs is likely to create localized hydrodynamic effects that could have localized impacts on food web productivity and pelagic eggs and larvae. The addition of vertical structure that spans the water column could alter vertical and horizontal water velocity and circulation.

Van Berkel et al. (2020) and Shultze et al. (2020) note that environments characterized by strong seasonal stratification are likely to be less sensitive to wind field and turbulent mixing effects on oceanographic processes. The SRWF and surroundings are characterized by strong seasonal stratification in summer and fall, within increased mixing and deterioration of stratification driven by storms and changes in upwelling in late fall into winter (Chen et al. 2018; Lentz 2017). In the Mid-Atlantic Bight, increased mixing could influence the strength and persistence of the cold pool, a band of cold, near-bottom water that exists at depth from the spring to fall. However, the turbulence introduced by monopile foundations is not expected to significantly affect the cold pool due to the strength of the stratification (temperature differences between the surface and the cold pool reach 50°F [10°C] [Lentz 2017]). Temperature anomalies created by mixing at each monopile would likely resolve quickly due to strong forcing towards stabilization (Schultze et al. 2020). Benthic habitats located at the base of the turbine structures would not be directly affected by changes in shallower water temperatures, but the indirect effect of these changes on temperature patterns along the bottom would potentially alter conditions.

BOEM has conducted a modeling study to predict how planned offshore wind development in the area could affect hydrodynamic conditions in the northern Mid-Atlantic Bight. Johnson et al. (2021) considered a range of development scenarios, including full buildout of both WEAs with a total of 1,063 WTG and OSS foundations. They determined that all scenarios would lead to small but measurable changes in current speed, wave height, and sediment transport in the northern Mid-Atlantic Bight. The resulting changes in current speed and wave height could influence larval transport and settlement and reduce bed shear stress, thereby affecting sediment transport. Particle tracking, which integrates the overall effect of objects subjected to the effects of currents, showed variations on the order of ± 10 percent between the baseline condition (no offshore wind farms) and the 12 MW full build-out scenario (1,063 WTG and OSS foundations). This is in line with the observed order of magnitude change in the depth-averaged currents (Johnson et al. 2021). In addition, small changes in stratification could occur, leading to prolonged retention of cold water near the seabed within the area during spring and summer.

Changes in the surface wind can in turn influence mixing and circulation patterns and associated biological processes which may have notable impacts (e.g., Daewel et al. 2022; Dorrell et al. 2022, Floeter et al. 2022; NASEM 2023). Recent modeling indicates that the impacts of wind farms on hydrodynamics may extend 10’s of kilometers downstream of the turbines from the extraction of wind energy on the leeward side of windfarms, which impacts on stratification, temperature, and salinity through a reduction of turbulent mixing (Christiansen et. al. 2022). However, this same modeling indicated that the effect on the ocean’s hydro- and thermodynamic properties is expected to be small in comparison to interannual variability, but that there could be large scale change in stratification and possible meso-scale effects on spatial variability, which is consistent with the level of potential impacts indicated in Johnson et al. (2021). A recent National Academy of Sciences panel convened to assess potential impacts from offshore windfarms in the Nantucket Shoals region on marine hydrodynamics and the availability of NARW prey confirmed that although these effects may occur, they would not likely be detectable from the other physical and biological factors impacting the occurrence of prey in the region. They noted that "the paucity of observations and uncertainty of the modeled hydrodynamic effects make it difficult to assess the ecological impacts of offshore wind farms, particularly considering the scale of both natural and human-caused variability in the Nantucket Shoals region" (NASEM 2023). While models can predict potential hydrodynamic effects of offshore wind structures, it may not be possible to actually detect impacts of these hydrodynamic effects on NARW food resources due to ongoing climate change and, in some foraging areas (i.e., Nantucket Shoals), numerous sources of natural variability (NASEM 2023). Given the relatively small magnitude of anticipated potential impacts combined, we anticipate that potential impacts associated with hydro- and thermodynamic impacts from the presence of existing and planned structures due to changes in hydrodynamic conditions would be negligible for NARWs and all other marine mammals.

Regarding potential impacts on prey species, Johnson et al. (2021) used an agent-based model to evaluate how these environmental changes could affect planktonic larval dispersal and settlement for three EFH species: summer flounder, silver hake, and Atlantic sea scallop. They determined that offshore wind development could affect larval dispersal patterns, leading to increases in larval settlement density in some areas and decreases in others, but would be unlikely to negatively impact population productivity for these species. Johnson et al. (2021) concluded that changes in larval distribution patterns on the order of miles or tens of miles are, therefore, unlikely to result in biologically significant effects on larval survival and recruitment. For example, in the case of sea scallops, larval dispersal to waters southwest of Block Island is predicted to increase while dispersal to waters south of Martha's Vineyard would decrease under all modeled scenarios (Johnson et al. 2021). These localized effects are unlikely to have a measurable population-level effect on this species because sea scallop larvae originate both local and distant spawning areas and dispersed regionally over along a southwesterly gradient (Johnson et al. 2021). In this context, localized shifts in larval transport and settlement density on the scale of miles to tens of miles are unlikely to lead to the development of significant population sinks. Even where they occur, localized changes in larval recruitment may not necessarily translate to negative effects on adult biomass.

While findings for these species are instructive, they are not necessarily representative of potential effects on all prey species that rely on planktonic dispersal of gametes and larvae. The BOEM modeling results determined that small but measurable changes in current speed, wave height, and sediment transport would occur across the northern Mid-Atlantic Bight. As stated, hydrodynamic effects could change how the planktonic gametes and larvae of many marine species are dispersed across the region. Changing larval dispersal pathways can disrupt connectivity between populations and the processes of larval settlement and recruitment (Pinsky 2020). Unfavorable changes can create a condition where prey populations may be negatively affected by a prolonged reduction in larval survival (Pinsky 2020). While hydrodynamic effects on these species could potentially be more significant, the available information does not suggest that such effects are likely.

While hydrodynamic impacts on prey species for marine mammals are likely to vary between species, the modeled findings show the potential for localized changes in prey species recruitment but with no indication of changes in overall net productivity. Based on the potential for localized changes in prey availability, the alteration of hydrodynamic and oceanic conditions from the presence of wind turbines could result in negligible to minor adverse impacts to NARWs and all other marine mammals from impacts to prey species.

Numerous surveys at offshore wind farms, oil and gas platforms, and artificial reef sites have documented increased abundance of smaller odontocete and pinniped species attracted to the increase in pelagic fish and benthic prey availability (Arnould et al. 2015; Lindeboom et al. 2011; Mikkelsen et al. 2013; Russell et al. 2014). Effects on fish populations may be adverse, beneficial, or mixed, depending on the species and location (van der Stap et al. 2016) but are expected to be small-scale within the context of the broader region. It is likely the reef effect caused by habitat alteration in the SRWF would provide beneficial foraging opportunities for some marine mammals although the number of species benefiting from this habitat and the significance of the benefit for these species remains uncertain (Bergström et al. 2014). Due to the well documented reef effect, odontocetes and pinnipeds may experience minor beneficial impacts from the reef effect, while NARWs and other mysticetes are not expected to receive any impact from this effect. Currently, there are no quantitative data on how large whale species (i.e., mysticetes) may be impacted by offshore windfarms (Kraus et al. 2019). Navigation through, or foraging within, the SRWF is not expected to be impeded by the presence of the WTG and OCS-DC foundations.

Current data suggest seals (Russell et al. 2014) and harbor porpoises (Scheidat et al. 2011) may be attracted to future offshore wind development infrastructure, likely because of the foraging opportunities and shelter provided. These species are expected to use habitat around the WTGs, as well as around offshore wind infrastructure, for feeding, resting, and migrating; however, the presence of structures may indirectly concentrate recreational fishing around foundations. In addition, ghost gear or lost commercial fishing nets may tangle around WTG foundations. Both could indirectly increase the potential for marine mammal entanglement leading to injury and mortality due to infection, starvation, or drowning (Moore and van der Hoop 2012). Entanglement in commercial fishing gear was identified as one of the leading causes of mortality in NARWs and may be a limiting factor in the species recovery, with more than 80 percent of observed individuals showing evidence of at least one and 60 percent showing evidence of multiple entanglements (Knowlton et al. 2012). Wind farm mitigation measures include annual inspections of WTG foundations and surroundings to find and report fishing gear and debris. These mitigation measures would provide information that could be used for planning the removal of derelict gear from the environment, would reduce entanglement risk for seals and porpoise foraging around the foundations and reduce entanglement risk for all marine mammal species in the analysis area.

The long-term presence of WTG structures could displace marine mammals from preferred habitats or alter movement patterns, potentially changing exposure to commercial and recreational fishing activity. The evidence for long-term displacement is unclear and varies by species. For example, Long (2017) studied marine mammal habitat use around two commercial wind farm facilities before and after construction and found that habitat use appeared to return to normal after construction. Long cautioned that these findings were not definitive and additional research was needed. In contrast, Teilmann and Carstensen (2012) observed clear long-term (greater than 10 years) displacement of harbor porpoises from commercial wind farm areas in Denmark. However, the studied project (Nysted Wind Farm) used geared turbines located in shallow water (< 32 ft [10 m]) within 6.2 mi (10 km) of an intertidal sandbar and did not provide data on underwater noise associated with the turbines themselves, and the results are likely not generally applicable, especially considering the use of geared turbines instead of the direct driver turbines proposed for SRWF. Displacement effects remain a focus of ongoing study (Kraus et al. 2019).

The combined effects of the presence of wind farm structures on marine mammals are variable, ranging from incrementally adverse to incrementally beneficial, and difficult to predict with certainty. Broadly speaking, any effects on marine mammal prey species are expected to be localized and seasonal (NMFS 2020). Potential long-term, intermittent impacts would persist until conceptual decommissioning is complete and structures are removed. On balance, the presence of wind farm structures could alter marine mammal behavior at local scales and could indirectly expose individuals to injury but would not adversely affect marine mammal populations, and therefore may have minor adverse impacts for NARWs, mysticetes, odontocetes, and pinnipeds, and minor beneficial effects to odontocetes and pinnipeds over the long term.

Port utilization: Any port expansions required for reasonably foreseeable projects could increase the total amount of disturbed benthic habitat, potentially resulting in impacts on some marine mammal prey species. Increases in port utilization due to other offshore wind energy projects would lead to increases in vessel traffic and associated risk of vessel strike (refer to Traffic subsection below). The resulting change in vessel traffic in the GAA cannot be predicted because, while some ports have been identified as possibilities for expansion, no specific project plans have been proposed. However, any future port expansion and associated increase in vessel traffic would be subject to independent NEPA analysis and regulatory approvals requiring full consideration of potential effects on marine mammals regionwide. However, in general, changes in port utilization are concurrent with changes in vessel traffic, and resultant potential impacts to marine mammals are driven by changes in vessel traffic, and those potential impacts are discussed in the vessel traffic section above.

3.11.3.3 Impacts of Alternative A – No Action on ESA-Listed Species

Impacts to ESA-listed marine mammals are not expected to be different than for non-ESA-listed marine mammals. The primary sources of potential impacts for ESA-listed marine mammals include increased sound levels from pile installation activities and G&G surveys, project-related vessel traffic, and alteration of prey availability. Based on the information contained in this document, it is anticipated that IPFs associated with the reasonably foreseeable offshore wind activities are likely to result in a range of negligible to major impacts to NARWs; a range of negligible to moderate adverse impacts to sei, fin, or sperm whales; and negligible impacts to blue whales due to their lack of presence in the Project Area.

3.11.3.4 Conclusions

Impacts of the No Action Alternative

Under the No Action Alternative, BOEM would not approve the COP; Project construction and installation, O&M, and conceptual decommissioning would not occur. Marine mammals would continue to be affected by existing environmental trends and ongoing activities. Not approving the COP would have no additional incremental effect on marine mammals. Similarly, the NMFS No Action Alternative (i.e., not issuing the requested incidental take authorization) would also have no additional incremental impact on marine mammals and their habitat.

Under the No Action Alternative, ongoing stressors and activities contributing to baseline conditions would result in a range of temporary to long-term impacts (disturbance, displacement, injury, mortality, and reduced foraging success) on marine mammals. Climate change would continue to affect marine mammal foraging and reproduction through changes to the distribution and abundance of marine mammal prey. Vessel activity (vessel collisions) and gear utilization associated with ongoing non-offshore wind activities would continue to cause long-term detectable and measurable injury and mortality to individual marine mammals. Underwater noise from pile driving during construction of offshore wind structures would also result in detectable impacts on marine mammals; major for NARWs and moderate impacts for all other marine mammal species; however, these impacts would be short term. Accidental releases and discharges, EMF, the presence of structures, cable emplacement and maintenance, port utilization, and lighting would also result in long-term minor to moderate impacts on marine mammals, even after accounting for minor beneficial impacts for odontocetes and pinnipeds from the reef effect associated with structures. Although impacts on individual marine mammals and their habitat are anticipated from offshore wind activities, the level of impacts would be minimized due to the mitigation measures that are being implemented during construction, operation, and maintenance. The No Action Alternative, as a result of the environmental baseline, would result in **moderate** impacts on mysticetes (with the exception of the NARW), and **minor** to **moderate** impacts for odontocetes and pinnipeds.

Because of the low population size for the NARWs and continuing stressors, population-level effects on NARWs are occurring. Vessel activity (vessel collisions) and gear utilization (e.g., entanglement) associated with ongoing non-offshore wind activities would continue to result in long-term population-level impacts. The effects of climate change would further exacerbate impacts on NARWs. For NARWs, the No Action Alternative (in consideration of baseline conditions) would result in **major** impacts. Ongoing offshore wind construction, operation, and maintenance activities would be conducted with Applicant-proposed and agency-required mitigation measures developed to avoid and minimize impacts on NARWs, so impacts from offshore wind activities are not anticipated to substantially contribute to the major impacts.

Cumulative Impacts of the No Action Alternative

Under the No Action Alternative, existing environmental trends and ongoing activities and mysticetes, odontocetes, and pinnipeds would continue to be affected by natural and human-caused IPFs. Planned non-offshore wind activities would also contribute to impacts on marine mammals. Planned non-offshore wind activities include increasing vessel traffic; new submarine cable and pipeline installation and maintenance; marine surveys; commercial and recreational fishing activities; marine minerals extraction; port expansion; channel-deepening activities; military readiness activities; and the installation of new towers, buoys, and piers. BOEM anticipates that planned non-offshore wind activities would result in moderate long-term impacts on marine mammals (with the exception of NARWs) primarily driven by ongoing underwater noise impacts, vessel activity (vessel strikes), gear entanglement, and seabed disturbance and the lack of knowledge regarding any mitigation and monitoring requirements for these planned non-offshore wind activities. Offshore wind activities would be responsible for a majority of the impacts associated with pile-driving noise, which could lead to major impacts to MARWs and moderate short-term impacts on all other marine mammals in the GAA. BOEM anticipates that the combined ongoing and planned activities would result in moderate impacts on marine mammals (with the exception of NARWs which would be major). Additionally, the presence of structures could contribute adverse impacts with potentially beneficial impacts on some marine mammal species.

Impacts are often magnified in severity to major long-term impacts for the NARW due to low population numbers and the potential to compromise the viability of the species from the loss of a single individual. Offshore wind construction, operation, and maintenance activities would be conducted with Applicant-proposed and agency-required mitigation measures developed to minimize impacts on NARWs, so impacts from offshore wind activities are not anticipated to substantially contribute to the major impacts.

BOEM anticipates that the cumulative impacts of the No Action Alternative would result in **moderate** impacts on mysticetes (expect NARWs), odontocetes, and pinnipeds. Impacts would be **major** to NARWs. Impacts on individual NARWs could have population-level effects, and it is unknown whether the population can sufficiently recover from the loss of an individual to maintain the viability of the species. Some **minor beneficial** impacts on odontocetes and pinnipeds could be realized through artificial reef effects. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures, and the overall impact level determination for odontocetes and pinnipeds from the presence of structures is **minor** adverse.

3.11.4 Relevant Design Parameters and Potential Variances in Impacts

This Final EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than described in the following sections. The following proposed PDE parameters (Appendix C) would influence the magnitude of the impacts on marine mammals:

- The number of WTGs;
- Installation methods; and
- The time of year during which construction occurs.

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

- WTG number and locations: the level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would result in lower behavioral disturbance and decreased risk of short-term or permanent threshold shift for marine mammals during construction and installation and O&M. The potential reductions included in Alternatives C-1 and C-2 may reduce the extent and number of individuals affected but would not lower the overall impact level.
- Final installation methods: any variance to installation methods or materials used for the assumptions described in the COP (COP, Appendix I1, Küsel et al 2022) may result in large changes to the areas where marine mammals may experience injury, PTS, TTS, or behavioral effects. Potential changes to installation methods may reduce or increase the extent and number of individuals affected but would not alter the overall impact level to marine mammals.
- Offshore export cable routes: the route chosen (including variants within the general route) would determine the amount of seafloor disturbance and duration of sediment suspension but would not alter the level of impacts to marine mammals.

- Season of construction: different marine mammals are present and active in the proposed Project Area at different times of year. Construction when fewer marine mammals are present would have a lesser impact than construction when higher numbers are present. Changes to the construction schedule could alter the number of individuals affected or change which species are primarily affected. This would not change the overall impact determination but may help reduce impacts to species whose populations are more sensitive to impacts.

3.11.5 Impacts of Alternative B - Proposed Action on Marine Mammals

The activities associated with offshore SRWF (94 11-MW WTGs within 102 potential positions) and SRWEC-OCS/SRWEC-NYS cabling, and OnCS-DC, transmission cable, and interconnection cable with Alternative B include construction and installation, O&M, and decommissioning. These actions have the potential to cause both direct and indirect impacts to marine mammals. The IPFs associated with construction and post-construction O&M activities include accidental releases, seafloor disturbance, sediment suspension and deposition, electric and magnetic fields, lighting, noise, presence of structures, traffic, and port utilization. These IPFs are thoroughly discussed in the marine mammal assessment prepared for this Project (Appendix O, Sunrise Wind 2023a). The conclusions of the marine mammal assessment are presented in this section and include consideration of the Project's mitigation and monitoring measures (Appendix H).

3.11.5.1 Construction and Installation

3.11.5.1.1 Onshore Activities and Facilities

Construction and operation of onshore facilities is not expected to have any direct impacts to marine mammals, and the potential for impacts is negligible.

3.11.5.1.2 Offshore Activities and Facilities

Construction impacts to marine mammals could occur from the following IPFs: seafloor disturbance, sediment suspension and deposition, noise, electric and magnetic fields, discharges and release, trash and debris, vessel traffic, and lighting. Unless otherwise noted, construction-related impacts would be short-term. The potential for the impacts is discussed in detail the following sections.

Seafloor disturbance: Construction of the SRWF Project components would physically disturb the water column and seabed including seafloor preparation, structure footprint, scour protection, and CPS stabilization; however, the area affected at any given time would be minimal relative to the size of the area of direct effects and insignificant compared to current baseline levels of disturbance (Table 3.7-3 and Table 3.7-4). Additionally, seabed and water column disturbance from the construction of the SRWF is not expected to have any direct impact on prey resources for marine mammals. Therefore, direct effects to marine mammals and indirect effects to fish and invertebrate prey resources would not adversely impact annual rates of recruitment or survival: effects would be negligible (refer to Section 3.7 *Benthic Habitat* and Section 3.10 *Finfish, Invertebrates, and Essential Fish Habitat* for additional discussion).

Installation methods and anticipated maximum disturbance corridors during construction are detailed in Section 3.3.3.4 of the COP (Sunrise Wind 2023a). Construction activities could temporarily disturb marine mammals or their prey species in the activity area. As detailed in Section 3.10 of this Final EIS, mobile fish species are expected to temporarily relocate from the area immediately surrounding seafloor-disturbing activities, and marine mammals foraging in the vicinity may encounter a localized reduction in foraging opportunities; however, because prey would still be available within the overall region surrounding the SRWEC, impacts are limited to short-term effects on individual marine mammals and not groups or populations and would not adversely impact annual rates of recruitment or survival.

Therefore, the effects of seafloor disturbance would be negligible for NARWs and all other marine mammals.

Sediment suspension and deposition: Seabed disturbance during Project construction would result in short-term plumes of suspended sediments in the immediate construction area. Elliott (2017) monitored TSS levels during construction of the BIWF. The observed TSS levels were far lower than levels predicted using the same modeling methods, dissipating to baseline levels less than 50 ft (15.2 m) from the disturbance. Both the modeled TSS effects, which are conservatively high, and the observed TSS effects were short-term and within the range of baseline variability; however, these effects would be short-term (lasting only a few tide cycles) due to the low mobility of sediments (primarily sand) in the proposed dredge area (Stantec 2020). As discussed in Section 3.11.3, seals and dolphins have evolved in and are able to forage and move effectively in low-visibility conditions. This suggests that short-term reduction in visibility would not significantly impair behavior in response to elevated TSS. Even if marine mammals were to temporarily alter their behavior (e.g., by avoiding the disturbance and/or interrupting foraging), the disturbance would be localized in extent, limited in magnitude, and short-term.

As previously described, installation of the SRWEC would require the excavation of the seafloor within the SRWEC corridor in OCS and NYS waters. These seafloor-disturbing activities are expected to result in localized increases in suspended sediments and an associated increase in turbidity levels. As previously described for the SRWF, increased turbidity can decrease visibility and water quality around the SRWEC.

Sediment transport modeling was completed for the installation of the SRWEC in both offshore and nearshore waters. As described in the COP, Appendix H (Woods Hole Group 2022), TSS concentrations are predicted to return to ambient levels (less than 10 mg/L) within 0.4 hours following installation of the modeled SRWEC-OCS cable corridor centerline and within 0.5 hours following installation of the modeled SRWEC-NYS cable corridor centerline. Furthermore, the TSS plumes were shown to be primarily contained within the lower portion of the water column, approximately 9.8 ft (3.0 m) above the seafloor for both SRWEC-OCS and SRWEC-NYS installation. These limited temporal effects over a relatively small area are not expected to interfere with marine mammal foraging success. Furthermore, after review of sediment transport modeling results, Sections 4.4.2 and 4.4.3 of the COP (Sunrise Wind 2023a) concluded that only short-term, limited impacts to fish and benthic species are expected from suspended sediments; therefore, secondary effects on availability of prey to marine mammals are not expected.

Additionally, HDD would occur within nearshore NYS waters when the SRWEC makes landfall on Fire Island. In general, this would involve HDD under the seafloor and intertidal zone using a drilling rig that would be located onshore within a designated Landfall Work Area. Drilling fluid (comprised of bentonite, drilling additives, and water) would be pumped to the drilling head to stabilize the created hole. Drilling fluid would then be used to prevent a collapse of the hole and cuttings would be returned to the landfall drill site. Excavation of exit pits would occur offshore within the surveyed corridor and outside of the Fire Island National Seashore boundary. Sediment transport modeling at the HDD exit pit is also reported in Appendix H. TSS concentrations were predicted to return to ambient levels (less than 10 mg/L) within 0.3 hours following completion of the excavation, while sediment deposition was predicted to extend a maximum of 79 ft (24 m) from the HDD exit pit, and to cover an area of 0.1 ha of the seafloor. The TSS plumes are predicted to be contained within the lower half of the water column, approximately 7.2 ft (2.2 m) above the seafloor. Considering the results of the sediment transport modeling and existing conditions along the modeled SRWEC cable corridor centerline, suspended sediments due to construction of the Project are expected to be a short-term disturbance to benthic habitats and are not expected to impact marine mammals directly. Similarly, suspended sediments are not likely to have long-term adverse impacts to prey species targeted for consumption by marine mammals along the SRWEC. Because the effects of sediment suspension are short-term, would not appreciably affect prey base, and would not adversely impact annual rates of recruitment or survival, the impact to NARWs and all other marine mammals would be negligible. Even if marine mammals were to alter their behavior in response to elevated TSS (e.g., by avoiding the disturbance and/or interrupting foraging), any potential exposures would be localized in extent, limited in magnitude, and short-term and would not result in biologically significant effects to any individuals.

Noise: Sources of underwater noise during the construction phase of the SRWF include G&G survey equipment, MEC/UXO surveys, MEC/UXO detonations, impact pile driving, vibratory pile driving, vessels, and air traffic. Underwater noise generated by SRWF construction activities could adversely impact marine mammals that are present within areas of elevated noise. Section 4.4.4.2 of the COP (Sunrise Wind 2023a) provides a detailed overview of how underwater sounds may affect marine mammals.

As described in the COP, Appendix I1 (*Underwater Acoustic Assessment*; Küsel et al 2022), BOEM and NOAA adopted the marine mammal injury thresholds based on the dual criteria of L_{pk} and sound exposure level (SEL) recommended by NMFS (2018). Table 3.11-4 summarizes the agency-adopted acoustic thresholds for marine mammals, which are used to evaluate noise impacts to marine mammals from impulsive sounds from impact pile driving and non-impulsive sounds generated by vessel traffic. Potential effects were modeled over a range of potential construction schedules and include the results for the highest level of potential impacts among all the construction schedules in this document. The primary sources of underwater noise that could be generated by the Project during construction of the SRWF are discussed in the following text.

Table 3.11-4. Summary of Relevant PTS Onset Acoustic Thresholds for Marine Mammal Hearing Groups

Faunal Group	Impulsive Signals[1]		Non-Impulsive Signals
	Unweighted L_{pk} (dB re 1 µPa)	Frequency-weighted $L_{E,24h}$ (dB re 1 µPa²·s)	Frequency-weighted $L_{E,24h}$ (dB re 1 µPa²·s)
Low-frequency Cetaceans	219	183	199
Mid-frequency Cetaceans	230	185	198
High-frequency Cetaceans	202	155	173
Phocid Pinnipeds in Water	218	185	201

Source: NMFS 2018; included in COP, Appendix I1 (Underwater Acoustic Assessment; Küsel et al 2022)

Notes:

µPa = micropascal; μPa^2 s = micropascal squared second; dB = decibel(s); $L_{E,24hr}$ = decibel re 1 micropascal squared second cumulative sound exposure level; L_{pk} = peak sound pressure level; m = meter

[1] Dual-metric acoustic thresholds for impulsive sounds: The largest isopleth result of the two criteria is used for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds have also been considered.

The primary sources of underwater noise that could be generated by the Project during construction of the SRWF are discussed in the following sections.

Geophysical & geotechnical survey noise: Short-term, localized G&G surveys during the construction period may include the use of multi-beam echosounders, side-scan sonar, shallow penetration sub-bottom profilers, medium penetration sub-bottom profilers, and marine magnetometers. The survey equipment to be employed would be equivalent to the equipment utilized during the G&G survey campaigns associated with Lease Area OCS-A 0500 conducted in 2016, 2017, 2018, 2019, and 2020 and with Lease Area OCS-A 0487 conducted in 2018, 2019, and 2020 (Gardline 2021a; 2021b; Smultea Sciences 2020a; 2020b). Site-specific verification was conducted of all geophysical equipment sound sources deployed within the marine portions of the proposed Project Area that operate within the functional hearing range of marine mammals. Without mitigation, certain types of G&G surveys could result in long-term, high-intensity impacts on marine mammals. These effects may include behavioral avoidance of the ensonified area and increased stress; short-term loss of hearing sensitivity; and permanent auditory injury depending on the type of sound source, distance from the source, and duration of exposure.

However, G&G noise resulting from offshore wind site characterization surveys is of less intensity than the acoustic energy characterized by seismic air guns and affects a much smaller area than G&G noise from seismic air gun surveys typically associated with oil and gas exploration. Several different types of equipment may be used during HRG surveys, including single-beam echosounders, multibeam echosounders, side scan sonars, nonparametric SBPs, parametric SBPs, boomers, and sparkers. Only the sounds produced by SBPs, boomers, and sparkers have the potential to cause incidental take so representative instruments were modeled and distances to threshold levels determined (Table 3.11-5 and Table 3.11-6).

Table 3.11-5. Summary of Representative High-Resolution Geophysical Survey Equipment and Operating Parameters Used to Calculate Distances to Incidental Take Threshold Levels

Equipment Type	Representative Model	Operating Frequency (kHz)	Source Level SPL_{rms} (dB)	Source Level 0-pk (dB)	Pulse Duration (ms)	Repetition Rate (Hz)	Beamwidth (degrees)	Information Source
Sub-bottom Profiler	Edge Tech 216	2 - 16	195	-	20	6	24	MAN
	Edge Tech 424	4 - 24	176	-	3.4	2	71	CF
	Edgetech 512	0.7 - 12	179	-	9	8	80	CF
	GeoPulse 5430A	2 - 17	196	-	50	10	55	MAN
	Teled yn: Benthos Chrip III-TTV 170	2 - 17	197	-	60	15	100	MAN
Sparker	Applied Acoustics Dura-Spark UHD (400 tps, 500 J)	0.3 - 1.2	203	211	1.1	4	Omni	CF
Boomer	Applied Acoustics triple plate S-Boom (700-1,000J)	0.1 - 5	205	211	0.6	4	80	CF

Source: Sunrise Wind, 2022b

Notes:

Source Levels are given in dB re 1 micropascal @ 1 meter

- = not applicable; dB = decibel(s); CF = Crocker and Fratantonio; Crocker and Fratantonio (2016); Hz = hertz; kHz = kilohertz; MAN = Manufactures Specifications; ms = millisecond(s); SPL_{rms} = sound pressure level, root mean square

Table 3.11-6. Estimated Exposures to Level B / Behavioral Harassment from G&G Surveys during Construction

Group	Species	Estimated # of Individuals Exposed
Low-frequency	Blue whale*	2.0
	Fin whale*	14.0
	Humpback whale	26.0
	Minke whale	34.0
	North Atlantic right whale*	8.0
	Sei whale*	4.0
Mid-frequency	Atlantic spotted dolphin	58.0
	Atlantic white-sided dolphin	86.0
	Bottlenose dolphin	150.0
	Common dolphin	3,520.0
	Long-finned pilot whale	18.0
	Short-finned pilot whale	12.0
	Risso's dolphin	12.0
	Sperm whale*	4.0
High-frequency	Harbor porpoise	216.0
Pinniped	Gray seal	184.0
	Harbor seal	410.0

Source: Sunrise Wind 2023a

* Species listed as threatened or endangered under the ESA

Although seismic air guns are not used for offshore wind site characterization surveys, sub-bottom profiler technologies that are hull-mounted on survey vessels may incidentally harass marine mammals and would be required to follow mitigation and monitoring measures. Typically, mitigation and monitoring measures are required by BOEM through requirements of lease stipulations and required by Incidental Take Authorizations from NMFS pursuant to Section 101(a)(5) of the MMPA. Mitigation and monitoring measures would lower the stock-level effects of the take of any marine mammals to negligible levels, as required by the MMPA, including potential for adverse behavioral responses and auditory injury (PTS/TTS). Similarly, the requirement to comply with avoidance and minimization measures for these surveys would avoid any effects on individuals that could result in population-level effects to threatened and endangered populations listed under the ESA. These measures include ramp-up procedures, PSOs, PAM, pre-clearance monitoring, and the establishment of exclusion zones in which sound sources would be shut down when marine mammals are present (Appendix H). Pre-clearance and shutdown zones are 1,640.4 ft (500 m) for NARWs, and 328 ft (100 m) for the following species: fin whale, minke whale, sei whale, humpback whale, blue whale, sperm whale, Risso's dolphin, long- and short- finned pilot whales, harbor porpoise, gray seal, and harbor seal.

NMFS and BOEM anticipate requiring sufficient monitoring and mitigation measures during G&G surveys to avoid the risk of any auditory or non-auditory injury to NARWs and all other marine mammals. Because of the required monitoring and mitigation measures, impulsive noise from G&G surveys may result in negligible to minor adverse impacts on NARWs and all other marine mammals.

UXO detonation and deflagration noise: As detailed in the COP, Section 3.3.3.4 (Sunrise Wind 2023a), prior to seafloor preparation, cable routing, and micro-siting of all assets, the Project would implement a MEC/UXO Risk Assessment with Risk Assessment with Risk Mitigation Strategy (RARMS) designed to evaluate and reduce risk in accordance with the ALARP risk mitigation principle. The RARMS consists of a phased process beginning with a Desktop Study and Risk Assessment that identifies potential sources of MEC/UXO hazard based on charted MEC/UXO locations and historical activities, assesses the baseline (pre-mitigation) risk that MEC/UXO pose to the Project, and recommends a strategy to mitigate that risk to ALARP. COP, Appendix G2 (Ordtek 2022) presents this study and strategies.

Avoidance is the preferred approach for MEC/UXO mitigation; however, it is anticipated that there may be instances where confirmed MEC/UXO avoidance is not possible due to layout restrictions, presence of archaeological resources, or other factors that preclude micro-siting. In such situations, confirmed MEC/UXO may be removed through in-situ disposal or physical relocation. Selection of a removal method would depend on the location, size, and condition of the confirmed MEC/UXO and would be made in consultation with a MEC/UXO specialist and in coordination with the appropriate agencies.

In-situ disposal would be performed with low noise methods like deflagration of the MEC/UXO or cutting the MEC/UXO up to extract the explosive components. The MEC/UXO may be relocated through a “Lift and Shift” operation; the relocation would be to another suitable location on the seabed within the Area of Potential Effect (APE) or previous designated disposal areas for either wet storage or disposal through low noise methods as described for in-situ disposal. For all MEC/UXO clearance, mitigation measures include the use of noise attenuation to achieve a 10 dB reduction in sound levels (options include bubble curtains, containment structures, or other technologies), PSOs, PAM, pre-survey clearance monitoring, and the establishment of exclusion zones in which sound sources would be shut down when marine mammals are present (Appendix H). Pre-clearance zones would be monitored for 60 minutes prior to blasting, with clearance zones detailed in Table 3.11-7.

Table 3.11-7. Mitigation and Monitoring Zones[1] Associated with Unmitigated UXO Detonation of Binned Charge Weights

Species	UXO Charge Weight [2]				
	E4 (2.3 kg)	E6 (9.1 kg)	E8 (45.5 kg)	E10 (227 kg)	E12 (454 kg)
	Pre-Start Clearance Zone[3] (m)	Pre-Start Clearance Zone[3] (m)	Pre-Start Clearance Zone[3] (m)	Pre-Start Clearance Zone[3] (m)	Pre-Start Clearance Zone[3] (m)
Low-frequency cetaceans	400	800	1,600	3,000	3,700
Mid-frequency cetaceans	50	50	100	400	500
High-frequency cetaceans	1,800	2,600	3,900	5,400	6,200
Phocid pinnipeds	100	250	600	1,100	1,500

Source: Adapted from the draft Protected Species Mitigation and Monitoring Plan dated April 2022 (Sunrise Wind 2022c).

Notes:

kg = kilograms; m = meters; PK = peak pressure level; SEL = sound exposure level.

[1] Modification in Mitigation and Monitoring Zones may be included in the final MMPA ITA.

[2] 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) for the detonation of each charge weight bin).

[3] Pre-start clearance zones were calculated by selecting the largest Level A harassment (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.

While mitigation and monitoring efforts are likely to reduce the potential for take, modeling was conducted to estimate the maximum number of individuals that may be exposed to effects for UXO/MEC detonations using the maximum area of potential impact using 10 dB of attenuation multiplied by species densities and number of possible events (3). Due to the included monitoring and mitigation and clearance zones, no injury other than PTS or TTS is anticipated. The results model the worst-case scenario of up to three unmitigated detonations of the largest explosive category. Full details of the modeling and analysis can be found in the Sunrise Wind Petition for Incidental Take (Sunrise Wind 2022a).

Table 3.11-8. Estimated Number of Animals that May Experience PTS and Behavioral Disturbance from up to Three UXO/MEC Detonations in SRWF without Attenuation

Species	Level A Density-based Take Estimate	Level B Density-based Take Estimate	PSO Data Take Estimate	Mean Group Size	Highest Level B Take
Blue whale*	0.0	0.0	-	1.0	1
Fin whale*	2.4	12.2	0.7	1.8	13
Humpback whale	2.9	14.7	2.2	2.0	15
Minke whale	1.6	8.0	0.5	1.2	8
North Atlantic right whale*	2.0	10.3	0.1	2.4	11
Sei whale*	0.2	0.9	0.0	1.6	2
Atlantic spotted dolphin	0.0	0.3	-	29.0	29
Atlantic white-sided dolphin	1.3	19.6	0.3	27.9	28
Bottlenose dolphin	0.5	8.2	3.2	7.8	9
Common dolphin	5.3	82.5	89.3	34.9	90
Harbor porpoise	52.0	178.6	0.1	2.7	179
Pilot whales	0.2	2.8	-	8.4	9
Risso's dolphin	0.0	0.1	0.2	5.4	6
Sperm whale*	0.0	0.1	-	1.5	2
Gray seal	2.0	17.5	0.2	0.4	18
Harbor seal	4.6	39.4	0.3	1.0	40

Source: Sunrise Wind Petition for Incidental Take (Sunrise Wind 2022a)

* ESA-listed mammals

Note: PSO = Protected Species Observer

During Project construction, the likelihood of MEC/UXO encounter is very low. Sunrise Wind would work with BOEM to identify appropriate response actions, which may include developing an emergency response plan, conducting MEC/UXO-specific safety briefings, retaining an on-call MEC/UXO consultant, or other measures. Because the potential for effects from MEC/UXO clearance is extremely unlikely, but if required could result in injury of a low numbers of individuals, the effects would be negligible to minor and short-term for NARWs and all other marine mammals.

Impact pile-driving noise: Underwater noise generated by impact pile driving is considered one of the predominant IPFs that could result in potential physiological and behavioral impacts on marine mammals due to the relatively high source levels produced by impact pile driving and the large distances over which the noise is predicted to propagate. Up to 94 WTG foundations and 1 OCS-DC foundation with four legs would be installed. The typical SRWF WTG foundation pile installation would require approximately 1 to 4 hours of impact pile driving to a final embedment depth of 164 ft (50 m) below the seafloor, with some difficult installations potentially taking up to 12 hours to install due to more difficult substrate conditions. After installation, the WTG would be placed on top of the foundation pile and the vessels would be repositioned to the next site. Between 1 and 3 WTG monopile foundations may be installed per day. For the OCS-DC foundation, the jacket foundation would be placed first, with the pin pile placed through the jacket and driven to its penetration depth (295 ft [90 m]). Pile driving of each pin pile may take up to 48 hours. Because separate vessels are anticipated to be used for WTG and OCS-DC foundation installations, these activities may occur concurrently.

Potential noise effects on marine mammals are evaluated based on the intensity of the noise source, distance from the source, the duration of sound exposure, and species-specific sound sensitivity. Underwater noise impacts on marine mammals were evaluated using behavioral and injury-level thresholds for different marine mammal species groups developed by (NMFS 2018). Specific injury thresholds are defined for different marine mammal species groups based on hearing sensitivity. Dual injury criteria have been defined for each group for instantaneous exposure to a single pile strike, and cumulative exposure to multiple pile strikes or extended non-impulsive sources like vibratory pile driving or vessel noise over a 24-hour period (NMFS 2018). NMFS behavioral thresholds are based on noise levels known to alter behavior and/or interfere with communication. These thresholds by species group for impulsive and non-impulsive noise are summarized in Table 3.11-9 and Table 3.11-10.

As part of the COP, Appendix I1 (*Underwater Acoustic Assessment*) (Küsel et al 2022), impacts to marine mammals, sea turtles, and fish were assessed. The acoustic propagation model predicts sound fields for a 24-hour period, or a specific scenario, which includes consideration of the hammer energies required to drive the pile from start to finish, as well as the silent periods between two consecutive piles (if applicable in the impact pile driving scenario), and any proposed noise mitigation measures. Within this assessment, the JASCO Animal Simulation Model Including Noise Exposure (JASMINE) was utilized to predict the probability of exposure of animals to sound arising from pile driving operations during construction activities. Simulated animals (animats) were used to sample predicted three-dimensional sound fields derived from animal movement observations. Predicted sound fields were sampled so that animats were programmed to behave like marine species are expected to behave, including modeled responses to elevated sound levels. The output provided an exposure history for each animat included within the simulation. Both L_{pk} and SEL injury isopleths were calculated for each species based on corresponding acoustic criteria.

COP, Appendix I1 (Küsel et al 2022), additionally modeled sound propagation distances based on expected construction scenarios associated with the PDE such as hammer type, pile type, pile schedule (hammer energy, number of strikes, piling duration), season, geographic location, and implementation of noise mitigation (i.e., sound attenuation) measures. The acoustic ranges to the SEL physiological threshold assume an animal is stationary within the propagated sound field and therefore the animal accumulates noise levels for the full 24-hour period. When realistic animal behavior and movement are considered, the predicted risk of exposure to accumulated noise levels with the potential to cause a physiological impact is lower. As evidenced by the variable monthly densities of marine mammals in the SRWF, seasonality is also an important parameter when estimating exposures and impacts from potential sources of underwater noise.

Project mitigation measures include an in-water construction window of May 1 to December 31 to minimize potential noise impacts on NARWs. No pile driving would occur at the SRWF and OCS-DC facility outside of the construction window. This would effectively reduce the potential for NARWs' exposure to pile driving noise; however, other marine mammal species may be present in the vicinity during this construction window and could be exposed to behavioral and injury-level noise effects. In addition, underwater noise could indirectly affect marine mammals by killing, injuring, or altering the behavior of fish prey species. As described in Appendix H, additional protection measures include noise attenuation technologies, soft starts for pile driving, timing restrictions, the use of trained 6 to 8 PSOs for monopile installation, exclusion and monitoring zones, PAM systems, reduced visibility monitoring tools, adaptive vessel speed reductions, and utilization of software to share visual and acoustic detection data between platforms in real time. PSOs would perform pre-clearance monitoring of the area surrounding the construction site for 60 minutes prior to beginning pile driving. PSOs would also enforce shutdown zones when marine mammals are observed within the shutdown zones. Pile driving would not resume until individuals leave the shutdown zone of their own volition, and no animals are observed within the shutdown zone for at least 30 minutes. Pre-clearance monitoring and shutdown zones are detailed in Table 3.11-9, Table 3.11-10, and Table 3.11-11. NOAA and BOEM are likely to require additional mitigation measures to reduce the likelihood of harmful noise exposure. The Project permitting would require similar and additional impact avoidance and minimization measures to limit the potential for adverse effects on marine mammals (refer to Appendix H).

Table 3.11-9. Mitigation and Monitoring Zones[1,2] during Impact Pile Driving for WTG monopile installation during Summer and Winter with 10-dB Broadband Sound Attenuation

Monitoring Zone Species	Summer (May through November) 6,070 m Pre-Start Clearance Zone and Shutdown Zone (m)[1,2]	Winter (December only) 6,500 m Pre-Start Clearance Zone and Shutdown Zone (m)[4,5]
North Atlantic right whale	At any distance	At any distance
Large whale	3,700	4,300
Delphinids	NAS perimeter	NAS perimeter
Harbor porpoise	NAS perimeter	NAS perimeter
Seals	100	100

Source: (adapted from the Protected Species Mitigation and Monitoring Plan dated August 2022 (Sunrise Wind 2022c))

Notes: The shutdown zones for large whales (including NARW), porpoise, and seals are based upon the maximum Level A harassment zone for each group.

[1] Zones are based upon the following modeling assumptions and further modification in Mitigation and Monitoring Zones may be included in the final MMPA ITA:

- 7/12-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 would 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 Protected Species Mitigation and Monitoring Plan Section 7.1).

[4] The pre-start clearance zones for large whales, porpoise, and seals are based upon the maximum Level A harassment zone for each group.

[5] The shutdown zones for large whales (including NARW), porpoise, and seals are based upon the maximum Level A harassment zone for each group.

Table 3.11-10. Mitigation and Monitoring Zones[1,2] during Impact Pile Driving for OSC-DC Piled Jacket Foundation Installation during Summer and Winter with 10-dB Broadband Sound Attenuation

Monitoring Zone Species	Summer (May through November) 6,470 m Pre-Start Clearance and Shutdown Zone (m)[1,2]	Winter (December only) 6,500 m Pre-Start Clearance Zone and Shutdown Zone (m)[4,5]
North Atlantic right whale	At any distance	At any distance
Large whale	3,700	4,300
Delphinids	NAS perimeter	NAS perimeter
Harbor porpoise	900	600
Seals	180	180

Source: (adapted from the Protected Species Mitigation and Monitoring Plan dated August 2022 (Sunrise Wind 2022c))

Notes: The shutdown zones for large whales (including NARW), porpoise, and seals are based upon the maximum Level A harassment zone for each group.

[1] Zones are based upon the following modeling assumptions and further modification in Mitigation and Monitoring Zones may be included in the final MMPA ITA:

7/12-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 would 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 Protected Species Mitigation and Monitoring Plan Section 7.1).

[4] The pre-start clearance zones for large whales, porpoise, and seals are based upon the maximum Level A harassment zone for each group.

[5] The shutdown zones for large whales (including NARW), porpoise, and seals are based upon the maximum Level A harassment zone for each group.

Table 3.11-11. North Atlantic Right Whale Clearance and Real-time Passive Acoustic Monitoring Zones[1] during Impact Piling in Summer and Winter

Season	Minimum Visibility Zone (m)[2]	PAM Clearance Zone (m)[3]	Visual Clearance Delay or Shutdown Zone (m)	PAM Shutdown Zone (m)	PAM Zone (km)
Summer WTG	3,700	Any Distance	Any Distance	Any Distance	10
Winter WTG	4,300	Any Distance	Any Distance	Any Distance	10
Summer OCS-DC	5,600	Any Distance	Any Distance	Any Distance	10
Winter OCS-DC	6,500	Any Distance	Any Distance	Any Distance	10

Source: Protected Species Mitigation and Monitoring Plan dated August 2022 (Sunrise Wind 2022c)

Notes:

[1] Sunrise 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 harassment zones for the whale group.

[3] The passive acoustic monitoring (PAM) pre-start clearance zone was set equal to the Level B harassment to avoid any unnecessary take.

Each potential effect from impact pile driving has a range (isopleth) at which that impact may occur. Potential impacts, ordered in increasing likelihood, include single strike injury, PTS, TTS, and behavioral impacts. The ranges where a single strike injury, cumulative SEL injury, and behavioral impacts may occur are described in Table 3.11-12. Full details and results of all scenarios are provided in the COP, Appendix I1 (Küsel et al 2022).

Table 3.11-12. Summary Table of Maximum Anticipated Exposure Ranges (ER95%) in km to Injury and Behavioral Effects from Impact Pile Driving Associated with Monopile and OCS-DC Foundation Installation across All Installation Scenarios Assuming a Minimum of 10 dB of Attenuation

Species		Injury		Behavior	
		SEL	L_{pk}	SPL_{rms}[1]	SPL_{rms}[2]
Low-frequency	Fin whale[3]	5.55	<0.01	6.23	6.24
	Minke whale (migrating)	2.88	<0.01	5.71	24.87
	Humpback whale	5.13	<0.01	6.23	6.24
	North Atlantic right whale[3]	3.62	<0.01	5.75	5.77
	Sei whale[3] (migrating)	4.22	<0.01	6.10	26.13
Mid-frequency	Atlantic white-sided dolphin	0	0	5.52	2.76
	Atlantic spotted dolphin	0	0	6.70	2.23
	Short-beaked common dolphin	0	0	5.64	2.85
	Bottlenose dolphin, offshore	0	0	4.94	2.58
	Risso's dolphin	0	0	5.83	2.86
	Long-finned pilot whale	0	0	5.69	2.82
	Short-finned pilot whale	0	0	5.74	2.80
	Sperm whale[3]	0	0	5.95	2.84
High-frequency	Harbor porpoise	0.81	0.25	5.83	43.29
Phocids (in water)	Gray seal	1.72	0	6.61	4.84
	Harbor seal	0.75	<0.01	5.96	4.32
	Fin whale[3]	5.55	<0.01	6.23	6.24

Source: Sunrise Wind 2023. Maximum values are from Tables 4.5-2 through 4.5-6 in COP, Appendix I1 (Küsel et al 2022).

Notes:

1 Unweighted thresholds (NMFS 2005).

2 Frequency-weighted thresholds (Wood 2012).

3 Listed as Endangered under the ESA.

Sunrise Wind (2022a) estimated the number of individual marine mammals that could experience PTS (i.e., permanent hearing injury) and TTS (temporary loss of hearing sensitivity) or other short-term physiological and behavioral effects from exposure to construction-related underwater noise. Sunrise Wind's model considered proposed construction timing restrictions, the overall duration of monopile installation, and monthly species occurrence and density within and around the noise impact area. The impact scenarios assumed the installation of two to four pin piles and one to four monopiles per day, with a range of pile driving day of 26 to 51 pile driving days, and use of a noise attenuation systems to achieve a minimum of 10 dB of source reduction. PTS or TTS could occur in up to 2.59 percent of affected populations, while up to 5.19 percent of affected populations could experience behavioral impacts (Table 3.11-13); however, most populations experience much lower impacts.

Table 3.11-13. Maximum Estimated Level A and Level B Harassment from Installation of 94, 7/12 M WTG Monopile Foundations and 1 OCS-DC Piled Jacket Foundation Using an IHC S-4000 Hydrohammer Assuming 10 Db of Noise Attenuation among the Five Modeled Installation Scenarios. Level A harassment is 20% of Modeled Level A Exposures. Level B Exposure Modeling Take Estimates are Based on the Unweighted Distances to the 160 Db Level. "Static" Level B harssment Estimates are from the Standard Density X Area Method Described in the Text, Not from Exposure Modeling

Species		Injury		Behavior
		Modeled Level A (SEL_{cum})	Estimated Level A	SPL_{rms}[1]
Low-frequency	Blue whale*	0	0	1
	Fin whale*	17.7	4.4	55.2
	Humpback whale	12.9	3.3	56.2
	Minke whale	122.2	24.9	342.6
	North Atlantic right whale*	7.9	0	23.8
	Sei whale*	6.3	2.2	21.7
Mid-frequency	Atlantic spotted dolphin	0	0	37.9
	Atlantic white-sided dolphin	0	0	507.9
	Bottlenose dolphin	0	0	222.6
	Common Dolphin	0	0	4,816.7
	Long-finned pilot whale	0	0	31.4
	Short-finned pilot whale	0	0	31.4
	Risso's dolphin	0	0	30.3
	Sperm whale*	0	0	8.7
High-frequency	Harbor porpoise	4.4	1.1	674.3
Phocids (in water)	Gray seal	2.2	1.1	700.2
	Harbor seal	8.8	2.2	1,573.2
	Harp seal	7.2	0	1,264.3

Source: Sunrise Wind 2023b

Notes: values extrapolated to 94 WTGs from the estimates of Level A harassment and Level B harassment for 87 WTGs using static density by area method described in Sunrise 2023b.

[1] Unweighted thresholds (NMFS 2005).

* Listed as Endangered under the ESA.

Overall, the use of protection measures would reduce the likelihood of injury-level noise exposure to marine mammals. These measures would effectively avoid and minimize harmful noise exposure in most cases; however, the effect areas for PTS impacts to low-frequency cetaceans, auditory masking, and behavioral impacts to all marine mammal species are large enough that the potential for exposure cannot be ruled out. Some individual marine mammals, most likely belonging to the low-frequency cetacean group, could suffer permanent hearing injuries. Depending upon the severity of the injury, affected individuals may be less able to communicate, feed effectively, or identify predators. This could adversely affect the long-term survival and fitness of multiple individuals within a species. Masking and behavioral effects may include decreased ability to communicate, find food, or identify predators; increased physiological stress; interruption of feeding; and avoidance of desirable habitats and interruption of feeding. These physiological and behavioral effects are likely to dissipate within hours to days after the exposure ceases (NMFS 2020; Pyć et al. 2018). The potential for injury, PTS, TTS, and repeated intermittent behavioral disturbances would create short-term, moderate impacts to NARWs and all other marine mammals from the proposed Project. Additional monitoring and mitigation would be required as described in Section 3.11.11 to decrease the potential impacts for NARW all other marine mammals.

Impact pile driving noise could kill or injure or temporarily alter the distribution of fish and invertebrate prey (refer to Section 3.7, *Benthic Habitat*, and Section 3.10, *Finfish, Invertebrates, and Essential Fish Habitat*) leading to indirect effects on marine mammal prey resources. These effects are limited in extent, short-term, and are unlikely to measurably affect the amount of prey available to marine mammals across the OCS. Therefore, the indirect adverse effects of underwater noise on marine mammal prey species would be negligible.

Vibratory piling-driving noise: Although vibratory pile-driving noise can cause behavioral effects at greater distances compared to impact pile driving noise (NMFS 2022), the overall sound levels are less intense and less likely to cause injury. Low-frequency cetaceans would have to remain within 16 ft (4.9 m) over an entire day of vibratory pile driving during temporary cofferdam installation to experience permanent hearing injury, while high-frequency cetaceans would need to remain within less than 591 ft (180.1 m) from the cofferdam installation for an entire workday to experience hearing injury. Phocid pinnipeds would need to remain closer than 34 ft (10.4 m) from cofferdam installation to experience hearing injury. It is unlikely that highly mobile species like whales and seals would remain so close to a source of behavioral disturbance for an entire construction day, meaning that the likelihood of permanent hearing injury is low. Sunrise Wind (2022c) evaluated potential marine mammal exposure to 8-hour periods of vibratory pile driving occurring between October 1 and May 31 and concluded that cofferdam installation would not result in PTS effects on any of the 11 marine mammal species likely to occur in this noise exposure area. In contrast, depending on the month in which the activity occurs, 8 to 11 of these species could experience TTS or behavioral exposures (Table 3.11-14).

Table 3.11-14. Ranges to Level A Harassment from Cumulative Sound Exposure Levels and Level B Harassment from Vibratory Pile Driving for Marine Mammal Hearing Groups. Results are Maximum Modeled Distances Vibratory Installation of Metal Sheet Piles for Cofferdam Installation at the Export Cable Landfall Site

Hearing Group	Level A		Level B SPL Threshold: 120 dB re 1 µPa Distance (m)
	Sound Exposure Levels (SEL) Threshold[1] (dB re 1 $\mu Pa^2 s$)	Distance (m)	
Low-frequency cetaceans (Baleen whales)	199	5	9,740
Mid-frequency cetaceans (Dolphins & other toothed whales)	198	0	9,740
High-frequency cetaceans (Porpoises)	173	210	9,740
Phocid pinnipeds (Seals)	201	10	9,740

Source: COP, Appendix I1, Küsel et al 2022.

1 Threshold of accumulated sound energy based on weighted exposure values that may result in PTS (permanent hearing injury) from NMFS 2018.

Monitoring and mitigation for vibratory pile installation includes the use of PSOs, pre-clearance and shutdown zones, and ramp-up procedures during days with decrease visibility of the shutdown zone. The pre-clearance and shutdown zone would be 492.1 ft (150 m) for all cetaceans. The PSO would halt pile driving if an individual enters the shutdown zone, and pile driving would not resume until the individual has left the shutdown zone and no animals have been observed for at least 15 minutes (dolphins, porpoises, and seals) or 30 minutes (whales). Appendix H describes the monitoring and mitigation for vibratory pile driving in further detail.

Behavioral effects for all marine mammals may extend 31,955.4 ft (9,740 m) based on NMFS unweighted threshold of 120 dB re 1 $\mu Pa^2 s$. These effects would be short-term and intermittent and would result in short-term changes to behavior that may include avoidance, reduced communication, increased volume of vocalizations, and suspension of foraging activities. Based on the duration of these potential impacts, it is not expected that any population-level effects would occur to marine mammals from vibratory pile driving actions.

Because vibratory pile-driving impacts would occur on a limited number of days and have a small area of potential auditory injury that would be monitored by protected species observers with shutdown zones, vibratory pile-driving noise from construction of the Proposed Action would result in minor, short-term impacts on NARWs and all other marine mammals.

Vessel noise: Denes et al. (2020) modeled the distance required for construction vessel noise to drop below marine mammal behavioral thresholds. They determined that marine mammals would have to remain within 115 to 367 ft (35 to 112 m) of a stationary vessel using its dynamic positioning thrusters for 24 hours to experience cumulative injury. Construction vessel noise would exceed marine mammal behavioral thresholds over a larger area, extending from 42,362 to 48,077 ft (12,911 to 14,654 m) from the source. The likelihood of any marine mammal species remaining close enough to a construction vessel for long enough to experience hearing injury is remote because marine mammals are mobile and unlikely to stay so close to noise exceeding behavioral thresholds for extended periods. Vessels underway produce lower noise levels and are moving, so the likelihood of injury-level exposure for any marine mammal species is similarly remote.

Noise associated with cable laying would be produced by vessels and equipment during route identification, trenching, jet plow embedment, backfilling, dredging, and cable protection installation. Noise intensity and propagation would depend upon bathymetry, local seafloor characteristics, vessels, and equipment used (Taormina et al. 2018). Modeling estimates that underwater noise would remain above the 120 dB SPL threshold in an area of 98,842 ac (400 km^2) near the source (Bald et al. 2015; Nedwell and Howell 2004; Taormina et al. 2018). Assuming cable laying activities occur 24 hours per day and vessels continually move along the cable route, then estimated ensonified areas would not remain in the same location for more than a few hours (developed using Kirkpatrick et al. [2017]). Although this suggests a large area of effect, it is important to place construction vessel noise in context with the existing underwater noise environment. A significant proportion of cable-laying activities would cross through high vessel traffic areas (see COP, Appendix X, DNV-GL 2022) where ambient underwater noise levels are likely to exceed the 120 SPL behavioral threshold. Based on existing conditions, the potential impacts from cable laying noise are expected to be minor for NARWs and all other marine mammals.

Although construction vessels can produce noise levels sufficient to cause behavioral effects in marine mammals, BOEM anticipate that significant impacts affecting many individuals are unlikely given the patchy distribution of species in the direct effects area. In addition, a substantial portion of construction vessel activity would occur in an area having high levels of existing levels of vessel traffic. Construction vessel noise would be similar to baseline noise levels produced by existing large vessel traffic in the vicinity. BOEM concludes that although some individual marine mammals may experience short-term behavioral effects from vessel noise exposure, the limited nature of these effects and number of individuals affected would not be significant at stock or population levels. On this basis, the effects of vessel noise on NARWs and all other marine mammals would be short-term and minor.

Aircraft noise: Additional sources of non-impulsive noise associated with construction of the Proposed Action include aircraft noise. Fixed-wing aircraft may be used during construction for marine mammal monitoring, and helicopters may be used for crew transport to and from construction vessels. Monitoring aircraft would operate at an altitude of 1,000 ft (300 m) consistent with established guidance. Aircraft operations at these altitudes have not been associated with observable behavioral effects on marine mammals (Patenaude et al. 2002). Noise from crew transport helicopters would increase during approach and departure from vessel landing pads but would not be expected to exceed disturbance thresholds or add significantly to behavioral disturbance caused by the presence of the vessels. For this reason, the effects of noise from aircraft operations on marine mammals would be negligible. Additional details on aircraft helicopter operations are provided in Appendix I3 of the COP (Stantec 2022a).

EMF: Because EMFs are generated by power production when WTGs are operating, no effects from the IPF are expected during construction of the offshore facilities.

Accidental releases – contaminants: Accidental discharges and releases represent a risk factor to marine mammals because marine mammals could potentially ingest, inhale, or have their fur or baleen fouled by contaminants. 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 (Mohr et al. 2008; Sullivan et al. 2019; Takeshita et al. 2017).

Project-related marine vessels operating during construction would be required to comply with regulatory requirements for management of onboard fluids and fuels including prevention and control of discharges. Trained, licensed vessel operators would adhere to navigational rules and regulations, and vessels would be equipped with spill containment and cleanup materials. Additionally, Sunrise Wind would comply with applicable international (IMO MARPOL), federal (USCG), and state (NY) regulations and standards for reporting treatment and disposal of solid and liquid wastes generated during all phases of the proposed Project. As described in the COP, Appendix E1 (Sunrise Wind 2020), some liquid wastes would be permitted as discharge into marine waters (i.e., domestic water, deck drainage, treated sump drainage, uncontaminated ballast water, and uncontaminated bilge water); these are not expected to pose an adverse impact to marine resources as they would quickly disperse, dilute, and biodegrade (BOEM 2013).

All vessels would similarly comply with USCG standards regarding ballast and bilge water management. Liquid wastes from vessels (including sewage, chemicals, solvents, and oils and greases from equipment) would be properly stored, and disposal would occur at a licensed receiving facility. As required by 30 *CFR* 585.626, chemicals to be utilized during the Project are provided in COP, Appendix E1 (Sunrise Wind 2020). Any unanticipated discharges or releases are expected to result in minimal, short-term impacts; activities are heavily regulated, and unpermitted discharges are considered accidental events that are unlikely to occur. In the unlikely event that a reportable spill was to occur, the National Response Center would be notified, followed by the USEPA, BOEM, and USCG, as outlined in COP, Appendix E1 (Sunrise Wind 2020). Because of the restrictions and mitigation measures designed to prevent spills and discharges, and the implementation of spill response plans, the risk to NARWs and all other marine mammals from discharges and releases is negligible.

Accidental releases – trash and debris: Construction vessels pose a theoretical source of marine debris and accidental discharges of petroleum products and other toxic substances. Marine debris are a known source of adverse effects to marine mammals (Laist 1997; NOAA-MDP 2014a; 2014b). BOEM prohibits the discharge or disposal of solid debris into offshore waters during any activity associated with the construction and operation of offshore energy facilities (30 *CFR* 250.300). The USCG similarly prohibits the dumping of trash or debris capable of posing entanglement or ingestion risk (MARPOL, Annex V, Public Law 100−220 (101 Stat. 1458)). The Project would comply with these requirements. Given these restrictions, the risk to NARWs and all other marine mammals from trash and debris from the Project is negligible.

Traffic (vessel strikes): Risk of collision injury is commensurate with vessel speed. The probability of a vessel strike increases significantly as speeds increase above 10 kt (Conn and Silber 2013; Kite-Powell et al. 2007; Laist et al. 2001; Vanderlaan and Taggart 2007). Vessels operating at speeds exceeding 10 kt under poor visibility conditions have been associated with the highest risk for vessel strikes of NARWs (Vanderlaan and Taggart 2007). Collision risk decreases significantly at speeds below 10 kt (Conn and Silber 2013); however, collisions at lower speeds are still capable of causing serious injury even when smaller vessels (<20 m length) are involved (Kelley et al. 2021). Vessel strikes are also implicated in sea turtle mortality, with collision risk similarly commensurate with vessel speed although at much lower speeds (Hazel et al. 2007; Shimada et al. 2017). Hazel et al. (2007) found that green sea turtles were unlikely to actively avoid vessels traveling faster than 2.1 kt (4 km/hour), indicating that voluntary speed restrictions below 10 kt may not be fully protective for this and potentially other sea turtle species.

In general, large vessels travelling at high speeds pose the greatest risk of serious injury or mortality to ESA-listed marine mammals, whereas sea turtles and sturgeon are vulnerable to a range of vessel types depending on the environment. Large vessels used during Proposed Action construction would likely include a cable-laying vessel (1), a rock-dumping vessel (1), jack-up barge (1), material and feeder barges (6) and tow tugs (4), a work vessel (1), and a fuel bunkering vessel (1). Similar vessels would be used during decommissioning. These vessels would largely remain on station or travel at speeds well below 10 kt during construction and decommissioning of the SRWF and SRWEC.

Other vessels used during construction would include crew transports and inflatable support vessels used for PSO monitoring. These vessels would adhere to speed restrictions and other mitigation measures outlined elsewhere in this document and, in general, are smaller and more maneuverable and better able to avoid collisions with protected species when combined with observers. For this reason, these vessels would pose a minimal risk of collision with ESA-listed species. Based on information provided by Sunrise Wind, Project construction would require an estimated total of 1,575 vessel trips between SRWF and ports in Rhode Island, Massachusetts, Connecticut, and New York over the 2-year construction period, with an estimated maximum of nine trips in any given month from U.S. ports outside of the Rhode Island/Massachusetts WEAs. Port traffic within the Rhode Island/Massachusetts WEAs would add an additional 127 one-way trips during WTG installation and 146 one-way trips during cable installation to the SRWF. The construction vessels used for Project construction are described in Table 3.11-15 and Figure 3.11-2. Typical large construction vessels used in this type of project range from 325 to 350 ft (99 to 107 m) in length, 60 to 100 ft (18 to 30 m) in beam, and draft from 16 to 20 ft (5 to 6 m) (Sunrise Wind 2022a). All project vessels operating between local ports and the Project Area would be required to comply with the mitigation described in Section 3.2 as well as the final Protected Species Mitigation and Monitoring Plan (PSMMP). Construction vessels pose a potential collision risk and generate disturbance and artificial light. Long (2017) observed that marine mammals were temporarily displaced by offshore energy facility construction vessels. Based on information provided by Sunrise Wind, Project construction would require an estimated total of 50 vessel trips between the Port of New London, Connecticut, and the SRWF over the 2-year construction period, with an estimated maximum of six trips in any given month from U.S. ports outside of the RI-MA WEAs. Port traffic within the RI-MA WEAs would add an additional 127 one-way trips during WTG installation and 146 one-way trips during cable installation to the SRWF. Depending on the contractor selected, up to eight construction vessels could travel to the Lease Area from unspecified ports in Europe or elsewhere in the world. The construction vessels used for Project construction are described in Section 3.3.10 and Table 3.3.10-3 of the COP (Sunrise Wind 2023a). Typical large construction vessels used in this type of project range from 325 to 350 ft (99 to 107 m) in length, 60 to 100 ft (18 to 30 m) in beam, and draft from 16 to 20 ft (5 to 6 m) (Denes et al. 2020).

NMFS (2020) evaluated marine mammal collision risk for the similarly sized Vineyard Wind project. They concluded that the collision risk was negligible because of the nature of construction and planned mitigation measures which include vessel strike avoidance measures. Specifically, construction vessels either remain stationary when installing the monopiles and WTG/OSS equipment or move slowly (i.e., at less than 10 knots) when traveling between foundation locations. Cable laying vessels move very slowly on the order of 1 mile per day.

The Proposed Action includes mitigation and monitoring requirements that are fully detailed in Appendix H. Vessels related to project planning, construction, and operation shall travel at speeds in accordance with NOAA requirements or the agreed to adaptive management plan per to Project PSMMP (Sunrise Wind 2022c) when assemblages of cetaceans are observed. Vessels would also maintain a reasonable distance from whales and small cetaceans, as determined through site-specific consultations. Project-related vessels would 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. Operators shall be required to undergo training on applicable vessel guidelines, the identification of protected species, and observation skills. Vessel operators would monitor NMFS 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 SMAs and/or DMAs. Within the SMAs and/or DMAs, vessel operators would implement the adaptive vessel speed plan in accordance with the PSMMP based on observations of NARW.

Planned mitigation measures, including voluntary speed restrictions and vessel operator training, would effectively limit collision risk when traveling to and from area ports. The Proposed Action would involve a similar number of vessels and vessel trips and would employ a similar suite of mitigation measures to those proposed for the Vineyard Wind project analyzed by NMFS. On this basis, BOEM concludes that collision-related effects on NARWs and all other marine mammals from the proposed Project are negligible.

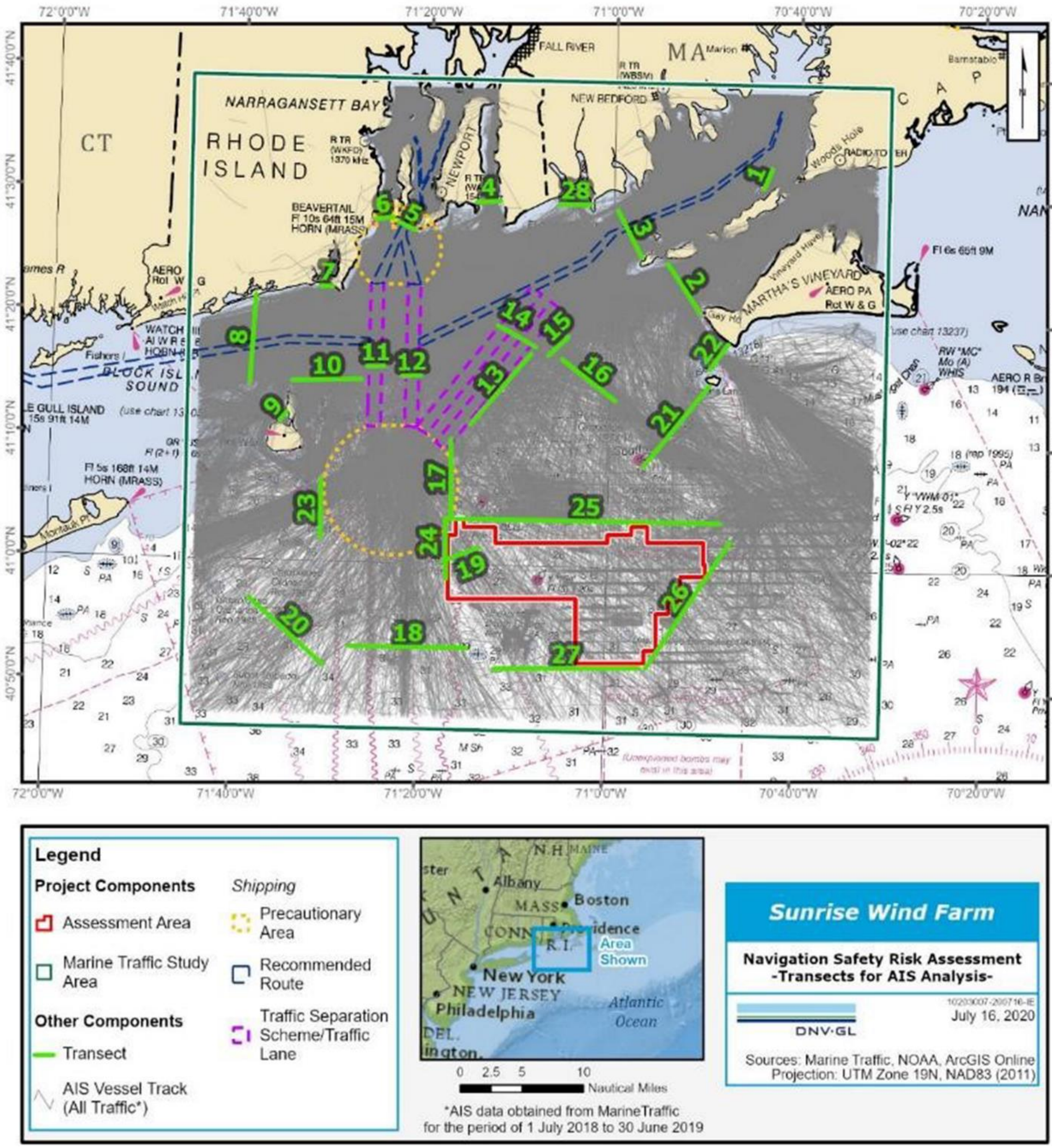
Table 3.11-15. Vessels and Unmanned Systems Proposed for the Sunrise Wind Project

Vessel Type	# of Vessels	Foundations	OCS–DC	SRWEC	IAC	WTGs
Heavy Lift Installation Vessel	2	X	X			
Multi-Purpose Supply Vessel	3	X	X			
Heavy Transport Vessel	5		X			
Rock Dumping Vessel	2	X	X			
Bubble Curtain Vessel	2	X	X			
Fuel Bunkering Vessel	2	X	X			
Transportation Barge	3	X	X			
Escort Tug for Barge	3		X			
Towing Tug	6	X	X			X
Anchor Handling Tug	2	X	X	X		
Assisting tug	2					X
Platform Supply Vessel	1					X
Jack-Up Vessel/Jack-up Accommodation Vessel	2	X	X	X	X	X
Transport Freighter	3			X		
Support Barge	1			X		
Boulder Clearance Vessel	2			X	X	
Sand Wave Leveling Vessel	2			X	X	
Pre-lay Grapnel Run Vessel	2			X	X	
Cable Laying Vessel	3			X	X	
Cable Burial Vessel	2			X	X	
Cable Remedial Protection Vessel	2			X	X	
Array Walk-2-Work Vessel	1				X	
Survey Vessel	5			X	X	
Crew Transfer Vessel	5	X	X	X	X	X
Guard / Safety Vessel	5	X	X	X	X	X
Service Operating Vessel	1	X	X		X	X

Source: Sunrise Wind 2023b

Notes: IAC = Inter-array Cable; OCS–DC = Offshore Converter Station; SRWEC = Sunrise Wind Export Cables; WTG = wind turbine generator

During construction, an estimated 924 vessel trips per year would cross transects 24 through 27 when transiting to and from SRWF (Figure 3.11-2). This would equate to a 64 percent increase in vessel traffic within the SRWF area; however, the Automatic Identification System (AIS) data used in transect analysis do not include many recreational vessels that lack AIS transponders and commercial fishing vessels that deactivate their transponders when actively fishing. These two vessel classes account for the vast majority of vessel activity. For example, Sunrise Wind (2022a) estimated 19,611 one-way trips per year by commercial fishing vessels between the SRWF and area ports. When commercial fishing vessel trips are included, Project construction and installation would result in a 4.4 percent increase in vessel transits per year across transects 24 through 27 during the construction and installation phase. In summary, this assessment indicates that construction and installation vessels would likely increase vessel traffic to some degree over baseline conditions. This indicates the potential for increased risk of marine mammal collisions, but that risk is mitigated in part by typically reduced vessel speeds during construction and installation, low relative increase in vessel traffic, and by proposed risk avoidance and minimization measures.



Source: Sunrise Wind 2022a

Figure 3.11-2. Transects Used for Analysis of Vessel Traffic

The Proposed Action includes mitigation and monitoring requirements that are fully detailed in Appendix H (*Mitigation and Monitoring*). Vessels related to project planning, construction, and operation shall travel at speeds in accordance with NOAA requirements or the agreed to adaptive management plan per the Project PSMMP (Sunrise Wind 2022a) when assemblages of cetaceans are observed. Vessels would also maintain a reasonable distance from whales and small cetaceans, as determined through site-specific consultations. Project-related vessels would 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. Operators shall be required to undergo training on applicable vessel guidelines, the identification of protected species, and observation skills. Vessel operators would monitor NMFS NARW reporting systems (e.g., the Early Warning System, Sighting Advisory System) daily for the presence of NARWs during planning, construction, and operations within or adjacent to SMAs and/or DMAs. Within the SMAs and/or DMAs, vessel operators would implement the adaptive vessel speed plan in accordance with the PSMMP based on observations of NARWs.

With the implementation of known and highly effective measures such as reduced vessel speeds and ships maintaining minimum distances from marine mammals, vessel strikes are not anticipated to occur; as such, there would be no effect. However, if a vessel strike of a NARW was to occur, this impact could be major and long term. Given general population status, any vessel strikes to non-NARW mysticetes would be minor to moderate, and vessel strikes to odontocetes and pinnipeds would be negligible to minor. However, given implementation of the APMs, vessel strike risk is very low and not anticipated to occur. There would be no effect on all marine mammals if no vessel strikes occur. Therefore, anticipated impacts of vessel traffic during construction are negligible to minor adverse from potential behavioral effects only for NARWs and all other marine mammals, with no anticipated and potentially more serious impacts from vessel strikes anticipated.

Gear utilization - fisheries surveys: The Fisheries and Benthic Research Monitoring Plan (FBRMP) for the Proposed Action has been developed in accordance with recommendations set forth in *Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf* (BOEM 2019; NMFS 2016b). The slow speed of mobile gear and the short tow times further reduce the potential for entanglements or other interactions for all mammals. Observations during mobile gear use have shown that entanglement or capture of large whale species is extremely rare and unlikely (NMFS 2016c). Although the trawl methods analyzed in commercial fisheries are comparable to the fishery monitoring methods proposed, the proposed trawl effort and tow times (20 minutes) for the proposed fisheries monitoring surveys are less than that previously considered by NMFS for commercial trawling activities. Consequently, the likelihood of interactions with listed species of marine mammals is lower than commercial fishing activities. Based on the above analysis, the likelihood of any potential impacts to is extremely unlikely to occur and the potential for impacts to NARWs and all other marine mammals is negligible.

Gear utilization - fisheries survey impacts to prey: Fisheries surveys are designed not to have measurable impacts to surveyed resources and are not anticipated to have any measurable impact on prey availability for marine mammals. Tow durations for trawl surveys would be short (20 minutes) and would sample only extremely small portions of the Project Area. All trawl bycatch would be returned to the water whether alive or dead. Trap surveys may capture small numbers of prey resources for odontocetes and pinnipeds but would not capture plankton, copepods, and small schooling fish that constitute capture prey items for mysticetes. Overall, the effects of fisheries surveys on potential prey resources would be so small that they cannot be meaningfully measured or evaluated and would have negligible impact to marine mammals.

Gear utilization - passive acoustic monitoring surveys: The use of PAM buoys or autonomous PAM devices to monitor noise, marine mammals, passive acoustic telemetry tags, and the use of sound attenuation devices placed on the seafloor for mitigation during pile driving have been proposed by Sunrise Wind (Sunrise Wind 2023a).

Based on previous consultations, BOEM anticipates requiring that moored and autonomous PAM systems that may be used for monitoring would either be stationary (e.g., moored) or mobile (e.g., towed, autonomous surface vehicles [ASVs], or autonomous underwater vehicles [AUVs]), respectively. Both fixed and mobile PAM systems have been recommended for marine mammal mitigation and long-term monitoring related to offshore wind development (Van Parijs et al. 2021). Moored PAM systems would use the best available technology to reduce any potential risks of entanglement, particularly a bottom-mounted mooring system without a surface buoy. PAM system deployment would follow the procedures described in the PSMMP to avoid and minimize impacts on ESA-listed species. The use of buoys for moored PAM systems, or any other intended purposes, would pose a negligible risk of entanglement to listed marine mammals.

Autonomous PAM systems could have hydrophone equipment attached that operates autonomously in a defined area. ASVs and AUVs in very shallow water can be operated remotely from a vessel or by line of sight from shore by an operator and in an unmanned mode. These autonomous systems are typically very small, lightweight vessels and travel at slow speeds. ASVs and AUVs produce virtually no self-generated noise and pose a negligible risk of injury to marine mammals from collisions due to their low mass, small size, and slow operational speeds. ASVs and AUVs are not expected to pose any reasonable risk of harm to listed species. Based on the above information, the potential impacts to NARWs and all other marine mammals from PAM is negligible.

Port utilization: Impacts from port utilization from construction and operation of SRWF are anticipated to be negligible for all marine mammals. Port expansion is unlikely to be needed for the Proposed Action. However, if it does occur, those 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. The impacts on water quality from sediment suspension during port expansion activities is temporary and short term, and would be similar to those described under the cable emplacement and maintenance IPF above, and are anticipated to be negligible for NARWs and all other marine mammals.

Lighting: Artificial lighting during SRWF construction would be associated with navigational and deck lighting on vessels from dusk to dawn. It is likely that reaction of marine mammals to this artificial light is species-dependent and may include attraction or avoidance of an area. Artificial lighting may disrupt the diel migration of some prey species, which may secondarily influence marine mammal distribution patterns. Observations at offshore oil rigs showed dolphin species foraging near the surface and staying for longer periods of time around platforms that were lit (Cremer et al. 2009). Only a limited area around Project-related vessels would be lit, relative to the surrounding unlit open ocean areas, therefore impacts to NARWs and all other marine mammals are negligible during construction.

Presence of structures: The potential impacts from the presence of structures created during the construction process are discussed below in the analysis for O&M.

3.11.5.2 Operations and Maintenance

3.11.5.2.1 Onshore Activities and Facilities

O&M of onshore facilities is not expected to have any impacts to marine mammals.

3.11.5.2.2 Offshore Activities and Facilities

Seafloor disturbance: Seafloor disturbance during O&M would primarily result from vessel anchoring and jack-up and any maintenance activities that would require exposing and reburying the IAC. These activities are expected to be non-routine events and are not expected to occur with any regularity. It is likely that pelagic and mobile benthic prey species present near the SRWF during any maintenance activities would temporarily avoid the area in which activities are occurring, and zooplankton species may face localized, short-term displacement; however, any alterations to marine mammal prey distributions are expected to occur over a small scale and a short period. Therefore, the potential impacts to NARWs and all other marine mammals from seafloor disturbance during O&M are negligible.

Sediment suspension and deposition: Any maintenance activities that would require exposing and reburying the IAC, and the use of vessel anchoring and jack-up may result in increases in sediment suspension and deposition, which may temporarily increase turbidity in the water column. These activities are expected to be non-routine events and are not expected to occur with any regularity. As discussed for the construction phase, sediment suspension and deposition could result in very short-term reductions in availability or detectability of marine mammal prey species and would have negligible impacts on prey species targeted for consumption by NARWs and all other marine mammals in the SRWF and the overall foraging success of marine mammals.

Noise: Direct impacts to marine mammals associated with noise during O&M of the SRWEC may result from G&G surveys, WTG operation, support vessel and aircraft noise during routine and non-routine maintenance trips.

Geophysical and geotechnical survey noise*:* Short-term, localized G&G surveys during the O&M period may include the use of multi-beam echosounders, side-scan sonar, shallow penetration sub-bottom profilers, medium penetration sub-bottom profilers, and marine magnetometers. The survey equipment to be employed would be equivalent to the equipment utilized during the G&G survey campaigns associated with Lease Area OCS-A 0500 conducted in 2016, 2017, 2018, 2019, and 2020 and with Lease Area OCS-A 0487 conducted in 2018, 2019, and 2020 (Gardline 2021a; 2021b; Smultea Sciences 2020a; 2020b). Site-specific verification has been conducted of all geophysical equipment sound sources deployed within the marine portions of the proposed Project Area that operate within the functional hearing range of marine mammals. Without mitigation, certain types of G&G surveys could result in long-term, high-intensity impacts on marine mammals. These effects may include behavioral avoidance of the ensonified area and increased stress; temporary loss of hearing sensitivity; and permanent auditory injury depending on the type of sound source, distance from the source, and duration of exposure.

However, G&G noise resulting from offshore wind site characterization surveys is of less intensity than the acoustic energy characterized by seismic air guns and affects a much smaller area than G&G noise from seismic air gun surveys typically associated with oil and gas exploration. Although seismic air guns are not used for offshore wind site characterization surveys, sub-bottom profiler technologies that are hull-mounted on survey vessels may incidentally harass marine mammals and would be required to follow mitigation and monitoring measures. Typically, mitigation and monitoring measures are required by BOEM through requirements of lease stipulations and required by Incidental Take Authorizations from NMFS pursuant to Section 101(a)(5) of the MMPA. Mitigation and monitoring measures would lower the stock-level effects of the take of any marine mammals to negligible levels, as required by the MMPA, including potential for adverse behavioral responses and auditory injury (PTS/TTS). Similarly, the requirement to comply with avoidance and minimization measures for these surveys would avoid any effects on individuals that could result in population-level effects to threatened and endangered populations listed under the ESA. G&G surveys performed during O&M would adhere to the same mitigation requirements described above for construction and installation and detailed in Appendix H.

Table 3.11-16. Estimated Level B Harassment from 3 Years of High-resolution Geophysical Surveys during Operations

Group	Species	# of Individuals Exposed
Low-frequency	Blue whale*	3
	Fin whale*	12
	Humpback whale	21
	Minke whale	27
	North Atlantic right whale*	9
	Sei whale*	6
Mid-frequency	Atlantic spotted dolphin	87
	Atlantic white-sided dolphin	84
	Bottlenose dolphin	117
	Common dolphin	2,715
	Pilot whale	27
	Risso’s dolphin	18
	Sperm whale*	6
High-frequency	Harbor porpoise	165
Pinnipeds	Gray seal	141
	Harbor seal	318

Source: Sunrise Wind 2023b

* ESA Listed Species

NMFS and BOEM anticipate requiring sufficient monitoring and mitigation measures for G&G surveys to avoid the risk of any auditory or non-auditory injury to NARWs and all other marine mammals. Because of the required monitoring and mitigation measures, impulsive noise from G&G surveys may result in negligible to minor adverse impacts on NARWs and all other marine mammals.

WTG noise: Operating WTGs produce mechanical noise that can transmit in the water column through the foundations, resulting in continuous underwater noise that is audible to marine mammals. The frequency and sound level generated from operating WTGs depends on WTG size, wind speed and rotation, foundation type, water depth, seafloor characteristics, and wave conditions (English et al. 2017; HDR 2019) (COP, Appendix O1; Stantec 2022b). The number of WTGs in the SRWF may present complex acoustic environments and potentially accumulative noise when assessed as a whole rather than as individual WTGs. Madsen et al. (2006) estimated that noise propagated from wind farms may be audible to low-frequency cetaceans up to 12.4 mi (10.8 nm; 20 km) away before reaching an ambient one-third octave band SPL of 90 dB; however, this was in an area with no masking influence from shipping traffic and using the same calculations, the behavioral SPL threshold of 120 dB would be reached within 390 ft (119 m) of the turbine.

Notably, some marine mammal species (seals, mid-frequency cetaceans, high-frequency cetaceans) may be attracted to operational wind farms for foraging and shelter (Hammar et al. 2010; Russell et al. 2014). Aggregation of marine mammals around operational wind farms may indicate noise levels are insufficient to elicit behavioral disturbances or that the individuals become habituated to WTG noise (Teilmann and Carstensen 2012). Madsen et al. (2006) noted that due to the low SPLs from WTGs, operations were unlikely to cause hearing impairment to marine mammals; however, the noise produced by wind farms and potential impacts should be assessed within the context of the surrounding acoustic environment. There is no published literature assessing long-term movement of baleen whales in and around offshore wind farms.

While operational WTG noise would be present throughout the 25- to 35-year life of the proposed Project, the severity of potential impacts to marine mammals during O&M would be less than during the construction phase as there is no potential for physiological impacts due to WTG noise (Madsen et al. 2006; Scheidat et al. 2011). During O&M, anticipated impacts are limited to audibility and short-term, reversible behavioral responses such as changes in foraging, socialization or movement, or auditory masking, which could impact foraging and predator avoidance (MMS 2007).

Any operational noise effects from the SRWF are likely to be of low intensity and highly localized. Jansen and de Jong (2016) and Tougaard et al. (2009) concluded that marine mammals are able to detect operational noise within a few thousand feet of WTGs, but the effects would have no significant impacts on individual survival, population viability, distribution, or behavior. Newer generation WTGs use direct drive motors that produce less noise and vibration than the models considered in the currently available research (Elliott et al. 2019; Tougaard et al. 2020), indicating that the effects of the proposed Project would likely be lower. On this basis, the effects of operational noise on NARWs and all other marine mammals would be minor.

Vessel noise: Throughout the operational life of the Sunrise Wind Project, Sunrise Wind expects to use a variety of vessels to support O&M including service operating vessels (SOVs) with deployable work boats (daughter craft), crew transfer vessels (CTVs), jack-up vessels, and cable laying vessels. Project vessels would undergo routine maintenance trips between the SRWF and potential ports in New York and Rhode Island. The types of impacts from vessel use during O&M would be similar to those described for construction, but the vessel traffic from O&M would be distributed over a much longer time period and result in fewer behavioral disruptions in any given year. Marine mammal individuals may experience direct, short-term, reversible behavioral disruptions due to the incremental contribution of O&M vessels at levels comparable to existing ambient vessel noise in the region. BOEM has concluded that although some individual marine mammals may experience short-term behavioral effects from vessel noise exposure, the limited nature of these effects and number of individuals affected would not be significant at stock or population levels. On this basis, the effects of vessel noise on NARWs and all other marine mammals would be minor.

Aircraft noise: Sunrise Wind expects to use a hoist-equipped helicopter and may also use unmanned aircraft systems to support O&M. Access to the OCS-DC would be provided from a boat landing or potentially a helicopter with a helideck located onsite. The type and number of unmanned aircraft systems and helicopters would vary over the operational lifetime of the Project. Impacts from aircraft use during O&M would be similar to those described for construction. All aircraft activities during O&M would comply with current approach regulations for any sighted NARWs or unidentified marine mammals. The expected impacts from O&M aircraft operations are expected to be negligible for NARWs and all other marine mammals.

EMF: The proposed Project would consist of two offshore electric transmission systems: 180 mi (290 km) of 161 kV alternating current IAC and up to 106 mi (170 km) of 320 kV direct current SRWEC. These effects would be most intense at locations where the SRWEC cannot be buried and is laid on the bed surface covered by a stone or concrete armoring blanket. Approximately 5 percent of the SRWEC (5.2 mi [8.4 km] of the SRWEC cable and up to 15 percent of the IAC (27 mi [43.4 km] would require secondary cable protection. Exponent Engineering, P.C. (2018) modeled anticipated EMF levels generated by the SRWEC and IAC. It estimated induced magnetic field levels ranging from 110 to 392 mG on the bed surface above the buried and exposed SRWEC cable and 4.6 to 61 mG above the IAC. Induced field strength would effectively decrease to 0 mG within 25 ft (7.6 m) of each cable. By comparison, the earth's natural magnetic field is greater than the maximum potential EMF effect from the Project (Figure C-1, Appendix J1; Exponent Engineering P.C. 2022).

A modeling analysis of the magnetic and electric fields anticipated to be produced from Sunrise Wind's operational AC (i.e., IAC) and DC (i.e., SRWEC) cables was performed (COP, Appendix J1; Exponent Engineering P.C. 2022). Assuming a conservative minimum target burial depth and no shielding effect of cable sheathing or armoring, produced magnetic and electric fields are low and attenuate rapidly with increasing distance. For the IAC, at a height of 3.3 ft (1 m) above seabed, directly over the IAC at peak loading, AC magnetic and electric field levels were calculated to be 4.6 milligauss (mG) and less than 0.09 millivolts/meter (mV/m), decreasing to 0.5 mG and less than 0.1 mV/m or less at a horizontal distance of ±10 ft (3 m) from the cables; however, previous literature (e.g., Hutchison et al. 2018) suggest the magnetic fields and electric fields would generally be lower than the Sunrise Wind modeling suggests. For the SRWEC, DC magnetic fields over the majority of the route (where cables are bundled together) were calculated at a height of 3.3 ft (1 m) above the seabed at peak loading (assessed for permutations of four geographic directions and four cable configurations). The calculated change to Earth's ambient geomagnetic field is a maximum of ±104 mG, over the cables. The magnetic field from the cables decreases to ±41 mG at a horizontal distance of 10 ft (3 m) from the cables, contributing less than 10 percent of the ambient geomagnetic field level (approximately 506 mG). The flow of seawater within the ambient geomagnetic field from an ocean current of 2 feet per second (ft/s; 60 centimeters per second [cm/s]) induces a static DC electric field of 0.033 mV/m at a distance of ±10 ft (3 m) from the cables. At landfall, the DC magnetic field level evaluated at a height of 3.3 ft (1 m) above the seabed at peak loading was 1,730 mG above the 506 mG contributed by the geomagnetic field of the earth. The corresponding induced DC electric field over the SRWEC in a 2 ft/sec (60 cm/s) ocean current is 0.037 mV/m. The EMF present during operations would cease once the project is decommissioned.

To minimize potential effects from EMF, both the IAC and SRWEC is proposed to be buried between 4 to 6 ft (1.2 to 1.8 m) deep below the seafloor, to the extent feasible, and feature various protective armoring and sheathing. Still, the magnetic fields measured at the seafloor may be slightly higher than the naturally occurring geomagnetic field of the earth.

As marine mammals in the area would be transiting and/or foraging and would not spend significant time on the seafloor in proximity to the proposed cables, no species- or population-level impacts to marine mammals are expected. The mobile nature and surfacing behavior in marine mammals likely limit time spent near the IAC and SRWEC, reducing potential for EMF exposure. Data are limited but only minor responses, such as lingering near or attraction to cables, have been noted in electrosensitive species (e.g., elasmobranchs, benthic species) and no interactions with anthropogenic EMF from submarine cables have been recorded for marine mammals. Therefore, potential effects to NARWs and all other marine mammals from EMF exposure associated with the Sunrise Wind cable project, if present, are expected to be transient and negligible.

Operation of OCS-DC: Seawater cooling would be needed for the OCS-DC (refer to Section 3.3.6.1, COP, Sunrise Wind 2023a). During operation, the OCS-DC would require continuous cooling water withdrawals and subsequent discharge of heated effluent back to the receiving waters. The maximum DIF and discharge volume is 8.1 mgd with actual intake flow and discharge volumes that are dependent on ambient source water temperature and facility output. Preliminary hydrodynamic modeling indicates that there would be some highly localized increases in water temperature in the immediate vicinity of the discharge location of the OCS-DC. The design, configuration, and operation of the CWIS for the OCS-DC would be permitted as part of an individual NPDES permit.

The OCS-DC would include three openings for intake pipes located approximately 30 ft (10 m) above the pre-installation seafloor grade. The water depth of the intake pipe openings was selected to minimize the potential of biofouling and entrainment of ichthyoplankton and to take advantage of the cooler water temperatures found at depth to maximize cooling potential of water withdrawn. The design intake velocity at the intake screens is less than 0.5 ft/s (less than 15.25 cm/s). This intake velocity estimate is below the threshold required for new facilities defined at 40 *CFR* 125.84(c) and is protective against the impingement of marine mammals.

Based on the highly localized APEs on water temperature, it is unlikely that marine mammals would experience any impacts from cooling water discharges, and thus the potential for direct impacts would be negligible.

Operation of the seawater cooling system could potentially impact prey species for marine mammals. To analyze potential prey impacts that may be affected by OCS-DC operations, one representative species of zooplankton was considered. *Calanus finmarchicus* is a heavy-bodied, planktonic copepod that is an important prey species for several organisms in the region, including the NARW. Although additional species of zooplankton within the vicinity of the OCS-DC may also be susceptible to entrainment, *C. finmarchicus* was selected as representative due to its trophic importance in the ecosystem. Using the approach described in COP Appendix N2 (TRC 2023), the entrainment of *C. finmarchicus* from the

National Centers for Environmental Information density data was estimated to be 1.1 billion organisms annually. For context, assuming an even distribution of this species and an average depth of 148 ft (45 m), the total abundance of *C. finmarchicus* within Lease Area OCS-A 0487 (109,252 ac) would be close to 2 trillion, and the annual entrainment losses would represent less than 0.1 percent of the local population for this zooplankton species.

It is important to note that these potential estimates assume 100 percent mortality of entrained organisms. There is potential that entrained individuals would survive passage through the CWIS due to short residence time in the system and a maximum water temperature exposure of only 90°F (32°C). Entrainment survival studies at existing power plants do not include directly comparable facilities or environments, but Review of Entrainment Survival Studies: 1970–2000 by the Electric Power Research Institute (EPRI) identifies 91.4°F (33°C) as an upper threshold discharge temperature for many organisms to survive entrainment in existing power plants located along the Hudson River in New York (TRC 2003). These potential mechanisms for entrainment survival have not yet been applied to this analysis but could be considered when evaluating overall biological impacts of the OCS-DC operation. Because the total entrained portion of the population of prey is less than 0.1 percent, and survival rates are likely higher than the assumed 100 percent mortality associated with entrainment in the cooling water system, the proportion of prey base that may be affected by the operation of the cooling water system is insignificant, and therefore impacts from the operation of the CWIS for the OCS-DC are anticipated to be negligible for NARWs and all other marine mammals.

Accidental releases – contaminants: Impacts from accidental discharges and releases of contaminants during O&M are expected to be similar to, but of lesser likelihood than during, construction as there would be fewer Project-related marine vessels during this phase, and regulatory requirements and preventative measures would still apply. Unpermitted discharges or releases are considered accidental events, and, in their unlikely occurrence, these are expected to result in minimal, short-term impacts. Permitted discharges are not expected to pose an adverse impact to marine resources as they would quickly disperse, dilute, and biodegrade (BOEM 2013). Because the effects of authorized discharges would be extremely localized and accidental discharges are considered to be very unlikely, impacts from discharges and releases during O&M would be negligible for NARWs and all other marine mammals.

Accidental releases – trash and debris: Impacts from Project-related marine disposal of trash and debris during O&M are expected to be similar to, but of lesser likelihood than during, construction as there would be fewer Project-related marine vessels during this phase, and regulatory requirements and preventative measures would still apply. The unanticipated marine disposal of trash and debris is considered an unpermitted, accidental event, and containment and good housekeeping practices would be implemented to minimize the potential.

Indirectly, there may be an increased number of commercial and recreational fishing vessels that operate around the SRWF, which could increase the occurrence of trash and debris from these vessels being released in the SRWF. This could also increase the potential entanglement risk from netted fishing gear, longlines, ropes, traps, or buoy lines. Although unlikely, there is potential for entanglement or ingestion of line by marine mammals in the vicinity. Adverse impacts incurred from increased fishing activity in the SRWF are not anticipated, but in the event that a line or cable is lost, it could then present a higher risk to species entanglement including for the NARW. While such entanglements have the potential for a prolonged impact on the individual and may result in mortality, O&M of the SRWF is not expected to directly increase this risk. Therefore, project impacts from trash and debris during O&M would be negligible for NARWs and all other marine mammals.

Traffic (vessel strikes): The general risks for vessel strike are described above in the section for vessel traffic associated with Construction and Installation (Section 3.11.5.2) and are applicable to vessel traffic associated with O&M as well. Sunrise Wind expects to use a variety of vessels to support O&M, including SOVs with deployable work boats (daughter craft), CTVs, jack-up vessels, and cable laying vessels. During O&M, SRW anticipates using five vessel types (three for routine activities and two for non-routine activities). Table 3.11-15 provides a summary of O&M vessels currently being considered for support of O&M activities (Sunrise Wind 2023a). Although the type and number of vessels would vary over the operational lifetime of the Project, two vessel types are currently being considered for O&M of the SRWF. There would be fewer vessels used for routine maintenance trips than for construction or non-routine maintenance, but they would occur over a longer period considering the 25- to 35-year operational life of the proposed Project. During SRWF O&M activities, the SOV would remain within the SRWF for up to 28 days and would, therefore, not make daily trips to port; crew changes would occur every 14 days via CTVs. Potential ports expected to be utilized during O&M of the Sunrise Wind Project are detailed in the COP, Sections 3.3.10 and 3.5.5 (Sunrise Wind 2023a).

Sunrise Wind has estimated that proposed Project O&M would involve an estimated 76 trips per year, or 2,660 vessel trips over the lifetime of the Project. The majority of vessel trips (2,500) would originate from the Montauk O&M facility, with rare vessel trips (less than one per month) originating from New London, Connecticut, or potentially other unspecified ports (Table 3.14-3). The increase in vessel traffic of 76 vessel trips per year represents a 0.4 percent increase of vessel traffic within the Project Area. The negligible increase in vessel traffic during O&M is not expected to lead to a significant increase in risk of collision with ESA-listed species due to the low number of vessel transits and the low density of these species in the SRWF and SRWEC.

Passenger vessels as well as O&M related vessels are likely to increase within the Project Area if the proposed Project is operational as the WTGs are likely to increase public interest and the presence of recreational boaters in the area. Within the SRWF, potential impacts to marine mammals during O&M include direct effects from vessel strike and behavioral disturbance, and indirect effects from increased fishing vessel presence. However, overall vessel traffic for the region from passenger and recreational vessels is unlikely to change from vessel traffic levels excepted without the Proposed Action and, therefore, is unlikely to increase the risk of passenger and vessel strike risk to marine mammals. As potential effect of vessel traffic on marine mammals is a regionwide concern, BOEM is currently evaluating risk to whales from offshore vessel activities that support wind development. Results of this study are expected to contribute to existing knowledge and to inform decision-making on potential mitigation needs for vessel risks to whales in the U.S. north, mid-, and south Atlantic WEAs.

To monitor the number of vessels and traffic patterns for analysis and compliance with vessel speed requirements, all vessels associated with the proposed Project would be required to have operational AIS. All vessels would operate in accordance with applicable rules and regulations for maritime operation within U.S. and federal waters. Additionally, the Project would adhere to vessel speed restrictions as appropriate in accordance with BOEM and NOAA requirements. Vessel activity during O&M would be localized and short-term. Similar to impacts described for the construction phase, in the unlikely event a strike was to occur during Project O&M that resulted in mortality or serious injury impacts to the most vulnerable ESA-listed species (e.g., NARWs), the impact could result in population-level effects. Impacts to less vulnerable ESA-listed species and non-ESA-listed species from vessel strikes may result in injury or mortality of individuals; however, mortality impacts are expected to be less likely to result in population-level effects.

In addition to the potential for strike, the presence of vessel traffic during O&M can be a stressor to marine mammals but potential behavioral effects are not likely to be discernable from potential effects experienced during existing regional vessel traffic conditions due to the very small change in vessel traffic from baseline conditions.

Project-related vessel traffic during O&M would adhere to the same mitigation requirements described above for construction and installation and detailed in Appendix H.

With the implementation of known and highly effective measures, such as reduced vessel speeds and ships maintaining minimum distances from marine mammals, vessel strikes are not anticipated to occur; as such, there would be no effect. However, if a vessel strike of a NARW was to occur, this impact could be major and long term. Given general population status, any vessel strikes to non-NARW mysticetes would be minor to moderate, and vessel strikes to odontocetes and pinnipeds would be negligible to minor. However, given implementation of the APMs, vessel strike risk is very low and not anticipated to occur. There would be no effect on all marine mammals if no vessel strikes occur. Therefore, anticipated impacts of vessel traffic during O&M are negligible for NARWs and all other marine mammals, with no anticipated and potentially more serious impacts from vessel strikes anticipated.

Gear utilization – entanglement and bycatch: The potential for entanglement and bycatch is discussed in detail in section 3.11.3. It is anticipated that due to the reef effect and associated aggregation of recreational fish species near WTGs that the region and Project Area would experience increased recreational fishing. This increased recreational fishing activity along with scour protection and cable armoring are likely to result in lost gear. Lost gear associated with recreational fishing is not expected to pose a risk to large whale species including NARWs and other mysticetes. However, smaller species of marine mammals including odontocetes and pinnipeds may experience impacts at the individual level, but are not expected to be subject to impacts that affect their overall population, and are therefore likely to experience minor adverse impacts from lost gear and recreational fishery interactions associated with WTGs acting as fish aggregating areas.

Gear utilization - fisheries surveys: Fisheries surveys may be conducted during the O&M portion of the Proposed Action. Any surveys would be conducted with the same monitoring and mitigation measures described for surveys during the construction and installation phase. The potential impacts for marine mammals are evaluated in Section 3.11.5.1 in the construction and installation section. Based on that information, the potential for impacts to NARWs and all other marine mammals from gear utilization and fisheries surveys is negligible.

Port utilization: Impacts from port utilization from construction and operation of SRWF are anticipated to be negligible for all marine mammals. Port expansion is unlikely to be needed for the Proposed Action. However, if it does occur, those 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. The impacts on water quality from sediment suspension during port expansion activities is temporary and short term, and would be similar to those described under the cable emplacement and maintenance IPF above, and are anticipated to be negligible for NARWs and all other marine mammals.

Lighting: The Proposed Action includes the use of red flashing aviation obstruction lights on WTGs and ESPs in accordance with FAA and BOEM requirements (Sunrise Wind 2022a). The lights would consist of two L-864 medium-intensity red lights mounted on the nacelle and up to three L-810 low-intensity red lights mounted on the midsection of the WTG tower, and all lights would have a synchronous flash rate of 30 flashes per minute (Sunrise Wind 2022a). ADLS may also be installed so that obstruction lights would only be activated when aircraft are near the turbines. The use of ADLS would dramatically reduce the amount of time the obstruction lights are on. In the Sunrise Wind ADLS efficacy analysis (Appendix Y2 of the COP; Stantec 2022c), the total obstruction light system for historical air traffic data had an activated duration of 35 minutes and 14 seconds over a 1-year period for 636-ft WTGs. Total obstruction light system activated duration increases slightly to 1 hour 21 minutes and 29 seconds over a 1-year period for 968-ft WTGs. Since the Sunrise Wind WTGs would have a height of 787 ft above MSL, the activated duration of ADLS-controlled obstruction lights could fall around the middle of this range.

Navigational lights associated with WTGs would consist of two L-864 medium intensity red lights mounted on the nacelle and up to three L-810 low intensity red lights mounted on the midsection of the WTG tower, and all lights would have a synchronous flash rate of 30 flashes per minute. Per the IALA guidance, navigation lighting would have the following characteristics: corner structures with flashing yellow lights with a visible range of 5 nm (moderate intensity) and a special mark characteristic (special flash pattern) and external border towers with flashing yellow lights with a nominal range of 2 nm (low intensity). Significant peripheral structures would be up to 3 nm apart, and the border/periphery lighted structures would be up to 2 nm apart. All other towers could have flashing yellow lights visible for 2 NM.

Additionally, BOEM anticipates that any additional work lights on support vessels or Project structures would be hooded downward, directed when possible, to reduce illumination of adjacent waters and upward illumination, and would be used only when required to complete a project task (Sunrise Wind 2022a).

While the Sunrise Wind Project would introduce stationary artificial light sources to the analysis area, Orr et al. (2013) summarized available research on potential operational lighting effects from offshore wind energy facilities. They concluded that the operational lighting effects to marine mammal distribution, behavior, and habitat use would be negligible if recommended design and operating practices are implemented. Based on the minimized lighting, its intermittent nature, and the previous analysis by Orr et al. (2013), BOEM anticipates that potential adverse impacts from lighting associated with O&M would be negligible for NARWs and all other marine mammals.

Presence of structures: During O&M, the effects of the Project include the physical presence of the SRWF turbine and substation foundations, and alteration of benthic habitat by rock armoring and scour protection. Structural elements of the SRWF would be present throughout the 25- to 35-year operational life of the Project. Once WTG and OCS-DC foundations, scour protection, and IAC protection would alter the existing habitat, converting sandy bottom habitat to hard bottom habitat, and resulting in a reef effect that encourages colonization by assemblages of both sessile and mobile animals (Bergström et al. 2014; Coates et al. 2014; Wilhelmsson et al. 2006). Studies have shown that artificial structures can create increased habitat heterogeneity that is important for species diversity and density (Langhamer 2012).

Numerous surveys at offshore wind farms, oil and gas platforms, and artificial reef sites have documented increased abundance of smaller odontocete and pinniped species attracted to the increase in pelagic fish and benthic prey availability (Arnould et al. 2015; Lindeboom et al. 2011; Mikkelsen et al. 2013; Russell et al. 2014). Effects on fish populations may be adverse, beneficial, or mixed, depending on the species and location (van der Stap et al. 2016) but are expected to be small-scale within the context of the broader region. It is likely the reef effect caused by habitat alteration in the SRWF would provide beneficial foraging opportunities for some marine mammals although the number of species benefiting from this habitat and the significance of the benefit for these species remains uncertain (Bergström et al. 2014). Currently, there are no quantitative data on how large whale species (i.e., mysticetes) may be impacted by offshore windfarms (Kraus et al. 2019). Navigation through, or foraging within, the SRWF is not expected to be impeded by the presence of the WTG and OCS-DC foundations.

The long-term presence of WTG structures could displace some marine mammals from preferred habitats or alter movement patterns, potentially changing exposure to commercial and recreational fishing activity. The evidence for long-term displacement is unclear and varies by species. For example, Long (2017) studied marine mammal habitat use around two commercial wind farm facilities before and after construction and found that habitat use appeared to return to normal after construction. He cautioned that these findings were not definitive and additional research was needed. In contrast, Teilmann and Carstensen (2012) observed clear long-term (greater than 10 year) displacement of harbor porpoises from commercial wind farm areas in Denmark. Displacement effects remain a focus of ongoing study (Kraus et al. 2019).

The presence of the monopile foundations over the life of the Project would alter the character of the ocean environment that could indirectly affect marine mammals; however, the likelihood and significance of these effects are difficult to determine. The various types of impacts on marine mammals that could result from the presence of structures (i.e., hydrodynamic and artificial reef effects and their influence on the availability of prey and forage resources, potential for interaction with active or abandoned fishing gear, and displacement) are described in detail in Section 3.11.3.2.4. The strong seasonal stratification of the Mid-Atlantic bight is the dominant oceanographic feature limiting phytoplankton productivity, which then affects zooplankton prey productivity (Schofield et al. 2008). Localized turbulence and upwelling effects around the monopiles are likely to transport nutrients into the surface layer, potentially increasing primary and secondary productivity. That increased productivity at a local scale could be partially offset by the formation of abundant colonies of filter feeders on the monopile foundations. While the net impacts of these interactions are difficult to predict, they are not likely to result in more than localized effects on the abundance of zooplankton. Turbulent mixing would be increased locally within the flow divergence and in the wake, which would enhance local dispersion and dissipation of flow energy. However, because the monopiles would be spaced approximately 1 nm (1.85 km) apart, there would be less than 1 percent areal blockage, and the net effect over the spatial scale of the Project would be negligible. When considered relative to the broader oceanographic factors that determine primary and secondary productivity in the region, localized impacts on zooplankton abundance and distribution associated with the WTG structures are not likely to measurably affect the availability of prey resources for marine mammals.

Based on the above information, BOEM concludes that the presence of visible structures from the Proposed Action would have negligible to minor effects on marine mammal movement and migration for NARWs and all other marine mammals over the short to long term, and long-term minor beneficial indirect effects on the distribution, abundance, and availability of marine mammal prey and forage resources for some species (pinnipeds, odontocetes).

3.11.5.3 Conceptual Decommissioning

3.11.5.3.1 Onshore Activities and Facilities

Conceptual decommissioning activities from onshore components of the project are not anticipated to have any direct impact on marine mammals.

3.11.5.3.2 Offshore Activities and Facilities

Project conceptual decommissioning of offshore components would require the use of construction vessels of similar number and class as used during construction. Decommissioning activities would produce similar short-term effects on marine mammals to those described above for proposed Project construction, including short-term displacement,behavioral alteration, and elevated TSS exposure. Underwater noise and disturbance levels generated during conceptual decommissioning are similar to those described above for construction, with the exception that pile driving would not be required. The monopiles would be cut below the bed surface for removal using a cable saw or abrasive waterjet. Noise levels produced by this type of cutting equipment are generally indistinguishable from engine noise generated by the associated construction vessel (Pangerc et al. 2016). Therefore, this decommissioning equipment would have significantly lower potential for noise effects compared to those already considered for construction vessel noise. Decommissioning activities would be required to obtain all appropriate federal permits and would be required to implement mitigation measures based on those permits and the best available information at that time. It is anticipated that those mitigation measures would be similarly effective as those required for construction and installation. The effects of Project conceptual decommissioning on marine mammals would, therefore, range from negligible to minor.

3.11.5.4 Cumulative Impacts of the Proposed Action

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

Ongoing and planned activities other than offshore wind development activities that may affect marine mammals include new submarine cables and pipelines, tidal energy projects, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar, ship strikes), marine transportation, NMFS research initiatives, and installation of new structures on the United States Continental Shelf (refer to Appendix E for a description of ongoing and planned activities). These activities would contribute to the primary IPFs of noise, presence of structures, vessel strikes, and entanglement risk and could result in short-term or permanent displacement and injury to or mortality of individual marine mammals, but population-level effects would not be expected for most species. The exception to this is the NARW, due to the small size of its population and frequent occurrence in shallow coastal zones.

Climate change represents a persistent and ongoing issue that dominates foreseeable environmental trends. Impacts associated with climate change have the potential to reduce reproductive success and increase individual mortality and disease occurrence, which could have population-level effects for all marine mammals.

In the context of reasonably foreseeable environmental trends, ongoing, and planned activities, the Proposed Action would contribute an incremental increase in effects from the primary IPFs for marine mammals.

Seafloor disturbance: The proposed action will result in a marginal increase in seafloor disturbance and alteration to substrate in the Project Area through cable emplacement and the addition of cable armoring, scour protection, and sand wave leveling activities. As a result of seafloor-disturbing activities, marine mammals foraging in the vicinity during construction may encounter localized reduction in foraging opportunities. These impacts will be short-term and are not expected to have any detectable impact on individuals or populations and will have negligible impacts to marine mammals. The addition of armoring and scour protection will alter community composition but is expected to have negligible effects on prey availability for all marine mammals.

Sediment suspension and deposition: Project activities will result in increased suspended sediments and deposition patterns. However, these effects will be short-term and localized, and are not expected to have any detectable impact on individuals, populations, or their prey base.

Noise: The Proposed Action will measurably increase noise impacts to marine mammals in the Project Area through impact pile driving, vibratory pile driving, and MEC/UXO disposal over the short term. The impacts from these activities may result in PTS, TTS, temporary behavioral disturbance or avoidance. These effects would cause minor to moderate impacts for marine mammals. In the context of ongoing and proposed activities, the proposed action represents a small fraction of anticipated work and impacts. The proposed action would result in increases in noise at the local scale where project activities are actively occurring from cable-laying activities, vessel traffic, aircraft noise, and HRG surveys. However, these activities are not anticipated to result in a measurable increase in overall noise levels within the region and are not expected to exacerbate noise impacts from these activity types. The operation of WTGs will have localized detectable increases in noise, but which is not expected to result in measurable effects to individuals or populations.

EMF: The contribution of the project to EMF would likely be negligible. The area that would be affected by project-related EMFs is small; the 285 miles of subsea cables associated with the Proposed Action represent a small percent of the 11,268 miles of subsea export and IAC anticipated for ongoing and planned offshore wind farms in the GAA, including the Proposed Action.

Accidental releases: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to impacts of accidental releases from ongoing and planned activities on marine mammals would likely be negligible given the large volume of vessel traffic in the GAA. BOEM assumes all vessels would comply with laws and regulations to properly dispose of marine debris and minimize releases of fuels/fluids/hazardous materials. Additionally, large-scale releases are unlikely and impacts from small-scale releases would be localized and short term.

Traffic (vessel strikes): The Proposed Action would result in a marginal increase in regional vessel traffic, and approximately 4.4% increase in vessel traffic at the project site. Due to vessel speed restrictions, lookout requirements, vessel types, and other required risk avoidance and minimization measures, vessel traffic from the proposed action is expected to result in a negligible increase in the risk of vessel strikes for marine mammals.

Gear utilization: The Proposed Action would contribute an undetectable increment to the cumulative impacts of gear utilization from other ongoing and planned activities including offshore wind, which would likely be negligible, localized, and unlikely to result in short-term consequences to individuals or populations.

Port utilization: The Proposed Action will use several ports throughout the geographic analysis area. However, as no ports are planning on expanding their operations or capabilities to accommodate the Proposed Action, it will have a negligible impact on the operations and effects of those ports.

Lighting: The Proposed Action would contribute an undetectable increment to the cumulative lighting impacts, which would likely be negligible, localized, and long term but are not anticipated to have any measurable impact on individuals or populations of marine mammals.

Presence of structures: The contribution of the Proposed Action to impacts due to the presence of structures on marine mammals from ongoing and planned activities would be negligible. The 94 structures for the Proposed Action represent only 3.0 percent of the 3,121 offshore wind structures anticipated on the OCS for ongoing and planned offshore wind farms in the GAA, including the Proposed Action.

Operation of OCS CWIS: The cooling water intake system for the OCS will have localized measurable impacts on water temperature. Due to the small volume (relative to the Project Area) of water that will be used, it is not expected to have a measurable effect on prey availability in the region or geographic analysis area.

3.11.5.5 Impacts of Alternative B – Proposed Action on ESA-Listed Species

Impacts to ESA-listed marine mammals are not expected to be different than for non-ESA-listed marine mammals. The primary sources of potential impacts for ESA-listed marine mammals include increased sound levels from pile installation activities and G&G surveys, project-related vessel traffic, and alteration of prey availability. Based on the information contained in this document, we anticipate that IPFs associated with the Proposed Action (without baseline) for the Project are likely to result in a range of negligible to moderate impacts to NARWs; a range of negligible to moderate adverse impacts to sei, fin, and sperm whales; and negligible impacts to blue whales due to the lack of blue whale presence in the Project Area, with the only risk coming from a very small number of trips from vessels transiting to and from Europe.

3.11.5.6 Conclusions

Impacts of the Proposed Action

Project construction and installation, O&M, and conceptual decommissioning would physically disturb the water column and seabed, as well as generate impulsive and non-impulsive noise, increase collision, entanglement, and spill exposure risk, and generate artificial light. Project construction would primarily result in noise that would disturb marine mammals and potentially result in auditory impacts (i.e., PTS and TTS). APMs would minimize noise exposure such that any PTS of NARWs would be avoided and, for all marine mammals, any TTS and the severity of any behavioral responses would be minimized. Therefore, the incremental impact of the Proposed Action (without baseline) when compared to the No Action Alternative would be **moderate** for NARWs from construction given the likely outcome of noise exposure would be a deflection, but not abandonment of their migratory path. More severe impacts on marine mammals such as mortality or serious injury from vessel strikes, UXO detonation, and entanglement are not anticipated to occur due to the APMs and additional measures that would be required as part of the environmental permitting processes. The incremental impact of the Proposed Action when compared to the No Action Alternative would be **minor** to **moderate** for other mysticetes, odontocetes, and pinnipeds because with the implementation of APMs, mortality and non-auditory injury would not occur as a result of UXO detonation, only a few marine mammals of select species are anticipated to incur PTS incidental to pile driving and UXO detonation, vessel strike risk is very low and not anticipated to occur, and accidental spills are also not anticipated to occur. For those marine mammals anticipated to incur moderate impacts, this is driven primarily by the potential for PTS which is a permanent impact; however, no effects to the population are anticipated. Odontocetes and pinnipeds may experience long-term minor beneficial impacts from increased prey availability associated with the reef effect, but this would not change the overall impact level determination of minor to moderate for these species groups.

When including the baseline status of marine mammals into the impact findings and considering all phases of the Project, the impacts of the Proposed Action on NARWs would be long term and **major** adverse due to ongoing activities that result in noise impacts, vessel strikes, and gear entanglement, and long-term and **minor** to **moderate** adverse for other mysticetes, odontocetes, and pinnipeds. The incremental impacts of the proposed Project alone are not expected to include entanglements or vessel strikes. Some **minor beneficial** impacts on odontocetes and pinnipeds could be realized through artificial reef effects. Beneficial effects, however, are insufficient to offset the negative impacts associated with baseline conditions combined with the Proposed Action.

Cumulative Impacts of the Proposed Action

Existing environmental trends, including the effects of climate change, and ongoing activities would continue, and mysticetes, odontocetes, and pinnipeds would continue to be affected by natural and human-caused IPFs. Planned activities would also contribute to impacts on marine mammals. Although injury or mortality of individuals may occur, long-term population-level effects are not anticipated for marine mammals (with the exception of NARWs). Underwater noise impacts, vessel activity (vessel collisions), gear entanglement, and seabed disturbance, primarily from non-offshore wind activities, would result in **moderate** impacts to all marine mammals (except NARWs which would be **major** due to vessel strikes, underwater noise, and gear entanglement). The incremental impacts of the proposed Project alone are not expected to include entanglements or vessel strikes. Accidental releases and discharges, EMF, the presence of structures, port utilization, and lighting associated with offshore wind activities would be implemented with measures to minimize impacts on marine mammals, which would result in **minor** to **moderate** impacts to all marine mammals (except NARWs which would be **moderate** to **major**). Incremental impacts contributed by the Proposed Action to the cumulative impact on marine mammals would range from undetectable to noticeable. BOEM anticipates that the cumulative impacts for mysticetes, odontocetes, and pinnipeds in the GAA from the Proposed Action would be **major** adverse and long term for NARWs, and **moderate** adverse for other mysticetes, odontocetes, and pinnipeds. Some **minor beneficial** impacts on odontocetes and pinnipeds could be realized through artificial reef effects. Beneficial effects, however, are not anticipated to offset the adverse impacts associated with baseline conditions, planned activities, and the Proposed Action. While the significance level of impacts would remain the same between the No Action Alternative and the Proposed Action, BOEM could further reduce impacts from the Proposed Action to marine mammals with mitigation measures conditioned as part of the COP approval by BOEM that also includes the mitigation, monitoring, and reporting requirements required in the NMFS biological opinion.

3.11.6 Alternative C-1 - Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions

Under Alternative C-1, the same number of turbine locations (up to 94 WTGs) under the Proposed Action may be approved by BOEM; however, 8 WTG positions from NMFS's Priority Areas (Figure 2.1-7) would be excluded from consideration. The WTG sites to be removed from Priority Area 1 were selected to maximize the largest contiguous complex habitat area feasible and/or to reduce the number of 11-MW WTGs located near presumed Atlantic cod spawning location(s). This alternative would not significantly alter the construction methods, O&M, or conceptual decommissioning. This alternative would not increase the impact level or likelihood of impacts for marine mammals and may result in a slight reduction in potential impact duration and extent from construction activities and number of in-water structures. Therefore, the Alternative C-1 is expected to have negligible to moderate impacts on marine mammals from construction and installation, O&M, and conceptual decommissioning activities.

3.11.6.1 Construction and Installation

3.11.6.1.1 Onshore Activities and Facilities

No aspect of Alternative C-1 would alter the construction of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to the construction of the onshore activities or facilities other than what is described under the Proposed Action.

3.11.6.1.2 Offshore Activities and Facilities

None of the proposed changes from Alternative C-1 would significantly alter the construction methods for offshore structures and installation of equipment compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to the construction of the offshore activities or facilities other than what is described under the Proposed Action.

3.11.6.2 Operations and Maintenance

3.11.6.2.1 Onshore Activities and Facilities

No aspect of Alternative C-1 would alter the O&M of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to the operation and maintenance of the onshore activities or facilities other than what is described under the Proposed Action.

3.11.6.2.2 Offshore Activities and Facilities

None of the proposed changes from Alternative C-1 would significantly alter the O&M methods for offshore activities and facilities compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to the O&M of the offshore activities or facilities other than what is described under the Proposed Action.

3.11.6.3 Conceptual Decommissioning

3.11.6.3.1 Onshore Activities and Facilities

No aspect of Alternative C-1 would alter the conceptual decommissioning of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to conceptual decommissioning of the onshore activities or facilities other than what is described under the Proposed Action.

3.11.6.3.2 Offshore Activities and Facilities

None of the proposed changes from Alternative C-1 would significantly alter the conceptual decommissioning methods for offshore activities and facilities compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to the conceptual decommissioning of the offshore activities or facilities other than what is described under the Proposed Action.

3.11.6.4 Cumulative Impacts of Alternative C-1

The cumulative impacts of Alternative C-1 consider the impacts of this alternative in combination with other ongoing and planned wind activities.

Ongoing and planned activities other than offshore wind development activities that may affect marine mammals include new submarine cables and pipelines, tidal energy projects, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar, ship strikes), marine transportation, NMFS research initiatives, and installation of new structures on the United States Continental Shelf (refer to Appendix E for a description of ongoing and planned activities). These activities would contribute to the primary IPFs of noise, presence of structures, vessel strikes, and entanglement risk and could result in short-term or permanent displacement and injury to or mortality of individual marine mammals, but population-level effects would not be expected for most species. The exception to this is the NARW, due to the small size of its population and frequent occurrence in shallow coastal zones.

In the context of reasonably foreseeable environmental trends, ongoing, and planned activities, Alternative C-1 would contribute an incremental increase in effects from the primary IPFs for marine mammals as described in the cumulative impacts section of Alternative B.

3.11.6.5 Impacts of Alternative C-1 on ESA-Listed Species

Impacts to ESA-listed marine mammals are not expected to be different than for non-ESA-listed marine mammals. The primary sources of potential impacts for ESA-listed marine mammals include increased sound levels from pile installation activities and G&G surveys, project-related vessel traffic, and alteration of prey availability. Based on the information contained in this document, BOEM anticipates that IPFs associated with Alternative C-1 for the Sunrise Wind Project (without baseline) would result in a range of negligible to moderate impacts to NARWs; and a range of negligible to moderate adverse impacts to sei, fin, or sperm whales; and negligible impacts to blue whales.

3.11.6.6 Conclusions

Impacts from Alternative C-1

Alternative C-1 includes changes to turbine installation locations that would not alter any of the findings for mysticetes, odontocetes, or pinnipeds. Therefore, the conclusions for impacts and cumulative impacts of Alternative C-1 are the same as described under the Proposed Action (Alternative B).

Cumulative Impacts from Alternative C-1

Alternative C-1 includes changes to turbine installation locations that would not alter any of the findings for mysticetes, odontocetes, or pinnipeds. Therefore, the conclusions for impacts and cumulative impacts of Alternative C-1 are the same as described under the cumulative impacts of the Proposed Action (Alternative B).

3.11.7 Alternative C-2 - Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions and Relocation of up to 12 WTG Positions to the Eastern Side of the Lease Area

The primary effect of this alternative is the relocation of WTGs from Priority Areas to the eastern portion of the Lease Area. This proposed change would not significantly alter the construction methods, O&M, or conceptual decommissioning and would not result in additional impacts to marine mammals other than those described under the Proposed Action (Alternative B).

3.11.7.1 Construction and Installation

3.11.7.1.1 Onshore Activities and Facilities

No aspect of Alternative C-2 would alter the construction of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to the construction of the onshore activities or facilities other than what is described under the Proposed Action.

3.11.7.1.2 Offshore Activities and Facilities

None of the proposed changes from Alternative C-2 would significantly alter the construction methods for offshore structures and installation of equipment compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to the construction of the offshore activities or facilities other than what is described under the Proposed Action.

3.11.7.2 Operations and Maintenance

3.11.7.2.1 Onshore Activities and Facilities

No aspect of Alternative C-2 would alter the O&M of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to the operation and maintenance of the onshore activities or facilities other than what is described under the Proposed Action.

3.11.7.2.2 Offshore Activities and Facilities

None of the proposed changes from Alternative C-2 would significantly alter the O&M methods for offshore activities and facilities compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to the O&M of the offshore activities or facilities other than what is described under the Proposed Action.

3.11.7.3 Conceptual Decommissioning

3.11.7.3.1 Onshore Activities and Facilities

No aspect of Alternative C-2 would alter the conceptual decommissioning of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to conceptual decommissioning of the onshore activities or facilities other than what is described under the Proposed Action.

3.11.7.3.2 Offshore Activities and Facilities

None of the proposed changes from Alternative C-2 would significantly alter the conceptual decommissioning methods for offshore activities and facilities compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to the conceptual decommissioning of the offshore activities or facilities other than what is described under the Proposed Action.

3.11.7.4 Cumulative Impacts of Alternative C-2

The cumulative impacts of Alternative C-2 consider the impacts of this alternative in combination with other ongoing and planned wind activities.

Ongoing and planned activities other than offshore wind development activities that may affect marine mammals include new submarine cables and pipelines, tidal energy projects, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar, ship strikes), marine transportation, NMFS research initiatives, and installation of new structures on the United States Continental Shelf (refer to Appendix E for a description of ongoing and planned activities). These activities would contribute to the primary IPFs of noise, presence of structures, vessel strikes, and entanglement risk and could result in short-term or permanent displacement and injury to or mortality of individual marine mammals, but population-level effects would not be expected for most species. The exception to this is the NARW, due to the small size of its population and frequent occurrence in shallow coastal zones.

In the context of reasonably foreseeable environmental trends, ongoing, and planned activities, Alternative C-2 would contribute an incremental increase in effects from the primary IPFs for marine mammals.

3.11.7.5 Impacts of Alternative C-2 on ESA-Listed Species

Impacts to ESA-listed marine mammals are not expected to be different than for non-ESA-listed marine mammals. The primary sources of potential impacts for ESA-listed marine mammals include increased sound levels from pile installation activities and G&G surveys, project-related vessel traffic, and alteration of prey availability. Based on the information contained in this document, we anticipate that IPFs associated with Alternative C-2 for the Sunrise Wind Project (without baseline) would likely result in a range of negligible to moderate impacts to NARWs; negligible to moderate adverse impacts to sei, fin, or sperm whales; and negligible impacts to blue whales.

3.11.7.6 Conclusions

Impacts from Alternative C-2

Alternative C-2 includes changes to turbine installation locations that would not alter any of the findings for mysticetes, odontocetes, or pinnipeds. Therefore, the conclusions for impacts of Alternative C-2 are the same as described under the Proposed Action (Alternative B).

Cumulative Impacts from Alternative C-2

Alternative C-2 includes changes to turbine installation locations that would not alter any of the findings for mysticetes, odontocetes, or pinnipeds. Therefore, the conclusions for cumulative impacts of Alternative C-2 are the same as described under the cumulative impacts of the Proposed Action (Alternative B).

3.11.8 Alternative C-3 - Reduced Layout from Priority Areas Considering Feasibility Due to Glauconite Sands

Under the Fisheries Habitat Impact Minimization Alternative C-3, the construction, O&M, and eventual decommissioning of the 11-MW WTGs and an OCS within the proposed Project Area and associated inter-array and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, Alternative C-3 was developed to address concerns regarding pile refusal due to glauconite sands in the southeastern portion of the Lease Area while still minimizing impacts to benthic and fisheries resources. Alternative C-3a, C-3b, and C-3c described in Section 3.7.8, *Benthic Resources*, consider different WTG configurations to avoid sensitive habitats and engineering constraints while still meeting the NYSERDA OREC. This alternative only considered removal of WTGs from Priority Area 1 based on consultation with NMFS. Areas with high density of boulder, complex habitat, and data suggesting Atlantic cod aggregation and spawning was considered when determining which WTGs to remove.

3.11.8.1 Construction and Installation

3.11.8.1.1 Onshore Activities and Facilities

No aspect of Alternative C-3 would alter the construction of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to the construction of the onshore activities or facilities other than what is described under the Proposed Action.

3.11.8.1.2 Offshore Activities and Facilities

None of the proposed changes from Alternative C-3 would significantly alter the construction methods for offshore structures and installation of equipment compared to the Proposed Action (Alternative B). The primary effect of these changes would be a potential reduction in the number of installed WTGs, with a concurrent reduction in the number of individuals exposed to potential impacts during construction and a reduction in the areal extent of long-term impacts to habitat. However, these changes would not be significant enough to change the impact level determinations for any of the impact level determinations for any of the IPFs. Therefore, there would be no direct or indirect impacts to marine mammals due to the construction of the offshore activities or facilities other than what is described under the Proposed Action.

3.11.8.2 Operations and Maintenance

3.11.8.2.1 Onshore Activities and Facilities

No aspect of Alternative C-3 would alter the O&M of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to the operation and maintenance of the onshore activities or facilities other than what is described under the Proposed Action

3.11.8.2.2 Offshore Activities and Facilities

None of the proposed changes from Alternative C-3 would significantly alter the O&M methods for offshore activities and facilities compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to the O&M of the offshore activities or facilities other than what is described under the Proposed Action.

3.11.8.3 Conceptual Decommissioning

3.11.8.3.1 Onshore Activities and Facilities

No aspect of Alternative C-3 would alter the conceptual decommissioning of the proposed onshore facilities as compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to conceptual decommissioning of the onshore activities or facilities other than what is described under the Proposed Action.

3.11.8.3.2 Offshore Activities and Facilities

None of the proposed changes from Alternative C-3 would significantly alter the conceptual decommissioning methods for offshore activities and facilities compared to the Proposed Action (Alternative B). Therefore, there would be no direct or indirect impacts to marine mammals due to the conceptual decommissioning of the offshore activities or facilities other than what is described under the Proposed Action.

3.11.8.4 Cumulative Impacts of Alternative C-3

The cumulative impacts of Alternative C-3 consider the impacts of this alternative in combination with other ongoing and planned wind activities.

Ongoing and planned activities other than offshore wind development activities that may affect marine mammals include new submarine cables and pipelines, tidal energy projects, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar, ship strikes), marine transportation, NMFS research initiatives, and installation of new structures on the United States Continental Shelf (refer to Appendix E for a description of ongoing and planned activities). These activities would contribute to the primary IPFs of noise, presence of structures, vessel strikes, and entanglement risk and could result in short-term or permanent displacement and injury to or mortality of individual marine mammals, but population-level effects would not be expected for most species. The exception to this is the NARW, due to the small size of its population and frequent occurrence in shallow coastal zones.

In the context of reasonably foreseeable environmental trends, ongoing, and planned activities, Alternative C-3 would contribute an incremental increase in effects from the primary IPFs for marine mammals.

3.11.8.5 Impacts of Alternative C-3 on ESA-Listed Species

Impacts to ESA-listed marine mammals are not expected to be different than for non-ESA-listed marine mammals. The primary sources of potential impacts for ESA-listed marine mammals include increased sound levels from pile installation activities and G&G surveys, project-related vessel traffic, and alteration of prey availability. Based on the information contained in this document, we anticipate that IPFs associated with Alternative C-3 for the Sunrise Wind Project (without baseline) would likely result in a range of negligible to moderate impacts to NARWs; a range of negligible to moderate adverse impacts to sei, fin, or sperm whales; and negligible impacts to blue whales.

3.11.8.6 Conclusions

Impacts from Alternative C-3

Alternative C-3 includes changes to turbine installation locations that would not alter any of the findings for mysticetes, odontocetes, or pinnipeds. Therefore, the conclusions for impacts of Alternative C-3 are the same as described under the Proposed Action (Alternative B).

Cumulative Impacts from Alternative C-3

Alternative C-3 includes changes to turbine installation locations that would not alter any of the findings for marine mammals. Therefore, the conclusions for cumulative impacts of Alternative C-3 are the same as described under the cumulative impacts of the Proposed Action (Alternative B).

3.11.9 Comparison of Alternatives

Construction, O&M, and decommissioning of Alternatives B, C-1, C-2, and C-3 would have the same overall negligible to moderate adverse impacts and minor beneficial impacts on marine mammals. Table 3.11-17 provides an overall summary of alternative impacts.

Table 3.11-17. Comparison of Alternative Impacts on Marine Mammals

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
No Action Alternative (without baseline): Not approving the COP would have no additional incremental effect on marine mammals (i.e., no effect). *No Action Alternative (with baseline)*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on mysticetes (other than NARWs), and **minor** to **moderate** adverse impacts on odontocetes and pinnipeds. Adverse impacts on mysticetes, odontocetes, and pinnipeds would be primarily due to underwater noise, commercial and recreational fishing gear interactions, and ongoing climate change. Vessel	*Proposed Action (without baseline)*: The incremental impact of the Proposed Action when compared to the No Action Alternative would be **moderate** adverse for NARWs. The incremental impact of the Proposed Action when compared to the No Action Alternative would be **minor** to **moderate** adverse for other mysticetes, odontocetes, and pinnipeds. Adverse impacts are expected to result mainly from pile-driving noise and increased vessel traffic. **Minor beneficial** impacts on odontocetes and pinnipeds may result from increased prey availability as related to the artificial reef effect. *Proposed Action (with baseline):* BOEM expects the overall impact on marine	*Alternative C-1 (without baseline)*: Alternative C-1 includes changes to turbine installation locations that would not alter any of the findings for marine mammals. Therefore, the incremental impact of Alternative C-1 when compared to the No Action would be the same as described under the Proposed Action, **moderate** adverse impacts on NARWs, and **minor** to **moderate** adverse impacts on other mysticetes, odontocetes, and pinnipeds, with **minor beneficial** impacts on odontocetes and pinnipeds from increased prey availability. *Alternative C-1 (with baseline)*: Alternative C-1 includes changes to turbine installation locations that would	*Alternative C-2 (without baseline)*: Alternative C-2 includes changes to turbine installation locations that would not alter any of the findings for marine mammals. Therefore, the incremental impacts of Alternative C-2 are the same as described under the Proposed Action, **moderate** adverse impacts on NARWs, and **minor** to **moderate** adverse impacts on other mysticetes, odontocetes, and pinnipeds, with **minor beneficial** impacts on odontocetes and pinnipeds from increased prey availability. *Alternative C-2 (with baseline)*: Alternative C-2 includes changes to turbine installation locations that would not alter any of the	*Alternative C-3 (without baseline)*: Alternative C-3 includes changes to turbine installation locations that would not alter any of the findings for marine mammals. Therefore, the incremental impacts of Alternative C-3 are the same as described under the Proposed Action, **moderate** adverse impacts on NARWs, and **minor** to **moderate** adverse impacts on other mysticetes, and minor for odontocetes, and pinnipeds, with **minor beneficial** impacts from increased prey availability. *Alternative C-3 (with baseline)*: Alternative C-3 includes changes to turbine installation locations that would not alter any of the findings for marine

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
activity (vessel collisions) would also be a primary contributor to adverse impacts on mysticetes. For the NARW, continuation of existing environmental trends and activities under the No Action Alternative would result in **major** adverse impacts due to low population numbers and potential to compromise the viability of the species from the loss of a single individual. The presence of structures could potentially result in **minor beneficial** impacts for pinnipeds and odontocetes but would not change the overall minor adverse impact level determination. *Cumulative Impacts of the No Action Alternative:* Alternative A, the No Action Alternative, when combined with all other planned activities (including offshore wind) would result in **moderate**	mammals from the Proposed Action to be **major** adverse for NARWs due to noise, vessel strikes, and gear entanglement from ongoing activities, and **minor** to **moderate** adverse for other mysticetes, odontocetes, and pinnipeds. The overall impacts on individuals and/or their habitat could have population-level effects, but the population can sufficiently recover from the impacts or enough habitat still is functional to maintain the viability of the species both locally and throughout their range. **Minor beneficial** impacts on odontocetes and pinnipeds may result from increased prey availability as related to the artificial reef effect but would be insufficient to offset negative impacts associated with baseline conditions combined with the Proposed Action. *Cumulative Impacts of the Proposed Action:*	not alter any of the findings for marine mammals. Therefore, the conclusions for Alternative C-1 are the same as described under the Proposed Action, **major** adverse for NARWs, and **minor** to **moderate** adverse for other mysticetes,, odontocetes, and pinnipeds, with **minor beneficial** impacts from increased prey availability. *Cumulative Impacts of Alternative C-1*: Alternative C-1 includes changes to turbine installation locations that would not alter any of the findings for marine mammals. Therefore, the conclusions for cumulative impacts of Alternative C-1 are the same as described under the cumulative impacts of the Proposed Action.	findings for marine mammals. Therefore, the conclusions for Alternative C-2 are the same as described under the Proposed Action, **major** adverse for NARWs, and **minor** to **moderate** adverse for other mysticetes, odontocetes, and pinnipeds with **minor beneficial** impacts from increased prey availability. *Cumulative Impacts of Alternative C-2*: Alternative C-2 includes changes to turbine installation locations that would not alter any of the findings for marine mammals. Therefore, the conclusions for cumulative impacts of Alternative C-2 are the same as described under the cumulative impacts of the Proposed Action.	mammals. Therefore, the conclusions for Alternative C-3 are the same as described under the Proposed Action, **major** adverse for NARWs, and **minor** to **moderate** adverse for other mysticetes, odontocetes, and pinnipeds, with long-term **minor beneficial** impacts from increased prey availability. *Cumulative Impacts of Alternative C-3*: Alternative C-3 includes changes to turbine installation locations that would not alter any of the findings for marine mammals. Therefore, the conclusions for cumulative impacts of Alternative C-3 are the same as described under the cumulative impacts of the Proposed Action.

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
adverse impacts on mysticetes (except NARWs), odontocetes, and pinnipeds. For NARWs on which impacts would be **major** adverse due to low population numbers and potential to compromise the viability of the species from the loss of a single individual. Adverse impacts would be primarily due to underwater noise, vessel activity (vessel collisions), fishing entanglement, and climate change. **Minor beneficial** impacts on odontocetes and pinnipeds may result from increased prey availability as related to the artificial reef effect but would not change the overall minor adverse impact level determination.	BOEM anticipates that the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in **moderate** adverse impacts on mysticetes, odontocetes, and pinnipeds, except for the NARWs, on which impacts would be **major** adverse due to low population numbers and potential to compromise the viability of the species from the loss of a single individual. **Minor beneficial** impacts on odontocetes and pinnipeds may result from increased prey availability as related to the artificial reef effect but would be insufficient to offset negative impacts associated with baseline conditions combined with the Proposed Action.			

3.11.10 Summary of Impacts of the Preferred Alternative

BOEM has identified Alternative C-3b as the Preferred Alternative as depicted in Figure 2.1-10. Alternative C-3b would include installation of up to 84 WTGs, which is 10 fewer WTGs than the maximum WTGs proposed under the PDE of the Proposed Action. BOEM has identified Alternative C-3b as the Preferred Alternative as depicted in Figure 2.1-10. Alternative C-3b would include installation of up to 84 WTGs, which is 10 fewer WTGs than the maximum WTGs proposed under the PDE of the Proposed Action. Minor to moderate adverse impacts would be expected to result mainly from underwater noise (e.g., UXO detonations and impact pile driving) and increased vessel traffic potentially leading to vessel strikes. Minor beneficial impacts for odontocetes and pinnipeds are expected to result from the presence of structures and potential increase in prey abundance and availability. The implementation of the Preferred Alternative in comparison to the Proposed Action (Alternative B) would result in an incremental reduction in effects from some construction and installation, O&M, and decommissioning impacts. These adverse impacts would be avoided and minimized using the same APM's as described in the Proposed Action (see Table 3.11-18below).

BOEM anticipates, however, that any incremental reduction in impacts would not change the resulting effects on marine mammals to the extent necessary to alter the impact-level conclusions for any impact mechanism. The incremental impact of Alternative C-3b, when compared to the No Action Alternative, would be similar to the Proposed Action: **minor** to **moderate** adverse for mysticetes (except NARWs), with moderate adverse impacts to some mysticetes (other than NARWs) due to permanent hearing injury to individuals, and **moderate** adverse for NARWs due to potential exposure of several individuals to temporary behavioral disturbance in potentially important seasonal migratory and foraging habitats, respectively. Impacts to odontocetes would range from **minor** to **moderate**, with moderate impacts to harbor porpoise from permanent hearing injury to individuals. Pinnipeds would experience **minor** to **moderate** impacts to individuals from behavioral exposure and hearing injury to individuals. Because the implementation of APMs would avoid mortality and non-auditory injury would not occur as a result of UXO detonation, only a few marine mammals of select species are anticipated to incur PTS incidental to pile driving and UXO detonation, vessel strike risk is very low and not anticipated, and accidental spills are also not anticipated.

When including the baseline status of marine mammals into the impact findings and considering all phases of the Project, the impacts of the Proposed Action on NARWs would be long term and **major** adverse due to ongoing activities that result in noise impacts, vessel strikes, and gear entanglement, and long-term and **minor** to **moderate** adverse for other mysticetes, odontocetes, and pinnipeds. The incremental impacts of the proposed Project alone are not expected to include entanglements or vessel strikes. Some **minor beneficial** impacts on odontocetes and pinnipeds could be realized through artificial reef effects. Beneficial effects, however, are insufficient to offset the negative impacts associated with baseline conditions combined with the Proposed Action.

In the context of other reasonably foreseeable environmental trends and planned actions, BOEM anticipates that the impacts contributed by Alternative C-3b to the cumulative impacts on marine mammals would be similar to the Proposed Action and would range from undetectable to measurable. BOEM anticipates that the cumulative impacts of Alternative C-3b when combined with ongoing and planned activities, including offshore wind, would be the same as the Proposed Action: **major** for NARWs, **moderate** for all other marine mammals, and **minor beneficial** for odontocetes and pinnipeds.

3.11.11 Proposed Mitigation Measures

The mitigation measures summarized in Table 3.11-8 are recommended for inclusion in the Preferred Alternative and are fully described in Appendix H.

Table 3.11-18. Proposed Mitigation Measures: Marine Mammals

Measure	Description	Effect
Marine debris awareness training	The Lessee must 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 must submit to DOI an annual report that describes its marine trash and debris awareness training process, number of people trained, estimated related costs, and certifies that the training process has been followed for the previous calendar year.	This measure would further define existing APMs to minimize the risk of marine mammal ingestion of or entanglement in marine debris. While adoption of this measure would decrease risk to marine mammals under the Proposed Action, it would not alter the impact determination of negligible for accidental releases.
Training and coordination	All project personnel would be instructed regarding the authority of the marine mammal monitoring team(s). Relevant personnel and the marine mammal monitoring team would be required to participate in joint, onboard briefings that would be led by Sunrise Wind Offshore Wind Project personnel and the Lead PSO prior to the beginning of project activities. This measure includes NARW Awareness Monitoring protocols including the use of available sources of information on NARW 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. This measure also includes protocols for Protected Species Observers and PAM Operator Training which include the use of NMFS-approved observers and operators; use of observers during all foundation installations, sheet pile or casing pipe installation/removal activities, UXO/ MEC detonations, and HRG surveys; and a Permits and Environmental Compliance Plan training for observers and operators.	This would serve to ensure that all relevant responsibilities, communication procedures, marine mammal monitoring and mitigation protocols, reporting protocols, safety, operational procedures, and ITA requirements are clearly understood by all involved parties. Maintaining daily awareness and coordination affords increased protection of NARWs by understanding North Atlantic right whale presence in the area through ongoing visual and passive acoustic monitoring efforts and opportunities (outside of Sunrise Wind's efforts) and allows for planning of construction activities, when practicable, to minimize potential impacts on NARWs. The use of experienced, trained, and NMFS-approved during these activities would minimize the potential for Level A or Level B exposures and decrease risk to marine mammals during these activities but would not alter the overall impact determination of the Proposed Action.
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.	Compliance with LOA requirements would reduce risks for marine mammals under the Proposed Action. However, this measure

Measure	Description	Effect
		would not alter impact determinations for marine mammals because analysis of the Proposed Action already includes analysis of the APMs included in Sunrise Wind's LOA Application as outlined in Table H-1.
Passive Acoustic Monitoring (PAM) Plan	BOEM, BSEE, and USACE shall ensure that Sunrise 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 must be submitted to NMFS, BOEM and BSEE (via TIMSWeb) for review and concurrence at least 180 days prior to the planned start of pile driving.	Sunrise Wind has committed to implementing passive acoustic monitoring, pile driving monitoring, PSO coverage, sound field verification, and shutdown zones as part of the Proposed Action. Agency-proposed mitigation measures would further define how the effectiveness and enforcement of APMs would be ensured, by requiring that Sunrise Wind submit PAM 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 PSO coverage is sufficient and requiring deployment of additional PSOs 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 for any marine mammal hearing group or individual species as analyzed herein.
Pile driving monitoring plan	BOEM shall ensure that Sunrise Wind prepare and submit a *Pile Driving Monitoring Plan* and *Marine Mammal and Sea Turtle Monitoring Plan – Pile Driving* to NMFS and BSEE (via TIMSWeb) for review and concurrence at least 180 days before start of impact pile driving. The plan shall 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 shall also describe how BOEM, BSEE, and Sunrise 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. Sunrise Wind must obtain NMFS's concurrence with this plan prior to starting any pile driving.	
PSO Coverage	BOEM, BSEE, and USACE shall ensure that PSO coverage is sufficient to reliably detect marine mammals 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. PSO coverage and experience requirements specific to UXO/MEC detonations are also included (e.g.,	

Measure	Description	Effect
	aerial survey requirements for detonation zones larger than 5 km)	
Sound field verification	The *Sound Field Verification Plan* must be submitted to NMFS at least 120 calendar days before pile driving begins. The plan must describe how the first three monopile installation sites and installation scenarios are representative of the rest of the monopile installations and the piling schedule and sequence of events; communication and reporting protocols; methodology for collecting, analyzing, and preparing SFV data for submission to NMFS; and the number and location of hydrophones. Reports to NMFS are required no later than 48 hours after the installation of each of the first three monopiles and after the installation of the first full pin pile foundation. Final results are due to NMFS within 90 days of verification completion. BOEM, BSEE, and USACE shall 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 shall 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. Each observer would be responsible for maintaining watch in no more than 180° and of an area with a radius no greater than 1,500 m.	
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 shall ensure that Sunrise Wind submits a Sound Field Verification Plan for review and approval at least 90 days prior to the planned start of pile driving. BOEM, BSEE, and USACE may reduce, upon request, shutdown zones for ESA-listed sei, fin, or sperm whales based upon sound field verification of a minimum of three piles; however, the shutdown zone for sei, fin, and sperm whales will not be reduced to less than 1,000 m or less than 500 m for ESA-listed sea turtles. The clearance or shutdown zones for NARWs will not be reduced regardless of the results of sound field verification of a minimum of three piles.	

Measure	Description	Effect
Lost survey gear	All reasonable efforts that do not compromise human safety must be undertaken to recover any lost survey gear. Any lost gear must be reported to NMFS (nmfs.gar.incidental-take@noaa.gov) and BSEE (OSWsubmittals@bsee.gov) within 24 hours after the gear is documented as missing or lost. This report must include information on any markings on the gear and any efforts undertaken or planned to recover the gear. To facilitate identification of gear on any entangled animals, all trap/pot gear used in any Project survey must be uniquely marked to distinguish it from other commercial or recreational gear. Gear must be marked with a 3-foot-long strip of black and white duct tape within 2 fathoms of a buoy attachment. In addition, 3 additional marks must be placed on the top, middle and bottom of the line using black and white paint or duct tape.	This measure would complement existing APMs and ensure that entanglement risk and potential impacts of gear utilization on marine mammals remain negligible.
Periodic underwater surveys, reporting of monofilament and other fishing gear around WTG foundations	Sunrise must monitor potential loss of fishing gear in the vicinity of WTG foundations by surveying at least ten different WTGs in the project area annually. Sunrise must conduct surveys by remotely operated vehicles, divers, or other means to determine the locations and amounts of marine debris. Sunrise must report the results of the surveys to BOEM and BSEE in an annual report, submitted by April 30 for the preceding calendar year and meet all requirements specified in Appendix H, Table H-2. Required data and reports may be archived, analyzed, published, and disseminated by BOEM.	This measure would not modify the impact determination for marine mammals, but it would provide the information necessary to ensure that effects do not exceed the levels analyzed herein.
Reporting requirements	BOEM and BSEE would ensure that Sunrise 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. This includes immediate reporting (at least within 24 hours) of NARW detections to NMFS, weekly reporting of pile-driving activities, and monthly reporting of all in-water project activities. Details of reporting would be coordinated between Sunrise Wind, NMFS, BOEM and BSEE. All reports would be sent to: nmfs.gar.incidental-take@noaa.gov and BSEE via TIMSWeb	Reporting requirements to document take would improve accountability for documenting marine mammal take associated with the Proposed Action. While adoption of these measures would improve accountability, it would not alter the overall impact determination for the Proposed Action.
Reduced Visibility/Nighttime pile driving monitoring plan	BOEM would require Sunrise Wind to submit a *Reduced Visibility Monitoring Plan/Nighttime Pile Driving Monitoring Plan* to NMFS at least 180 calendar days before initiating impact pile driving activities. The purpose of the plan is to demonstrate that Sunrise Wind can meet the visual monitoring criteria for the Level A harassment zone(s)/mitigation and monitoring zones plus an agreed upon buffer zone (these combined zones are	Adoption of this measure would reduce the uncertainty in the ability of the nighttime monitoring techniques being proposed by Sunrise Wind to detect marine mammals in the Level A harassment monitoring zones. This would decrease the potential for PTS impacts to occur during nighttime

Measure	Description	Effect
	referred to henceforth as the nighttime clearance and shutdown zones) with the technologies Sunrise Wind is proposing to use for monitoring during nighttime impact pile driving. This plan would include the following components: identification of night vision devices and proof of the efficacy of monitoring device (e.g., mounted thermal/IR camera systems, hand-held or wearable NVDs, IR spotlights) that would be used to detect protected marine mammal and turtle species relative to the nighttime clearance and shutdown zones; discussion of the efficacy (range and accuracy) of the technology at detecting marine mammals and sea turtles in the clearance and shutdown zones under all the various conditions anticipated during construction; and a thorough description of how Sunrise Wind will monitor pile driving activities during daytime when unexpected changes to lighting or weather occur during pile driving that prevent visual monitoring of the full extent of the clearance and shutdown zones.	impact pile-driving operations. However, it could still result in PTS effects on some marine mammal species (LFC, HFC, and phocid pinnipeds in water). In addition, the impact determination for underwater noise effects is made on all underwater noise sources and, therefore, implementation of the plan would not alter the impact determinations.
Long-term monitoring	Support the development of a regional PAM network across lease areas to monitor long-term changes in baleen whale distribution and habitat use. Develop or support the development of a PAM array in the Sunrise Wind WDA to monitor changes in ambient noise and use of the area by baleen whales (and other marine construction, and to detect small-scale changes at the scale of the Sunrise Wind WDA. Bottom mounted recorders would be deployed at a maximum of 20 km distance from each other throughout the given study area in order to ensure near to complete coverage of the area over which North Atlantic right whales and other baleen whales can be heard.	Long-term PAM would provide data useful for documenting marine mammal presence in the Lease Area and vicinity and evaluating changes in population density and habitat use over the life of the project. This measure would not modify impact determinations on marine mammals but would provide the information necessary to ensure that these effects do not exceed the levels analyzed herein, and to inform existing uncertainty about potential effects on marine mammal species.
Data Collection Biological Assessment BMPs	BOEM and BSEE 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 Sunrise Wind Project as applicable.	This measure would not modify impact determinations on marine mammals but would provide the information necessary to ensure that these effects do not exceed the levels analyzed herein.
Vessel speed avoidance measures	The *Vessel Strike Avoidance Plan* is due to NMFS no later than 90 days prior to the planned start of in-water construction activities outside of SBMT (including cable installation) and must include mitigation and monitoring measures for listed species, vessel speeds and transit protocols from all planned ports, vessel-based observer protocols for transiting vessels, communication and reporting	Sunrise Wind has committed to implementing a vessel strike avoidance policy, vessel separation distances, and vessel speed restrictions as part of the Proposed Action. The Sunrise Wind measures include vessel speed restrictions; separation distances for NARWs and

Measure	Description	Effect
	plans, proposed alternative monitoring equipment to maintain vessel strike avoidance zones in varying weather and lighting conditions, and PAM protocols, if applicable. Between November 1st and April 30th, all vessels of all sizes would operate port to port (from ports in NJ, NY, MD, DE, and VA) at 10 knots or less, except for vessels while transiting in Narragansett Bay or Long Island Sound which have not been demonstrated by best available science to provide consistent habitat for NARWs. Vessels transiting from other ports outside those described will operate at 10 knots or less when within any active SMA or within the Wind Development Area (WDA), including the Sunrise Wind Farm and Sunrise Wind Export Cable. Year Round: Vessels of all sizes will operate at 10 knots or less in any Dynamic Management Areas (DMAs). All vessels would reduce speed to 10 knots or less when NARW is sighted and when any large whale, mother/calf pairs, or large groups of non-delphinid cetaceans are observed within 100 m. For small cetaceans and seals, all vessels must maintain a minimum separation distance of 164 ft (50 m) to the maximum extent practicable, except when those animals voluntarily approach the vessel. Vessel operators and crews will receive protected species identification training prior to the start of in-water construction activities. Measures also include crew watch for marine mammals; monitoring project's Situational Awareness System, WhaleAlert, the Right Whale Sighting Advisory System (RWSAS), and U.S. Coast Guard VHF Channel 16 for NARW sightings; the use of PSOs during vessel transits within or to/from the Sunrise Wind Offshore Wind Project Area; 500-m distance separation for NARWs; and 100-m distance separation for mysticetes and sperm whales. When vessels are traveling over 10 knots, they would also require real-time PAM of transit corridors. NARW detections would trigger a 10-knot or less slowdown for the next 12 hours.	other large whales as well as delphinids, porpoises, and seals; and use of a situational awareness network and PSOs for marine mammal detections. Adoption of these additional measures would further clarify requirements for vessel strike avoidance under the Proposed Action but would not alter the impact determinations for any marine mammal species as analyzed herein.

3.11.11.1 Effect of Measures Incorporated into the Preferred Alternative

The mitigation measures listed in Table 3.11-18 are recommended for inclusion in the Preferred Alternative. These measures include vessel speed restrictions, protocols for reporting, specific protocols for monitoring and mitigation during pile driving, and other strategies. 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.

In addition to the mitigation listed above, NMFS has identified terms and conditions in the Biological Opinion for the Sunrise Wind Project in support of BOEM's ESA consultation with NMFS. These terms and conditions are included in Appendix H, Section H.4 and the final terms and conditions would be incorporated into the ROD as conditions of COP approval.

3.12 Sea Turtles

Please see Appendix Q, Section 3.12 for the analysis of the Sea Turtle resource.

3.13 Wetlands and Other Waters of the United States

Please see Appendix Q, Section 3.13 for the analysis of the Wetland and Other Waters of the United States resource.

3.14 Commercial Fisheries and For-Hire Recreational Fishing

This section discusses potential impacts on commercial fisheries and for-hire recreational fishing from the proposed Project, alternatives, and ongoing and planned activities in the commercial fisheries and for-hire recreational fishing GAA. The commercial fisheries and for-hire recreational fishing GAA, as shown on Figure 3.14-1, includes the waters managed by the NEFMC and MAFMC for federal fisheries within the United States Exclusive Economic Zone (from 3 nm to 200 nm [5.6 km to 370.4 km] from the coastline, plus the state waters out to 3 nm (5.6 km) from the coastline from Maine to North Carolina. The boundaries for the GAA were developed to consider impacts on federally permitted vessels operating in all fisheries in state and United States and EEZ waters surrounding the proposed Project.

Due to size of the GAA, the analysis for this Final EIS focuses on the commercial fisheries and for-hire recreational fishing that would likely occur in the proposed Project Area or be affected by Project-related activities, while providing context within the larger GAA. Figure D-11 (Appendix D) provides the geographic study area of ongoing non-offshore wind activities, planned non-offshore wind activities, and offshore wind activities.

3.14.1 Description of the Affected Environment and Future Baseline Conditions

3.14.1.1 Commercial Fisheries

This section provides an overview of commercial fisheries management and the economic value of fisheries in the region and the proposed Project Area.

The primary source for regional fisheries data (Mid-Atlantic and New England regions) was Vessel Trip Report data provided by NMFS (2022a). The summary Vessel Trip Report data included catch estimates by fishing location combined with NMFS estimates of revenue using ex-vessel price data drawn from commercial fisheries data dealer reports. The primary source of fisheries data within the Lease Area was NMFS's *Socioeconomic Impacts of Atlantic Offshore Wind Development* website (https://www.fisheries.noaa.gov/resource/data/socioeconomic-impacts-atlantic-offshore-wind-development) (NOAA Fisheries 2022), which summarizes commercial fisheries data for each proposed WEA along the United States Atlantic coast. In addition, figures developed by BOEM based on NMFS Vessel Monitoring System (VMS) data provided by NMFS (2019) are included and provide additional information about fishing activities in the Lease Area.

To the extent that data are available, the commercial fishing described here includes federally permitted fishing activity in both state and federal waters. Data on the average annual revenue of federally permitted vessels by FMP fishery, gear type, and port of landing are summarized. In general, the data presented focus on those FMP fisheries, species, gear types, and ports that are relevant to commercial fishing activity in the Project Area.

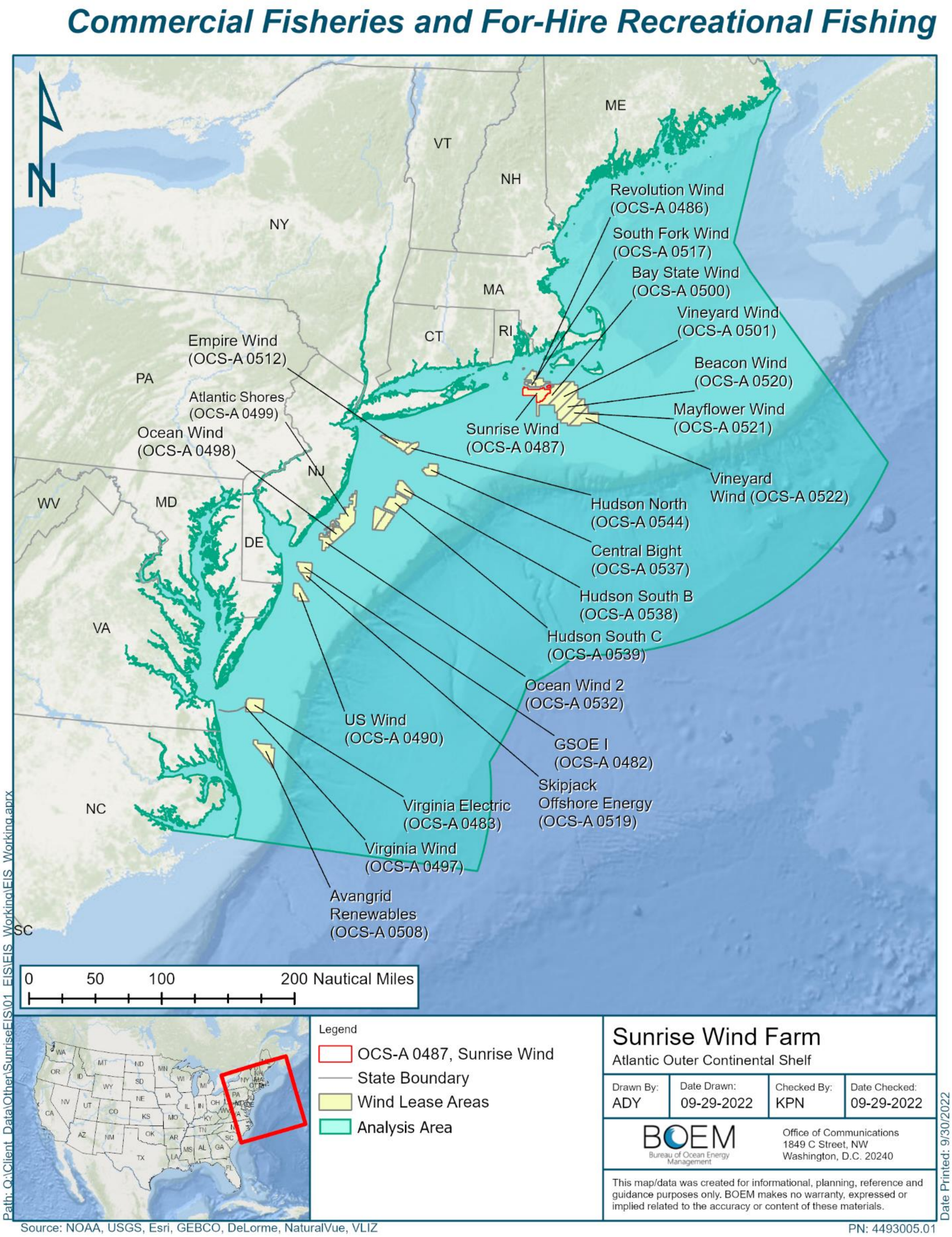


Figure 3.14-1. Commercial Fisheries and For-Hire Recreational Fishing Geographic Analysis Area

3.14.1.2 Regional Setting

Commercial fisheries in federal waters of the New England and Mid-Atlantic regions harvest a variety of finfish and shellfish species, including clams, crabs, groundfish, herring, lobster, squid, scallops, and skates. These species are harvested with a variety of fishing gear, including mobile gear (e.g., bottom trawl, midwater trawl, dredge) and fixed gear (e.g., demersal gillnet, lobster trap, crab trap, pots). The fishery resources are managed under numerous FMPs, including the Atlantic Herring FMP, Monkfish FMP, Northeast Multispecies (large and small mesh) FMP,[23] Red Crab FMP, Sea Scallop FMP, and Skate FMP (NEFMC 2021); Bluefish FMP, Mackerel/Squid/Butterfish FMP, Spiny Dogfish FMP, Summer Flounder/Scup/Black Sea Bass FMP, Surfclam/Ocean Quahog FMP, and Tilefish FMP (MAFMC 2021); Highly Migratory Species FMP (NMFS 2021b); and Atlantic Menhaden FMP, Lobster FMP, and Jonah Crab FMP (ASMFC 2021).

The predominant commercial fish and shellfish species in the GAA based on landed weight and ex-vessel revenue are summarized by species for the years 2010 through 2019 in Table 3.14-1 and Table 3.14-2 respectively. During this period, the species with the highest average annual landed weight included Atlantic menhaden, which represented 34 percent of the average landed weight, American lobster, Atlantic herring, blue crab, sea scallop, and surf clam. The most valuable species over this period were sea scallop and American lobster, which together represented 58 percent of the average annual ex-vessel revenue. Other valuable species harvested in state and federal waters included Atlantic herring, Atlantic menhaden, Atlantic surf clam, longfin and northern shortfin squid, summer flounder, and monkfish.

Commercial fisheries provide economic benefits to the coastal communities of New England and the Mid-Atlantic region by contributing to the income of vessel crews and owners and by creating demand for dockside services to process seafood products and maintain vessels. On average, commercial fishing activity in New England and the Mid-Atlantic generated approximately $1.2 billion in annual ex-vessel revenue from 2010 through 2021.

Table 3.14-3 summarizes the average annual revenue by port of landing from 2010 through 2021 for ports in the GAA. Landings in New Bedford, Massachusetts represented approximately 32 percent of the average annual commercial fishing revenue in the GAA. The ports with the next highest revenues— Cape May, New Jersey; Reedville, Virginia; and Hampton Roads area, Virginia—represented 7 percent, 6 percent, and 5 percent, respectively.

[23] The Northeast Multi-species (large mesh) FMP includes Acadian redfish, American plaice, Atlantic cod, Atlantic haddock, Atlantic halibut, Atlantic wolffish, ocean pout, pollock, white hake, witch flounder, windowpane flounder, winter flounder, and yellowtail flounder. The Northeast Multi-species small-mesh FMP includes offshore hake, red hake, and silver hake.

Table 3.14-1. Commercial Fishing Landings of the Top 20 Species by Landed Weight within the Geographic Analysis Area, 2008-2021

Species [1]	Fishery Management Plan (FMP) Fishery	Peak Annual Landings (millions of pounds)	Average Annual Landings (millions of pounds)	Percentage of Landings in Geographic Analysis Area
Atlantic menhaden	Atlantic Menhaden	504.8	423.8	33.8%
Atlantic herring	Atlantic Herring	224.5	135.5	10.8%
American lobster	American Lobster	159.4	132.5	10.6%
Blue crab	No federal FMP	119.0	69.6	5.5%
Atlantic sea scallop	Sea Scallop	60.6	49.7	4.0%
Atlantic surfclam	Surfclam/Ocean Quahog	50.4	36.7	2.9%
Skates	Skate	40.1	32.9	2.6%
Illex squid	Mackerel/Squid/Butterfish	61.4	28.9	2.3%
Loligo squid	Mackerel/Squid/Butterfish	40.1	24.4	1.9%
Monkfish	Monkfish	24.5	20.0	1.6%
Atlantic mackerel	Mackerel/Squid/Butterfish	49.9	18.2	1.5%
Ocean quahog	Surfclam/Ocean Quahog	31.7	16.7	1.3%
Spiny dogfish	Spiny Dogfish	24.1	15.2	1.2%
Jonah crab	Jonah Crab	20.2	13.9	1.1%
Silver hake	Northeast Multispecies (small-mesh)	17.8	13.9	1.1%
Scup	Summer Flounder/Scup/Black Sea Bass	17.8	13.4	1.1%
Haddock	Northeast Multispecies (large-mesh)	22.4	13.4	1.1%
Pollock	Northeast Multispecies (large-mesh)	22.0	10.7	0.9%
Acadian redfish	Northeast Multispecies (large-mesh)	12.9	8.4	0.7%
Summer flounder	Summer Flounder/Scup/Black Sea Bass	13.0	8.1	0.6%
	All Species[2]	**1,454.0**	**1,255.4**	--

Source: NMFS 2022a.

[1] Species are sorted by average annual landings in descending order.

[2] Includes 252 species and taxonomic groups (e.g., drums, skates) for which there were recorded landings.

Table 3.14-2. Commercial Fishing Revenue of the Top 20 Most Valuable Species within the Geographic Analysis Area, 2008–2021

Species [1]	Fishery Management Plan (FMP) Fishery	Peak Annual Revenue (millions of dollars)	Average Annual Revenue (millions of dollars)	Percentage of Revenue in Geographic Analysis Area
American lobster	American Lobster (ASMFC)	$924.7	$535.8	30.4%
Atlantic sea scallop	Sea Scallop	$670.6	$493.7	28.0%
Blue crab	No federal FMP	$127.5	$94.0	5.3%
Eastern oyster[2]	No federal FMP	$102.6	$64.8	3.7%
Atlantic menhaden	Atlantic Menhaden	$140.5	$49.0	2.8%
Northern quahog[2]	No federal FMP	$75.8	$44.7	2.5%
Loligo squid	Mackerel/Squid/Butterfish	$50.1	$29.5	1.7%
Atlantic surfclam	Surfclam/Ocean Quahog	$32.3	$27.6	1.6%
Soft-shell clam	No federal FMP	$34.2	$24.2	1.4%
Summer flounder	Summer Flounder/Scup/Black Sea Bass	$27.4	$22.2	1.3%
Atlantic herring	Atlantic Herring	$31.8	$21.9	1.2%
Monkfish	Monkfish	$27.1	$18.8	1.1%
Striped bass	No federal FMP	$22.0	$17.1	1.0%
Haddock	Northeast Multispecies (large-mesh)	$22.4	$14.7	0.8%
Atlantic cod	Northeast Multispecies (large-mesh)	$32.6	$13.7	0.8%
American eel	No federal FMP	$39.7	$13.6	0.8%
Ocean quahog	Surfclam/Ocean Quahog	$22.8	$12.4	0.7%
Illex squid	Mackerel/Squid/Butterfish	$27.3	$12.3	0.7%
Jonah crab	Jonah Crab	$18.6	$10.8	0.6%
Silver hake	Northeast Multispecies (small-mesh)	$11.2	$9.8	0.6%
	All Species[3]	**$2,476.4**	**$1,763.4**	**--**

Source: NMFS 2022a.

[1] Species are sorted by revenue in descending order.

[2] Farmed.

[3] Includes 250 species and taxonomic groups (e.g., drums, skates) for which there were recorded landings.

Table 3.14-3. Commercial Fishing Landings and Revenue for the Top 20 Highest Revenue Ports in the Geographic Analysis Area, 2010–2021

Port and State [1]	Peak Annual Landings (millions of pounds)	Average Annual Landings (millions of pounds)	Peak Annual Revenue (millions of dollars)	Average Annual Revenue (millions of dollars)	Percentage of Revenue in Geographic Analysis Area
New Bedford, Massachusetts	170.0	126.4	$569.7	$367.9	31.7%
Cape May, New Jersey	113.5	69.0	$147.7	$80.8	7.0%
Reedville, Virginia	426.1	349.0	$466.5	$65.4	5.6%
Hampton Roads Area, Virginia	19.3	15.1	$88.3	$60.8	5.2%
Gloucester, Massachusetts	122.3	72.5	$80.3	$54.1	4.7%
Stonington, Maine	25.4	17.7	$73.2	$50.4	4.3%
Point Judith, Rhode Island	57.3	45.6	$72.1	$49.2	4.2%
Vinalhaven, Maine	13.4	9.7	$55.8	$36.0	3.1%
Point Pleasant, New Jersey	43.3	25.2	$35.7	$28.7	2.5%
Portland, Maine	62.4	42.9	$38.1	$28.5	2.5%
Provincetown-Chatham,	26.5	18.7	$35.5	$28.3	2.4%
Barnegat Light, New Jersey	8.9	7.2	$33.8	$25.7	2.2%
Wanchese-Stumpy Point, North	25.6	18.7	$26.6	$22.4	1.9%
Friendship, Maine	9.1	6.2	$40.7	$22.0	1.9%
Beals Island, Maine	8.1	6.6	$35.6	$21.4	1.8%
Newington, New Hampshire	4.7	3.9	$30.0	$20.3	1.7%
Atlantic City, New Jersey	35.3	25.6	$24.1	$18.9	1.6%
Montauk, New York	14.8	11.7	$21.2	$16.8	1.4%
Boston, Massachusetts	20.2	14.8	$19.3	$16.3	1.4%
Spruce Head, Maine	6.3	4.4	$31.5	$16.1	1.4%
All Ports[2]	**1,073.7**	**998.1**	**$2,196.3**	**$1,160.1**	**--**

Source: NMFS 2022a.

[1] Ports are sorted by revenue in descending order. Includes 54 ports within the New England and Mid-Atlantic region.

[2] Includes 58 ports within the New England and Mid-Atlantic region, which encompasses the geographic analysis area.

Commercial Fisheries in the Lease Area

The commercial fisheries active in the Sunrise Wind Lease Area encompass a wide range of FMP fisheries, gears, and landing ports. Table 3.14-4 and Table 3.14-5 provide data on revenue and landings for 2008 through 2021 for commercial fisheries in the Lease Area. The top fisheries by revenue in the Lease Area were Monkfish, Sea Scallop, Skates, Summer Flounder/Scup/Black Sea Bass, and the All Others FMP.[24] The top five FMP fisheries accounted for approximately 73 percent of total revenue generated commercially within the Lease Area from 2008 through 2021 and approximately 75 percent of all landings. Other high revenue generating FMPs include the ASMFC FMP, Northeast Multispecies, and Mackerel/Squid/Butterfish, which all averaged over $100,000 annually during the 2008-2021 period. While the Sea Scallop FMP fishery only accounted for roughly 1.3 percent of the total landings, it was the second highest revenue producer, accounting for approximately 14 percent of the total revenue produced within the Lease Area, behind only monkfish, which accounted for 17 percent of the revenue produced in the Lease Area. In total, the Lease Area accounted for approximately 0.10 percent of the total revenue across all FMP fisheries in the GAA, when comparing average annual revenue.

Many of the following tables provide data from the period between 2008 and 2021, and it should be noted that the data from 2020 may not be indicative of historic or future operations. Both harvesters and other businesses reliant on fishing were affected by changes in fishing patterns due to the COVID-19 pandemic, associated responses and restrictions in some cases. An overwhelming majority of commercial fishing and for-hire recreational vessel operators and seafood processing and distribution sectors experienced significant impacts to their operations during the 2020 operating year, with half the vessel operators indicating they stopped fishing for more than three months and nearly 90 percent of the operators reporting revenue losses (Glazier et al. 2022). In the interest of being comprehensive and providing the most recent and relevant data for analysis, the 2020 data is included in the following tables; however, the entirety of the fourteen-year period being is utilized in assessing potential impacts.

[24] 'All others' FMP refers to FMP fisheries with fewer than three permits or dealers affected to protect data confidentially.

Table 3.14-4. **Commercial Fishing Revenue of Federally Permitted Vessels in Lease Area by FMP Fishery (2008–2021)**

Fishery Management Plan (FMP) Fishery	Average Annual Revenue	Total Annual Revenue	Average Annual Revenue as Percentage of Total Revenue from Geographic Analysis Area 1	Average Annual Number of Vessels in the Lease Area	Average Annual Number of Vessel Trips in the Lease Area
Monkfish	$300,475	$4,206,645	1.6%	169	2,004
Sea Scallop	$258,997	$3,625,964	0.05%	67	485
Skates	$168,405	$2,357,676	NA	124	1,766
Summer flounder, Scup, Black Sea Bass	$155,303	$2,174,239	0.07%	177	2,222
ASMFC FMP [2]	$149,027	$2,086,377	NA	130	1,879
Northeast Multispecies	$121,527	$1,701,374	0.43%	85	775
Mackerel, Squid, and Butterfish	$101,607	$1,422,494	0.24%	114	1,426
Small-mesh Multispecies	$60,198	$842,773	0.61%	98	1,178
Atlantic Herring	$18,503	$259,039	0.08%	16	53
Spiny Dogfish	$11,095	$155,335	NA	45	273
No Federal FMP	$8,157	$114,192	<0.00%	125	912
Bluefish	$3,547	$49,657	NA	108	824
Tilefish	$2,383	$33,367	NA	39	75
Highly Migratory Species	$916	$12,821	NA	27	92
SERO FMP [3]	$38	$530	NA	21	63
All others [4]	$437,675	$6,127,445	NA	NA	NA
All FMP Fisheries	**$1,797,853**	**$25,169,928**	**0.10%**	**1,343**	**14,028**

Source: Developed using data from NMFS 2022a.

Note: Numbers are in 2021 dollars and Total Revenue is rounded to nearest $1,000 and are sorted by revenue in descending order. NA indicates data not available to perform calculations. Differences in totals are due to rounding.

[1] Regional comparison is relative to the individual species noted, not all species combined.

[2] Atlantic States Marine Fisheries Commission (ASMFC).

[3] SERO FMP is NOAA's Southeast Regional Office Fishery Management Plan.

[4] All Others refers to FMP fisheries with fewer than three permits or dealers affected to protect data confidentially.

Table 3.14-5. Commercial Fishing Landings (pounds) of Federally Permitted Vessels in the Lease Area (2008–2021)

Fishery Management Plan (FMP) Fishery	Average Annual Landings (Pounds)	Total Landings (Pounds)
Skates	498,518	6,979,251
Monkfish	219,133	3,067,856
Atlantic Herring	139,249	1,949,482
Small-mesh Multispecies	118,441	1,658,180
Summer flounder, Scup, Black Sea Bass	117,545	1,645,630
Mackerel, Squid, and Butterfish	107,102	1,499,425
ASMFC FMP	63,287	886,022
Spiny Dogfish	60,881	11,095
Northeast Multispecies	56,881	796,340
Sea Scallop	26,117	365,631
No Federal FMP	5,723	80,123
Bluefish	4,684	65,577
Highly Migratory Species	1,886	26,405
Tilefish	654	9,151
SERO FMP	21	297
All others	654,606	9,164,482
All FMP Fisheries	**2,074,728**	**28,204,947**

Source: NMFS 2022a.

Notes: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region. Total landings rounded to nearest 1,000. Differences in totals are due to rounding.

Table 3.14-6 and Table 3.14-7 provide the revenue (average annual and total) and landings in pounds (average annual and total) in the Lease Area by gear type for the 2008–2021 period. Together, dredge-scallop, dredge-clam, all others, pot-other and trawl-bottom accounted for over 98 percent of the total revenue generated by commercial fishing activity in the Lease Area. The area accounted for less than 0.02% of the total revenue for the Mid-Atlantic and New England regions GAA for all gear types.

Table 3.14-6. **Commercial Fishing Revenue of Federally Permitted Vessels in the Lease Area by Gear Type (2008–2021)**

Gear Type	Average Annual Revenue	Total Revenue	Average Annual Revenue in Lease Area as a Percentage of Average Total Revenue from the Geographic Analysis Area [1]
Dredge-scallop	$122,558	$1,715,812	0.01%
Dredge-clam	$121,783	$1,704,958	0.01%
All others[2]	$44,418	$621,853	0.00%
Pot-other	$34,519	$483,265	0.00%
Trawl-bottom	$18,757	$262,593	0.00%
Gillnet-sink	$4,593	$64,303	0.00%
Pot-lobster	$1,090	$15,266	0.00%
Trawl-midwater	$667	$9,335	0.00%
All Gear Types	**$348,385**	**$4,877,385**	**0.02%**

Source: Developed using data from NMFS 2022a.

Notes: Revenue is in 2021 dollars, with total revenue rounded to nearest thousand. Differences in totals are due to rounding.

[1] Regional comparison is relative to the gear type noted, not all gear types combined.

[2] All Others refers to FMP fisheries with fewer than three permits or dealers affected to protect data confidentially and includes Seine-Purse.

Table 3.14-7. **Commercial Fishing Landings (pounds) of Federally Permitted Vessels in the Lease Area by Gear Type (2008–2021)**

Gear Type	Average Annual Landings (Pounds)	Total Landings (Pounds)
All others[1]	339,045	4,746,630
Dredge-clam	176,365	2,469,104
Trawl-bottom	24,349	340,879
Dredge-scallop	12,689	177,689
Pot-other	8,875	124,251
Trawl-midwater	6,262	87,665
Gillnet-sink	4,112	57,573
Pot-lobster	317	4,437
All Gear Types	**572,014**	**8,008,228**

Source: NMFS 2022a.

Notes: Differences in totals are due to rounding.

[1] All Others refers to FMP fisheries with fewer than three permits or dealers affected to protect data confidentially and includes Seine-Purse.

Table 3.14-8 provides the average number of vessel trips and average number of vessels fishing in the Lease Area by port for the period 2008 through 2021. Table 3.14-9 provides a ranking of ports by revenue of fishing vessels in the Lease Area from 2008 through 2021, as well as the level of commercial fishing engagement and reliance of the community in which the port is located. As noted earlier, these rankings portray the level of dependence of the community on commercial fishing and are compiled by NMFS (NOAA 2022). Fifty-one percent of the trips of fishing vessels that operate within the Lease Area originate from Point Judith, Rhode Island, followed by New Bedford, Massachusetts at almost 16 percent. Other ports did not originate more than 6 percent of the vessels that operate within the Lease Area. New Bedford and Point Judith receive the highest value of landings of any ports, with respective averages of $827,536 and $505,788 based upon the years 2008 through 2021. These ports contribute just over 67 percent of the total revenue for the Lease Area. The commercial fishing engagement and reliance differ across communities that engage in commercial fishing within the Lease Area. For example, New Bedford and Point Judith rank high in the commercial fishing engagement and they rank in the middle in commercial fishing reliance, but the city of Newport, Rhode Island ranks high in fishing engagement but low in the community's reliance on commercial fishing. Information regarding the ranking determinations for each community is provided in the community profiles available from NMFS (NOAA 2022). These profiles present the most recent data available for these key indicators of New England and Mid-Atlantic fishing communities related to dependence on fisheries and other economic and demographic characteristics. Selected socioeconomic characteristics of communities with fishing ports that could be affected by the proposed Project are presented in Section 3.16, *Demographics, Employment, and Economics* and Section 3.17, *Environmental Justice*.

Table 3.14-8. Commercial Fishing Trips and Vessels in the Lease Area by Port (2008–2021)

Port and State	Average Annual Trips[1]	Average Annual Vessels
Barnstable, Massachusetts	1	0
Beaufort, North Carolina	19	12
Belford, New Jersey	1	0
Boston, Massachusetts	11	2
Cape May, New Jersey	4	3
Chatham, Massachusetts	14	3
Chincoteague, Virginia	0	0
Chilmark, Massachusetts	159	6
Davisville, Rhode Island	1	0
Fairhaven, Massachusetts	32	4
Fall River, Massachusetts	19	1
Gloucester, Massachusetts	1	1
Hampton Bay, New York	1	0
Hampton, Virginia	16	10
Harwichport, Massachusetts	5	1
Little Compton, Rhode Island	284	12
Menemsha, Massachusetts	155	6
Montauk, New York	219	31
New Bedford, Massachusetts	785	81
New London, Connecticut	34	4
New Shoreham, Rhode Island	31	4
Newport News, Virginia	10	7
Newport, Rhode Island	287	13
Point Judith, Rhode Island	2,509	109
Point Pleasant, New Jersey	20	7
Shinnecock, New York	1	1
Stonington, Connecticut	66	12
Tiverton, Rhode Island	67	3
Wanchese, North Carolina	2	1
Westport, Massachusetts	153	9
Woods Hole, Massachusetts	11	1
Total	**4,916**	**345**

Source: NMFS 2022a.

Note: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region. Differences in totals are due to rounding.

[1] Trips were not necessarily made in every year, but all ports had at least one year where trips were made. Ports with only one year where trips to the Lease Area were made include Barnstable, Massachusetts (2008); Belford, New Jersey (2016); and Chincoteague, Virginia (2018).

Annual average commercial fishing landings and revenue within the Lease Area from 2008–2021 are summarized by fishing port in Table 3.14-9 and by state in Table 3.14-10. The fishing ports with the highest landed weight were New Bedford, Massachusetts followed by Point Judith, Little Compton, and Newport, all in Rhode Island. These four ports combined for over 85 percent of the total annual average landings from the Lease Area. These represent between a high of 0.07 percent (for New Bedford) and 0.01 percent of the total landings in the GAA. No other fishing port landed more than an average of 35,000 lbs (15,876 kg) per year, except the All Others category. From an average annual revenue perspective, these ports were also the top four ports generating revenue from the Lease Area. New Bedford alone accounted for almost 42 percent of the total revenue, and when the four ports were combined they account for over 85 percent of the revenue generated from the Lease Area. This represents between a high of 0.05 percent (for New Bedford) and 0.01 percent of the revenue generated in the GAA. No other fishing ports had above 0.01 percent of the GAA average annual revenue.

Table 3.14-9. Annual Average Commercial Fishing Landings and Revenue Exposed to the SRWF by Port Based on Annual Average Revenue 2008–2021

Port	Lease Area Landings (pounds)	Percentage of Landings in the Geographic Analysis Area[1]	Lease Area Average Annual Revenue (2020 dollars)	Percentage of Revenue in the Geographic Analysis Area[2]	Commercial Fishing Engagement Categorical Ranking[1]	Commercial Fishing Reliance Categorical Ranking[2]
New Bedford, Massachusetts	826,131	0.07%	$827,536	0.05%	High	Medium
Point Judith, Rhode Island	493,582	0.04%	$505,788	0.03%	High	Medium
Little Compton, Rhode Island	274,810	0.02%	$223,718	0.01%	Medium	Medium
Newport, Rhode Island	173,744	0.01%	$123,085	0.01%	High	Low
Westport, Massachusetts	34,221	0.00%	$45,251	0.00%	Medium-High	Low
Montauk, New York	23,105	0.00%	$38,827	0.00%	High	Medium-High
Tiverton, Rhode Island	41,501	0.00%	$32,190	0.00%	Medium	Low
Stonington, Connecticut	8,956	0.00%	$17,885	0.00%	High	Low
Fairhaven, Massachusetts	10,005	0.00%	$15,713	0.00%	High	Low
Hampton, Virginia	3,388	0.00%	$7,419	0.00%	High	Low
Menemsha, Massachusetts	1,144	0.00%	$6,455	0.00%	Medium	Medium
Woods Hole, Massachusetts	987	0.00%	$6,054	0.00%	Medium	Medium
Newport News, Virginia	2,430	0.00%	$5,656	0.00%	High	Low

Port	Lease Area Landings (pounds)	Percentage of Landings in the Geographic Analysis Area[1]	Lease Area Average Annual Revenue (2020 dollars)	Percentage of Revenue in the Geographic Analysis Area[2]	Commercial Fishing Engagement Categorical Ranking[1]	Commercial Fishing Reliance Categorical Ranking[2]
New London, Connecticut	6,260	0.00%	$5,344	0.00%	Medium-High	Low
Chatham, Massachusetts	4,579	0.00%	$4,997	0.00%	High	High
Chilmark, Massachusetts	973	0.00%	$4,446	0.00%	Medium	Medium
Beaufort, North Carolina	1,381	0.00%	$3,714	0.00%	High	Medium
Point Pleasant Beach, New Jersey	1,702	0.00%	$3,511	0.00%	High	Medium-High
Gloucester, Massachusetts	23,455	0.00%	$3,237	0.00%	High	Medium
Fall River, Massachusetts	9,593	0.00%	$2,391	0.00%	Medium	Low
Boston, Massachusetts	2,409	0.00%	$1,347	0.00%	High	Low
Wanchese, North Carolina	455	0.00%	$1,225	0.00%	High	Medium-High
Davisville, Rhode Island	1,535	0.00%	$1,160	0.00%	High	Low
Harwichport, Massachusetts	214	0.00%	$1,009	0.00%	Medium	Medium
Cape May, New Jersey	476	0.00%	$965	0.00%	High	High
New Shoreham, Rhode Island	349	0.00%	$576	0.00%	Medium	Medium
Shinnecock, New York	219	0.00%	$209	0.00%	High	Low
Chincoteague, Virginia	17	0.00%	$50	0.00%	Medium	Medium
Belford, New Jersey	18	0.00%	$42	0.00%	High	Medium
Barnstable, Massachusetts	18	0.00%	$37	0.00%	High	Low
Hampton Bay, New York	18	0.00%	$25	0.00%	High	Low
All Others[3]	126,438	0.00%	$90,267	0.00%	N/A	N/A

Sources: Developed using data from NMFS (NOAA Fisheries 2022).

Notes: Revenue values have been adjusted to real 2020 dollars and are estimated based on the annual average revenue by Port from 2008 through 2021. Ports were then sorted by revenue in descending order, with All Others listed last as it is not attributable to a specific port.

[1] Calculated as the landed weight at a port from the Lease Area divided by the total landed weight across all ports from the Geographic Analysis Area. A value of 0.00% means there is a value below 0.01%, but not zero.

[2] Calculated as the revenue at a port from the Lease Area divided by the total revenue across all ports from the Geographic Analysis Area. A value of 0.00% means there is a value below 0.01%, but not zero.

[3] "All Others" is for data that has been aggregated for confidentiality purposes.

When looking at average annual landings and revenue generated by state, Table 3.14-10 shows that ports in Rhode Island and Massachusetts generated the highest landings and revenue. Individually, Rhode Island accounted for over 52 percent of the landings and 48 percent of the revenue generated from the Lease Area. This was closely followed by Massachusetts that accounted for nearly 45 percent of the landings and nearly 47 percent of the revenue. Combined, ports in these two states landed 97 percent of fish by landing weight and were responsible for 95 percent of the total revenue. These represented 0.05 percent of the revenue, each, when compared to the GAA. No other states reached 0.01 percent of the GAA in average annual landings from the Lease Area.

In general, fishing ports and states that derive higher percentages of landings and revenue from the Lease Area are expected to experience greater impacts from the Proposed Action. However, this should also be considered relative to the overall commercial fishing engagement and reliance of ports, as outlined in Table 3.14-8. For instance, of the four ports generating the highest landings and revenue, all are “high” or “medium” in terms of fishing engagement, but with respect to reliance on fishing, New Bedford, Point Judith, and Little Compton are “medium” while Newport is “low.” Two ports with the highest percentage of annual average revenue generated within the Lease Area are the New Jersey ports of Atlantic City and Cape May. Both have a “high” commercial fishing engagement ranking, but Atlantic City has a “low” commercial fishing reliance rank and Cape May has a “high” commercial fishing reliance rank.

Table 3.14-10. Annual Average Commercial Fishing Revenue Exposed to the SRWF by State Based on Annual Average Revenue 2008–2021

State	Lease Area Landings (pounds)	Percentage of Landings in the Geographic Analysis Area [1]	Lease Area Average Annual Revenue (2020 dollars)	Percentage of Revenue in the Geographic Analysis Area [2]
Rhode Island	1,078,904	0.09%	$952,717	0.05%
Massachusetts	932,966	0.07%	$929,862	0.05%
New York	23,768	0.00%	$39,854	0.00%
Connecticut	16,941	0.00%	$24,820	0.00%
Virginia	6,830	0.00%	$15,339	0.00%
New Jersey	7,923	0.00%	$9,318	0.00%
North Carolina	2,661	0.00%	$6,687	0.00%
Maine	3,466	0.09%	$738	0.05%
All Others[3]	654	0.07%	$796	0.05%

Sources: Developed using data from NMFS (NOAA Fisheries 2022).

Notes: Revenue values have been adjusted to real 2020 dollars and are estimated based on the annual average revenue by State from 2008 through 2021. They were then sorted by highest average annual revenue, with All Others listed last as it is not attributable to a specific state.

1 Calculated as the landed weight at a port from the Lease Area divided by the total landed weight across all ports from the Geographic Analysis Area. A value of 0.00% means there is a value below 0.01%, but not zero.

2 Calculated as the revenue at a port from the Lease Area divided by the total revenue across all ports from the Geographic Analysis Area. A value of 0.00% means there is a value below 0.01%, but not zero.

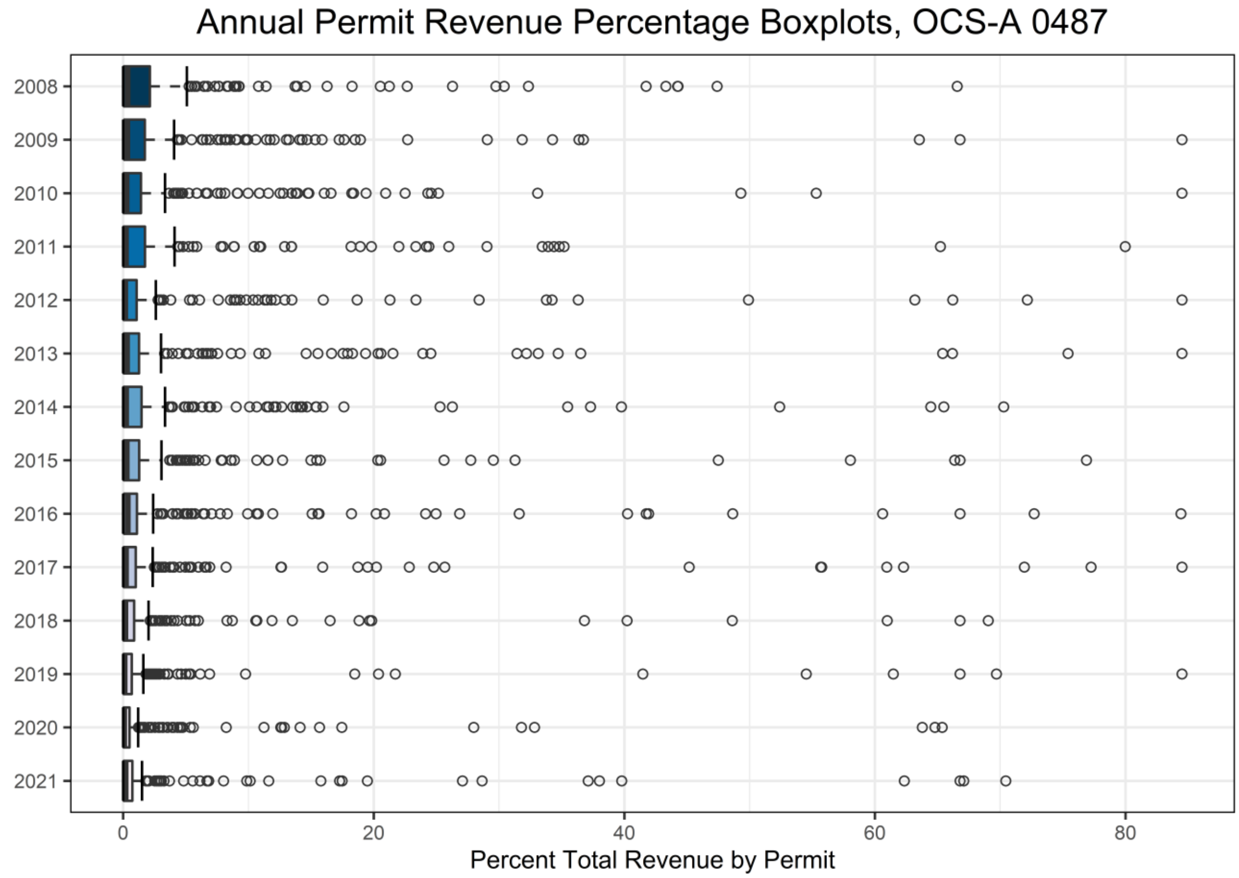
3 “All Others” is for data that has been aggregated for confidentiality purposes.

To analyze differences in the economic importance of fishing grounds in the Lease Area across the commercial fishing fleet, the NMFS analyzed the percentage of each permit's total commercial fishing revenue attributed to catch within the Lease Area during 2008 through 2021 (NMFS 2022a).

The vessel-level annual revenue percentages were divided into quartiles, which were created by ordering the data from lowest to highest percentage value and then dividing the data into four groups of equal size. The first quartile represents the lowest 25 percent of ranked percentages, while the fourth quartile represents the highest 25 percent.

The distribution of the vessel-level annual revenue percentages for the Lease Area is provided in the boxplot on Figure 3.14-2. The boxplot begins at the first quartile, or the value beneath which 25 percent of all vessel-level revenue percentages fall. A thick line within the box identifies the median, the observation that 50 percent of vessel-level revenue percentages are above or beneath. The box ends at the third quartile, or the vessel-level revenue percentage beneath which 75 percent of observations fall. Nonparametric estimates of the minimum and maximum values are indicated by the "whiskers" (dashed line terminating in a vertical line) that jut out from each side of the box. Any points outside of these whiskers are vessel-level revenue percentages that are considered outliers. In the context of this analysis, an outlier is a vessel that derived an exceptionally high proportion of its annual revenue from the Lease Area in comparison to other vessels that fished in the area.[25]

[25] Technically, an outlier in a boxplot distribution is an observation that is more than 1.5 times the length of the box away from either the first quartile (Q1) or third quartile (Q3). Specifically, if an observation is less than Q1 – (1.5 × IQR) or greater than Q3 + (1.5 × IQR), it is an outlier; where IQR = interquartile range = Q3 – Q1.



Source: NMFS 2022a

Figure 3.14-2. Percentage of Total Commercial Fishing Revenue of Federally Permitted Vessels Derived from the Lease Area by Vessel (2008–2021)

Table 3.14-11 presents the minimum, first quartile, median, third quartile, and maximum values for the Lease Area from 2008 through 2021. Table 3.14-12 presents the number of outliers by year.

Table 3.14-11. Analysis of 14-year Permit Revenue Boxplots for the Lease Area (2008–2021)

Minimum Revenue Percentage Value	First Quartile	Median	Third Quartile	Maximum Revenue Percentage Value[1]
0	0.04	0.24	1	85

Source: Developed using data from NMFS 2022a.

[1] Maximum value is inclusive of outliers.

Table 3.14-12. Number of Federally Permitted Vessels in the Lease Area (2008–2021)

Year	Number of Vessels	Number of Outliers	Number of Outliers as a Percentage of Total Vessels
2021	225	39	17%
2020	306	46	15%
2019	296	42	14%
2018	264	41	16%
2017	292	41	14%
2016	334	44	13%
2015	303	40	13%
2014	330	42	13%
2013	327	40	12%
2012	304	39	13%
2011	275	32	12%
2010	280	43	15%
2009	325	46	14%
2008	337	39	12%
Average	**300**	**41**	**14%**

Source: Developed using data from NMFS 2022a .

A total of 75 percent of the permitted vessels that fished in the Lease Area derived 1 percent or less of their total annual revenue from the area (NMFS 2022a). The highest percentage of total annual revenue attributed to catch within the Lease Area was 85 percent in seven different years during the 2008-2021 timeframe. Although outliers derived a high proportion of their annual revenue from the Lease Area in comparison to other vessels that fished in the area, Figure 3.14-2 shows that, in any given year, the revenue percentage for the majority of outliers was below 20 percent. As such, while some vessels depended heavily on the Lease Area for their commercial fishing revenue, most derived a much smaller percentage of their total annual revenue from the area.

Another aspect of commercial fishing within the Lease Area is the proportion of small business operations compared to large businesses. To characterize the amount of fishing revenue from the Lease Area that is generated by small businesses, NMFS conducted a small business analysis. The analysis defined a small business as a business that is independently owned and operated, is not dominant in its field of operation (including its affiliates) and has combined annual receipts not in excess of $11 million for all its affiliated operations worldwide. The analysis was conducted upon unique business interests, which can represent multiple vessel permits. Both within the northeast region as well as the Sunrise Wind Lease Area, there are more small businesses operating than large businesses. The number of small and large businesses engaged in federally managed fishing and the revenue of those businesses from 2019 through 2021 is summarized for the GAA in Table 3.14-13 and for the Lease Area in Table 3.14-14. During this three-year time period, an annual average of 1,166 businesses fished in the GAA, of which 1,155 (99 percent) were small businesses and 11 (1 percent) were large businesses. Businesses engaged in fishing in the GAA generated an annual average revenue of more than $1 billion, of which over $777 million (77 percent) was attributed to small businesses and $232 million (23 percent) was attributed to large businesses. During this same time period, an annual average of 224 businesses fishing in the Lease Area, of which 215 (96 percent) were small businesses and 9 (4 percent) were large businesses. Businesses generated an annual average revenue of $1,141 thousand in the Lease Area, of which $1,079 thousand (95 percent) was attributed to small businesses and $62 thousand (5 percent) was attributed to large businesses. Small businesses that fished inside the Lease Area generated 0.45 percent of their total revenue from the Lease Area, while large businesses that fished inside the Lease Area generated 0.03 percent of their total revenue from the Lease Area, demonstrating that small businesses were more reliant on revenue generated from the Lease Area.

Table 3.14-13. Number and Revenue of Small and Large Businesses Engaged in Federally Managed Fishing within the Geographic Analysis Area, 2019-2021

Year	Business Type	Number of Entities	Revenue (thousands of dollars)[1]
2019	Large business	11	$247,928
	Small business	1,130	$799,249
2020	Large business	11	$200,342
	Small business	1,144	$684,526
2021	Large business	11	$248,437
	Small business	1,190	$849,039
Annual Average	**Large business**	**11**	**$232,236**
	Small business	**1,155**	**$777,605**

Source: Developed using data from NMFS 2022b.

[1] Revenue values have been delated to 2021 dollars and rounded to the nearest thousand.

Table 3.14-14. Number and Revenue of Small and Large Businesses Inside the Lease Area Compared to the Total Revenue of those Businesses, 2019-2021

Year	Business Type	Number of Entities	Revenue from Lease Area (thousands of dollars)1	Total Revenue (thousands of dollars)1	Percentage of Revenue from Lease Area
2019	Large business	10	$60	$217,081	0.03%
	Small business	214	$1,032	$271,565	0.38%
2020	Large business	10	$82	$180,279	0.05%
	Small business	230	$1,071	$256,794	0.42%
2021	Large business	7	$43	$141,377	0.03%
	Small business	202	$1,134	$187,773	0.60%
Annual Average	**Large business**	**9**	**$62**	**$179,579**	**0.03%**
	Small business	**215**	**$1,079**	**$238,711**	**0.45%**

Source: Developed using data from NMFS 2022b.

[1] Revenue values have been delated to 2021 dollars and rounded to the nearest thousand.

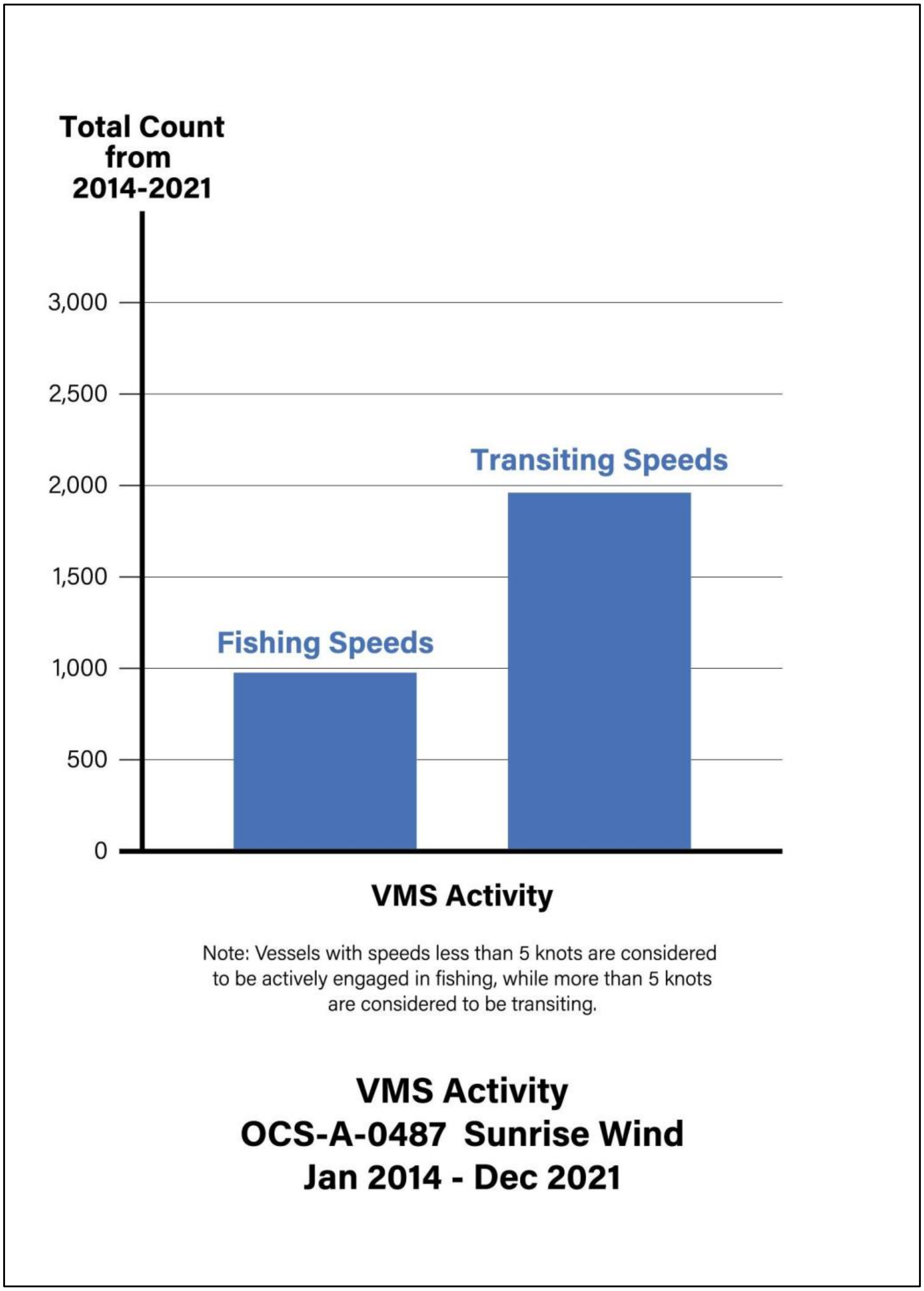
Commercial fishing regulations include requirements for VMS which is a satellite surveillance system that monitors the location and movement of commercial fishing vessels. Therefore, it is a good data source for understanding the spatial distribution of fishing vessels engaged in FMP fisheries in the northeast region. In 2018 there were 912 VMS-enabled vessels operating in the northeast region across all fisheries. These 912 vessels represented a substantial portion (71 to 87 percent) of summer flounder, scup, black sea bass, and skate landings, and greater than 90 percent of landings for scallops, squid, monkfish, herring, mackerel, large-mesh multispecies, whiting, surfclams, and ocean quahogs. VMS vessels represented less than 20 percent of highly migratory species and 10 percent of lobster/Jonah crab landings (NMFS 2021a, pers. comm.). Of these vessels, approximately 67 percent fished or transited in all reasonably foreseeable project areas, and 29 percent (262 vessels) fished or transited in the Lease Area in 2018 (NMFS 2019, pers. comm.).

Using VMS data conveyed in individual position reports (pings) from January 2014 to December 2021, BOEM compiled information about fishing activities within the Lease Area. From the VMS data, it is interpreted that vessels with speeds less than 5 knots (2.6 meters per second [m/s]) are actively engaged in fishing, although vessels may use slower speeds to transit or be engaged in other activities such as processing at sea. Vessels traveling faster than 5 knots (2.6 m/s) are generally interpreted to be transiting. Figure 3.14-3 presents the overall breakdown of the count of vessels that were either actively fishing or transiting the Lease Area from 2014 to 2021 (note, some vessels may be counted twice if they cover multiple transiting speeds). BOEM also developed polar histograms using the VMS data that show the directionality of VMS-enabled vessels operating in the Project Area and the targeted FMP fishery (Figure 3.14-4 through Figure 3.14-8). The larger bars in the polar histograms represent a greater number of position reports showing fishing vessels moving in a certain direction within the Project Area. The polar histograms differ with respect to their scales.

Figure 3.14-4 illustrates that for all activities (transiting and fishing combined), most of the 491 unique vessels participating in a VMS fishery generally operated in an east-west pattern with a secondary north-south pattern, while approximately 236 of the unique vessels participating in a non-VMS fishery[26] generally operated in a north-south pattern with a secondary east-west pattern. Figure 3.14-5 illustrates that VMS fishery vessels transiting the Lease Area followed primarily a north-south pattern with a secondary pattern of northwest-southeast and non-VMS fishery vessels also generally transited in a north-south pattern, with a secondary pattern of east-west. Figure 3.14-6 illustrates that most of the unique VMS fishery vessels fishing in the Lease Area followed a slightly northeast-southwest fishing pattern and those non-VMS fishery vessels actively fishing in the Lease Area followed a similar pattern.

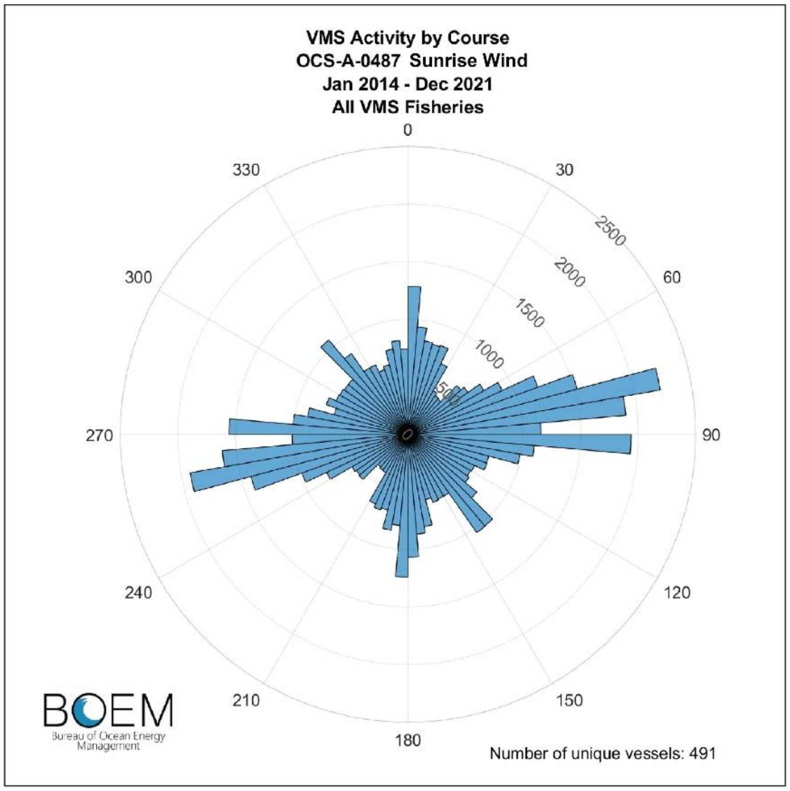
Figure 3.14-7 confirms that the orientation of vessels transiting the Lease Area varies amongst FMP fisheries with those in the Monkfish FMP fishery generally following a north-south pattern, the Atlantic Sea Scallop FMP fishery was variable with both a southwest-northeast pattern as well as a northwest-southeast pattern. The Northeast Multispecies FMP fishery was variable and the Squid, Mackerel, Butterfish FMP fisher followed a northwest-southeast pattern. Figure 3.14-8 provides the orientation of vessels actively fishing within the Lease Area varied by FMP fishery, with associated patterns. While the Monkfish FMP, Northeast Multispecies FMP, and Squid, Mackerel, Butterfish FMP fisheries followed a slightly south-west to north-east pattern. The Atlantic Sea Scallop FMP fishery also had a general east-west pattern with more variation.

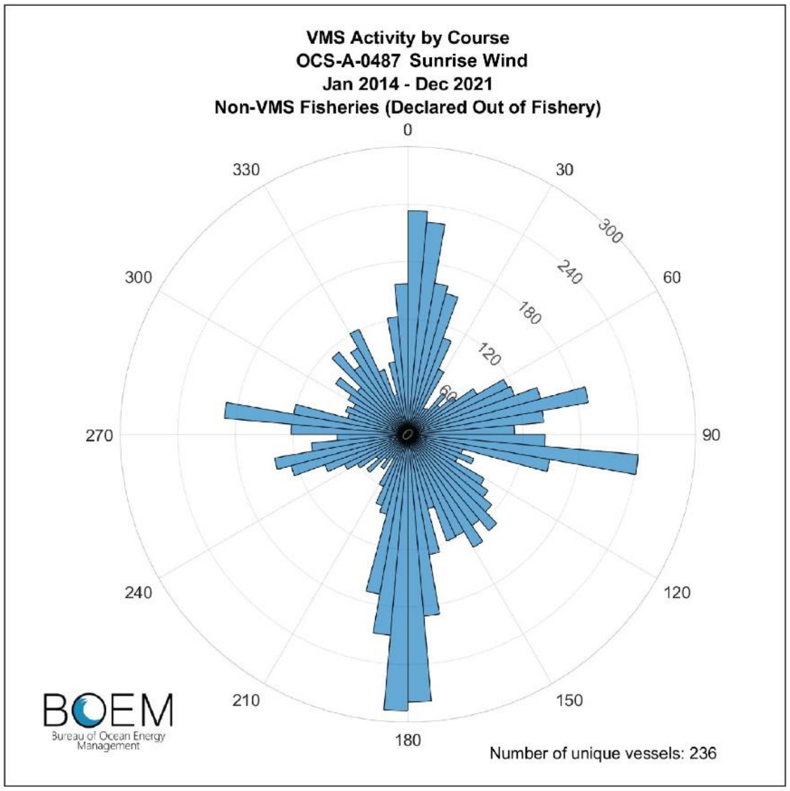
[26] These are fishing vessels that are transmitting VMS data after having declared themselves as participating in a non-VMS fishery (e.g., lobster, river herring).



Source: Developed by BOEM using VMS data provided by NMFS (2022a).

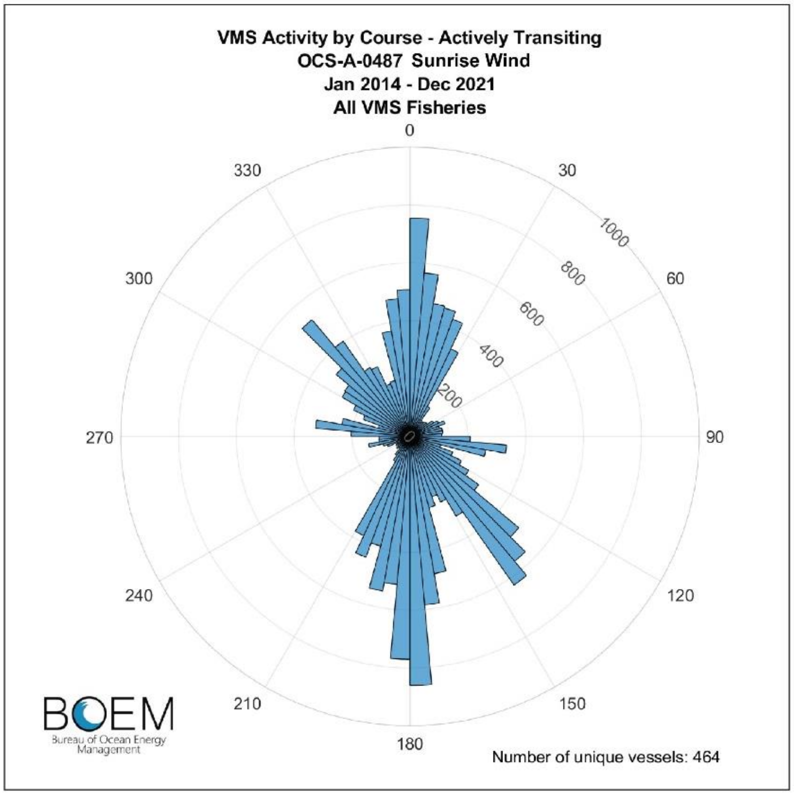
Figure 3.14-3. VMS Activity and Unique Vessels Operating in the Lease Area, January 2014-December 2021

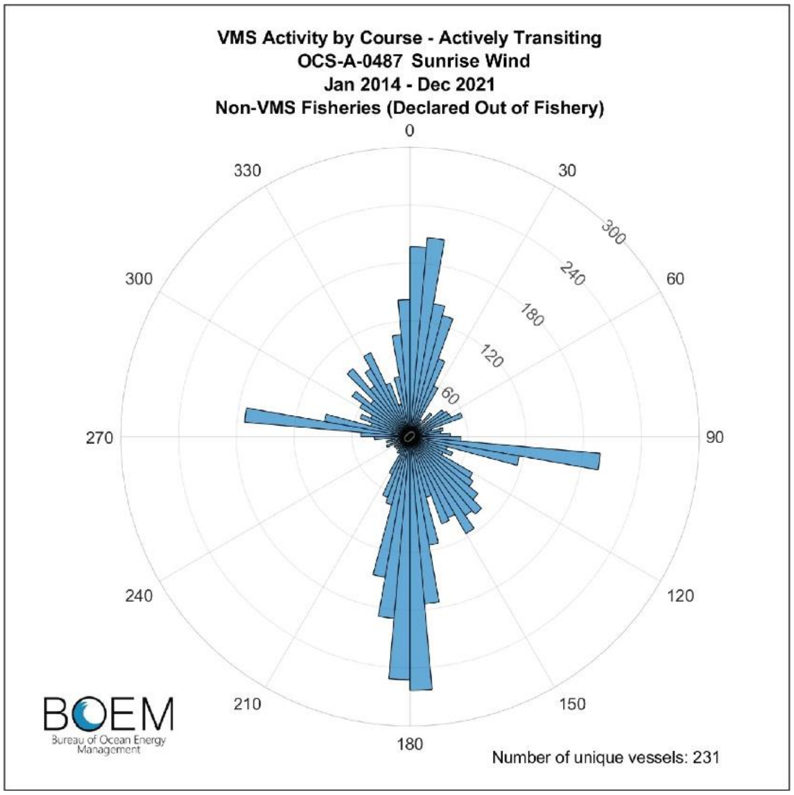




Source: Developed by BOEM using VMS data provided by NMFS (2022a).

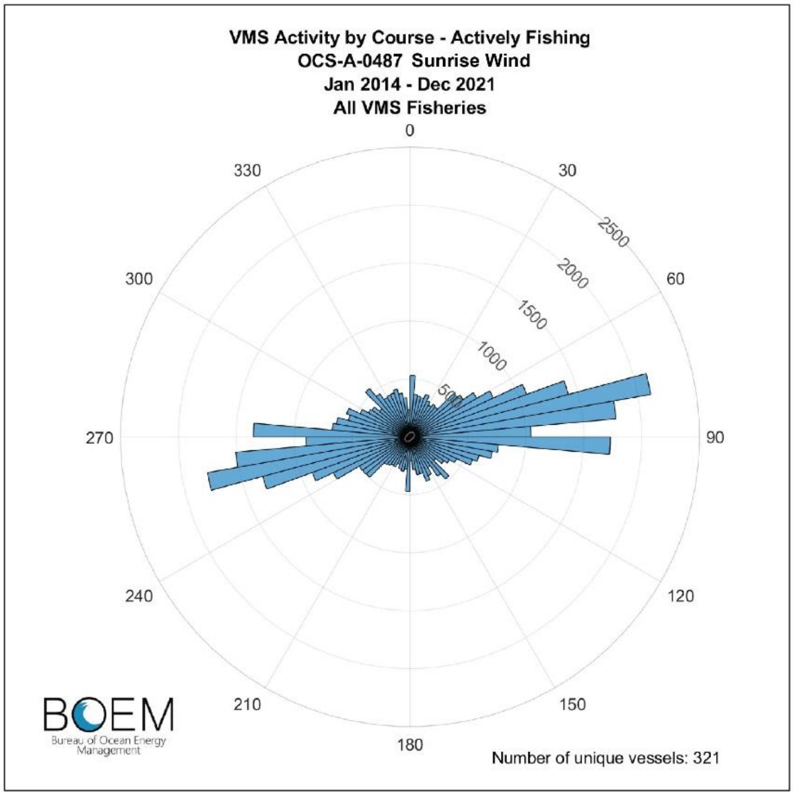
Figure 3.14-4. VMS Bearings for All Activity of VMS and Non-VMS Fisheries within the Lease Area, January 2014 – December 2021

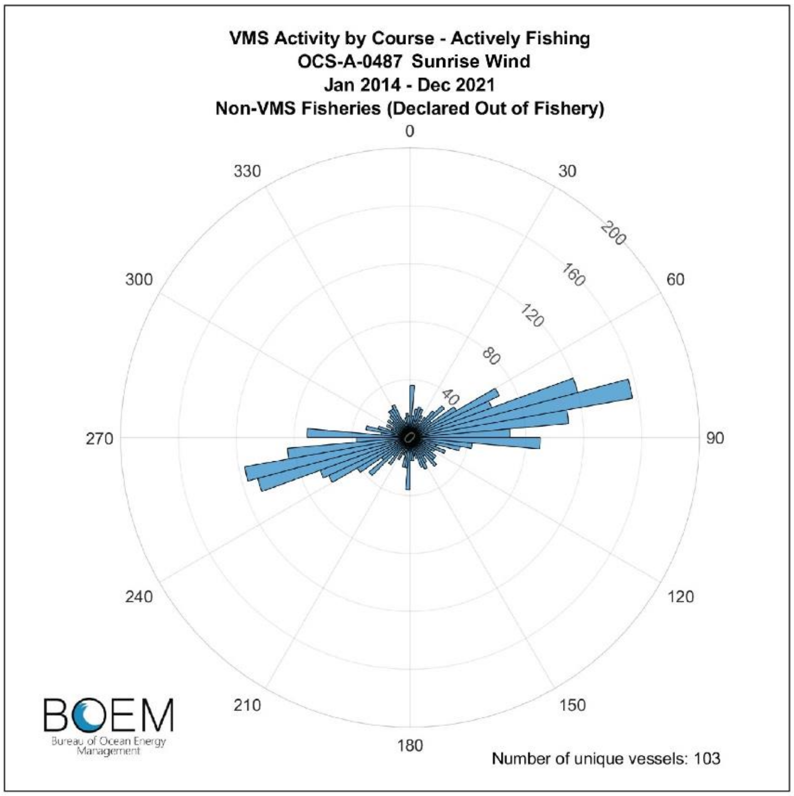




Source: Developed by BOEM using VMS data provided by NMFS (2022a).

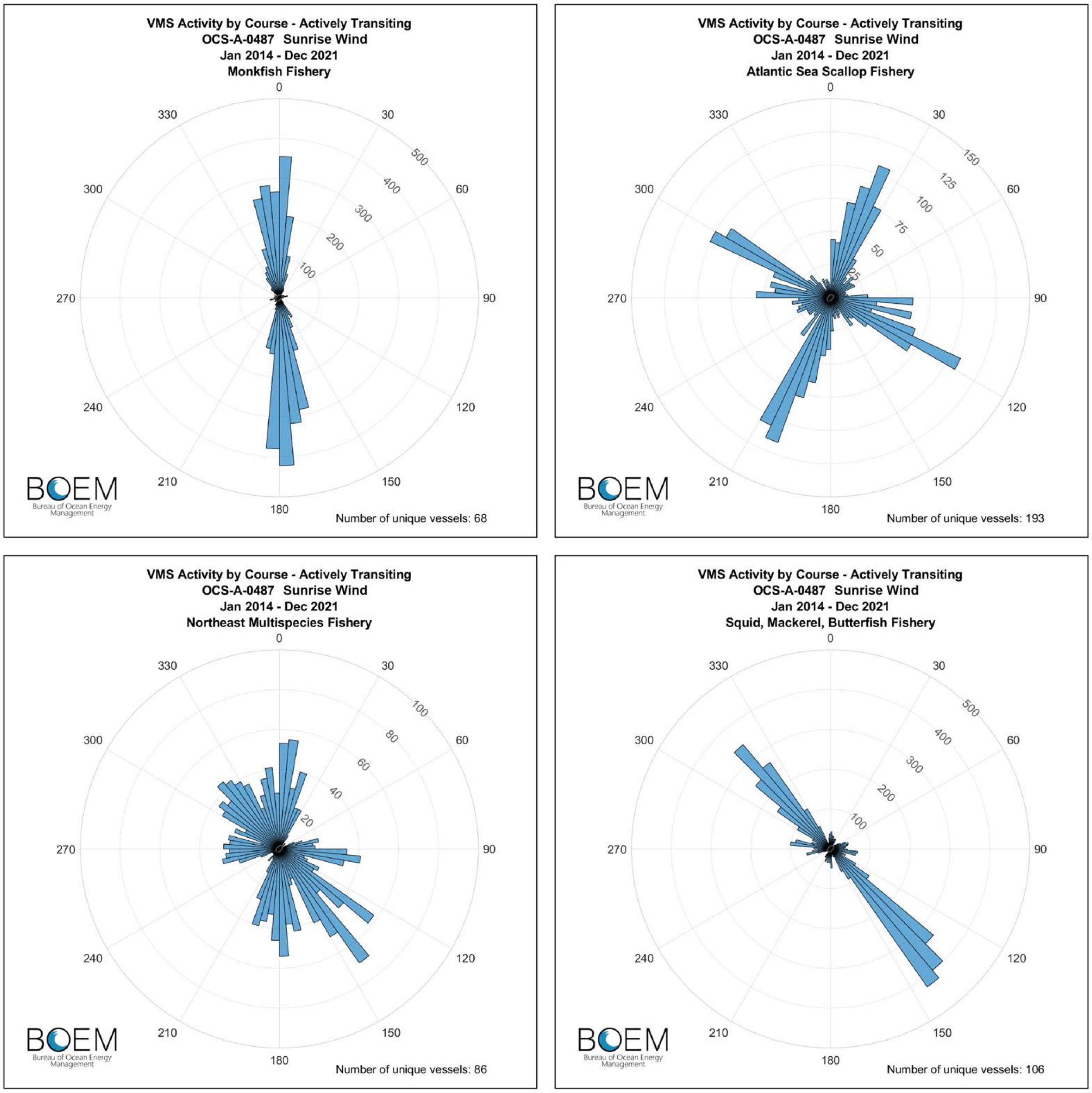
Figure 3.14-5. VMS Bearings for Transiting VMS and Non-VMS Fishery Vessels within the Lease Area, January 2014 – December 2021





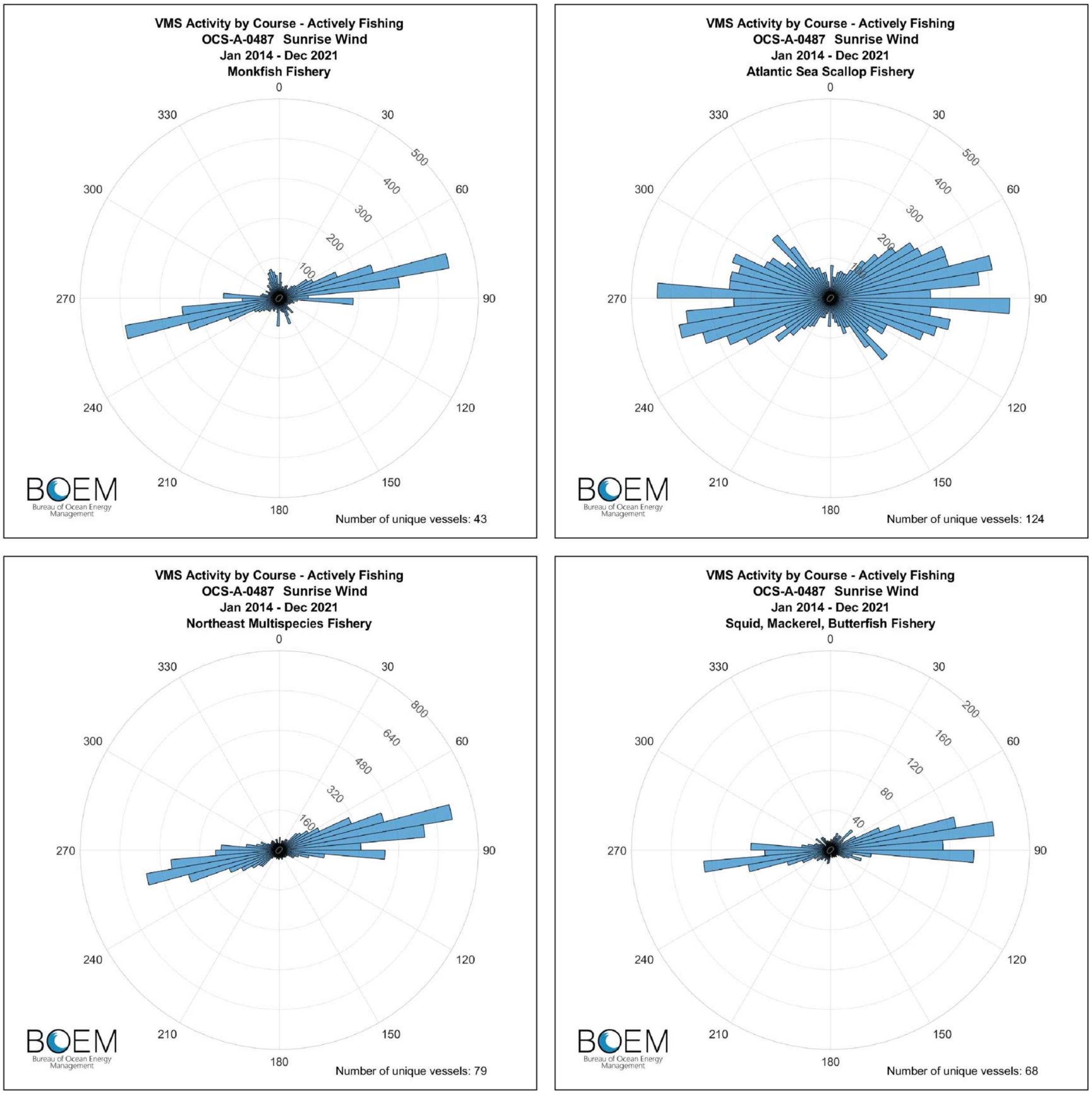
Source: Developed by BOEM using VMS data provided by NMFS (2022a).

Figure 3.14-6. VMS Bearings for Fishing Activity by VMS and Non-VMS Fishery Vessels within the Lease Area, January 2014 – December 2021



Source: Developed by BOEM using VMS data provided by NMFS (2022a).

Figure 3.14-7. VMS Bearings of Vessels Transiting the Lease Area by FMP Fishery, January 2014 – December 2021



Source: Developed by BOEM using VMS data provided by NMFS (2022a).

Figure 3.14-8. VMS Bearings of Vessels Actively Fishing in the Lease Area by FMP Fishery, January 2014 – December 2021

For-Hire Recreational Fishing

As with the commercial fishing industry, the for-hire recreational fishing fleets contribute to the economy through direct employment, income, and gross revenues of the for-hire businesses, as well as through purchasing products and services to maintain and operate their vessels, triggering further indirect multiplier effects that are dependent upon the initial demands of the for-hire fleet (Steinback and Brinson 2013). For-hire recreational fishing boats are operated by licensed captains for businesses that sell recreational fishing trips to anglers. These boats include both party (head) boats, defined as boats on which fishing space and privileges are provided for a fee, and charter boats, defined as boats operating under charter for a price and time, whose participants are part of a preformed group of anglers (NMFS 2021d).

NOAA works with state and local partners to monitor the recreational fishery catch and effort through the Marine Recreational Information Program (MRIP). The MRIP integrates a coast-wide angler intercept survey throughout the year to estimate recreational fishing effort (COP Appendix V, Section 2.2.8; Inspire 2022). The for-hire recreational fishing effort and catch data reported for New York, Connecticut, Massachusetts, New Jersey, and Rhode Island, which are the five states most likely to have anglers utilizing the Lease Area, are presented in Figure 2.2-21 of COP Appendix V, Section 2.2.8 (Inspire 2022). It indicates that recreational fishing effort is seasonal, with the highest activity from March through August, reaching its peak intensity in July and August for shore fishing and fishing in both federal and state waters by private or for-hire/charter vessel.

The MRIP data can be used to qualitatively understand relative angler effort for those states with coastlines/ports relatively close to the Lease Area; however, there is no spatial information within the MRIP data. Therefore, there is no way to determine where the actual fishing trips took place relative to the Lease Area. Therefore, these values are meant to categorize general angler efforts by mode and by location and capture the seasonal changes in activity.

As noted in COP Appendix V, Section 2.2.8 (Inspire 2022), overall, across the five states that would most likely utilize fishing areas around the Lease Area, New York had the highest number of trips, followed by New Jersey and Massachusetts. The majority of the trips were typically within state waters and from shore. For fishing trips in federal waters, the majority of trips were using private boats and the balance utilizing charters. However, as noted above, there are limitations to the MRIP data as there is no spatial information and therefore, these are meant to generally understand angler efforts and not necessarily absolute conditions.

In addition to the MRIP data, additional information was available through NMFS related to annual revenue of for-hire recreational fishing trips, as well as trips by port/location.

Recreational fishing for highly migratory species also occurs in and around the Lease Area and along the export cable corridor. Based on the NMFS Large Pelagics Survey, an intercept survey that includes both for-hire and private fishing, the level of recreational fishing effort for highly migratory species from 2002-2019 ranged primarily from 49 to 249 intercepts in the Project Area (Figure 3.14-9), which is considered a low to moderate range. The Large Pelagics Survey data metric is intercepts, meaning a fisherman intercepted by a dockside monitor reported fishing for highly migratory species in that block on the intercepted trip (i.e., a positive fishing effort for highly migratory species); therefore, it is not a census of all trips, but a sample of trips based upon dockside coverage in ports (Curtis 2023).

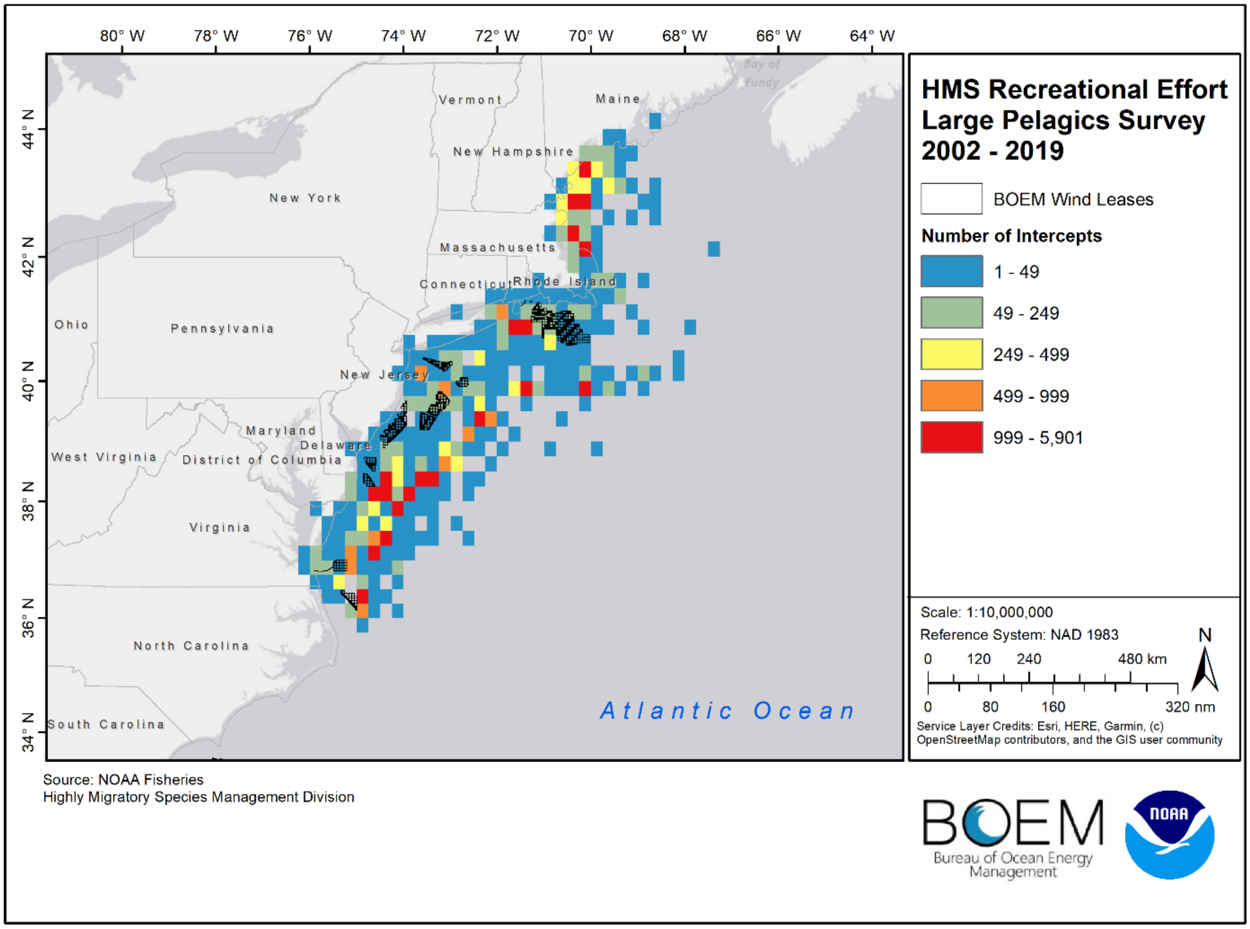


Figure 3.14-9. Fishing Effort for Highly Migratory Species in the Greater Atlantic

Note: Data are based on intercept surveys and include both for-hire and private fishing for highly migratory species. Leasing and planning areas are as of approximately 2020.

Table 3.14-15 presents the annual revenue from the for-hire recreational fishery operating in the Lease Area from 2008 to 2021. The annual revenue varied considerably, ranging from a low of $8,000 (rounded to the nearest thousand dollars) in 2019 to a high of $281,000 in 2010, while totaling $1,558,000 during the entire period.

Table 3.14-15. Total For-Hire Recreational Fishing Revenue by Year for Lease Area, 2008–2021

Year	Revenue
2008	$103,000
2009	$143,000
2010	$281,000
2011	$280,000
2012	$86,000
2013	$99,000
2014	$120,000
2015	$92,000
2016	$121,000
2017	$150,000
2018	$28,000
2019	$8,000
2020	$34,000
2021	$14,000
Total	**$1,558,000**

Source: NMFS 2022a.

Table 3.14-16 presents the total number of party/charter boat trips by port for the years 2008 to 2021 specifically fishing the Lease Area. Similarly, Table 3.14-17 presents the total number of angler trips by port and year for the Lease Area. The two ports consistently among the highest number of trips are Montauk, NY and Point Judith, RI. For certain years, other ports in Rhode Island also had high numbers, specifically in 2014 to 2017. In addition, other ports in New York had a high number of trips in 2020 for both categories.

Table 3.14-16. Total Number of Party/Charter Boat Trips by Port and Year for Lease Area, 2008–2021

Port	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Montauk, NY	25	33	69	79	23	15	14	0	7	3	12	18	0	28
Point Judith, RI	32	29	37	37	29	59	41	17	15	77	5	0	4	0
Other Ports, RI	1	5	7	6	5	0	60	94	96	82	0	2	3	7
Other Ports, MA	0	1	1	2	0	0	1	3	0	6	1	0	0	0
Other Ports, NY	0	1	2	0	0	0	0	7	0	1	1	0	67	0
Other Ports, CT	0	0	1	0	0	0	0	0	1	0	0	0	0	0
No Port Data	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Total	**58**	**69**	**115**	**122**	**52**	**74**	**115**	**120**	**119**	**168**	**18**	**21**	**75**	**36**

Source: NMFS 2022a.

Note: The "Other Ports" category refers to ports with fewer than three permits to protect data confidentiality.

Table 3.14-17. Total Number of Angler Trips by Port and Year for Lease Area, 2008–2021

Port	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Montauk, NY	293	766	1,314	1,516	107	185	185	0	94	24	185	74	0	127
Point Judith, RI	859	597	1,018	646	580	667	524	259	497	981	107	0	23	0
Other Ports, RI	2	28	36	41	26	0	355	541	543	429	0	11	18	27
Other Ports, MA	0	4	2	12	0	0	6	11	0	15	3	0	0	0
Other Ports, NY	0	4	22	0	0	0	0	27	0	3	4	0	334	0
Other Ports, CT	0	0	62	0	0	0	0	0	16	0	0	0	0	0
No Port Data	0	0	0	0	0	0	0	0	0	0	0	6	3	5
Total	**1,154**	**1,399**	**2,442**	**2,203**	**688**	**852**	**1,066**	**833**	**1,150**	**1,447**	**280**	**91**	**378**	**159**

Source: NMFS 2022a.

Note: The "Other Ports" category refers to ports with fewer than three permits to protect data confidentiality.

Table 3.14-18 presents the annual party vessel trips, angler trips and number of vessels utilizing the Lease Area for the years 2008 to 2021 as a percent of the total northeast region. The highest percent was under angler trips as a percent of total that reached a peak of 19.44 percent in 2019. The vessel trips as a percent of total never reached 1 percent during this time period while the number of vessels as a percent of total fluctuated between 1 and 4 percent.

Table 3.14-18. Annual Party Vessel Trips, Angler Trips, and Number of Vessels in Lease Area as a Percentage of the Total Northeast Region, 2008–2021

Year	Vessel Trips as % of Total	Angler Trips as % of Total	Number of Vessels as % of Total
2008	0.21%	14.18%	1.06%
2009	0.24%	6.43%	2.73%
2010	0.35%	5.61%	3.64%
2011	0.38%	4.67%	3.73%
2012	0.18%	6.17%	2.22%
2013	0.25%	4.35%	1.80%
2014	0.41%	3.99%	3.04%
2015	0.45%	6.62%	2.58%
2016	0.46%	4.77%	2.46%
2017	0.69%	13.35%	3.07%
2018	0.08%	1.95%	2.33%
2019	0.09%	19.44%	0.88%
2020	0.35%	17.03%	1.41%
2021	0.16%	15.50%	1.73%

Source: NMFS 2022a.

To understand the relative importance of the Lease Area to the regional for-hire recreational fishing industry, Table 3.14-19 compares the landings reported in the Lease Area for the most common species to the entire northeast region by year during the 2008–2021 period.

Table 3.14-19. Total Fish Count for Most Common Species as a Percent of Total in the Lease Area, 2008–2021

Species	Fish Count as % of Total
Cunner	2.96%
Cod	2.36%
Spiny dogfish	0.86%
Summer flounder	0.85%
Ocean pout	0.76%
Tautog	0.48%
Skates	0.40%
Black sea bass	0.28%
Scup	0.15%

Source: NMFS 2022a.

[1] "All Others" refers to species with fewer than three permits to protect data confidentiality.

To analyze differences in the importance of fishing grounds in the Lease Area for the for-hire recreational fishery, NMFS analyzed the percentage of each permit's total angler trips in the Lease Area from 2008 through 2021 (NMFS 2022a). Results are presented on Figure 3.14-10 which displays the data in a boxplot. A description of the meaning of the quartiles and other information for the boxplot can be found in the previous commercial fisheries discussion within this section, in the text associated with Figure 3.14-10. Table 3.14-20 presents the minimum, first quartile, median, third quartile, and maximum values for the Lease Area from 2008 through 2021.

Table 3.14-20. Analysis of 14-year Summary of Permit Angler Trip Percent Boxplots for the Lease Area (2008–2021)

Minimum	1st Quartile	Median	3rd Quartile	Maximum Revenue Percentage Value[1]
0.12%	2%	4%	16%	100%

Source: Developed using data from NMFS 2022a.

[1] Maximum value is inclusive of outliers.

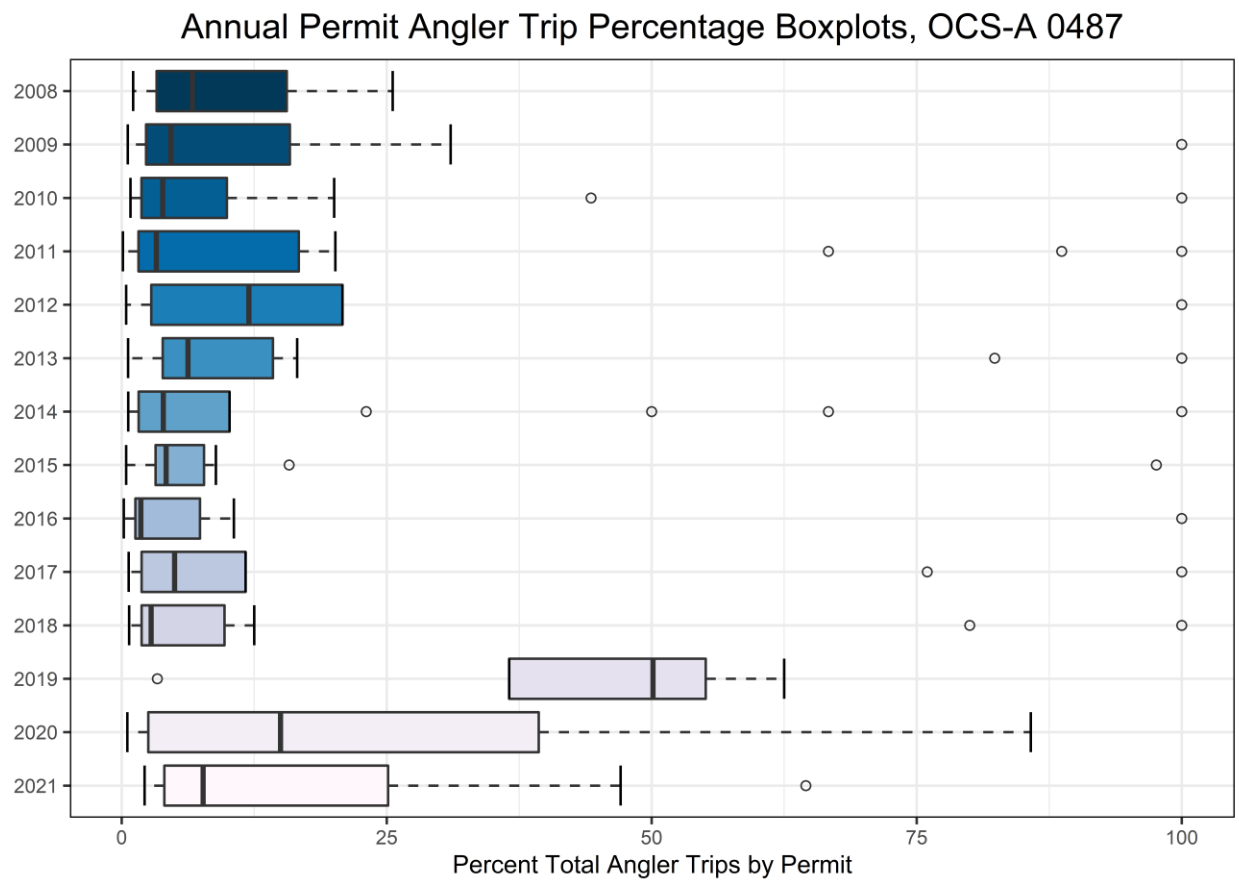


Figure 3.14-10. Annual Permit Angler Trip Percentage Boxplots for the Lease Area, 2008–2021

Source: NMFS 2022a.

A total of 75 percent of the permitted vessels that fished in the Lease Area derived less than 16 percent of their total annual revenue from the area (NMFS 2022a). The highest percentage of total annual angler trips attributed to the Lease Area was 100 percent in multiple years (2009-2014 and 2016-2018). Although outliers made a high proportion of their annual angler trips to the Lease Area in comparison to other vessels that fished in the area, in any given year, the trip percentage for the majority of for-hire recreational fishers was below 25 percent (Figure 3.14-8).

3.14.2 Impact Level Definitions for Commercial Fisheries and For-hire Recreational Fishing

This Final EIS uses a four-level classification scheme to analyze potential impact levels on commercial fisheries and for-hire recreational fishing from the alternatives, including the Proposed Action. Table 3.14-21 lists the definitions for both the potential adverse impact levels and potential beneficial impact levels for commercial fisheries and for-hire recreational fishing. Table G-13 (Appendix G) identifies potential IPFs, issues, and indicators to assess impacts to commercial fisheries and for-hire recreational fishing. Impacts are categorized as beneficial or adverse and may be short-term or long-term in duration. Short-term impacts may occur over a period of 1 year or less. Long-term impacts may occur throughout the duration of a project. Short-term effects extend potentially for several months but not several years or longer (assume 1-2 years). Long-term effects last for several years or longer.

Table 3.14-21. Definition of Potential Adverse and Beneficial Impact Levels for Commercial Fisheries and For-hire Recreational Fishing

Impact Level	Definition of Potential Adverse Impact Levels	Definition of Potential Beneficial Impact Levels
Negligible	No measurable impacts would occur.	No measurable impacts would occur.
Minor	Adverse impacts would not disrupt the normal or routine functions of the affected activity or community. Once the impacting agent is eliminated, the affected activity or community would return to condition with no measurable effects.	A small and measurable benefit to related to commercial fishing and for-hire recreational fishing could occur.
Moderate	The affected activity or community would have to adjust somewhat to account for disruptions due to impacts of the Project. Once the impacting agent is eliminated, the affected activity or community would return to a condition with no measurable effects if proper remedial action is taken.	A notable and measurable benefit related to commercial fishing and for-hire recreational fishing could occur.
Major	The affected activity or community would experience substantial disruptions, and, once the impacting agent is eliminated, the affected activity or community could retain measurable effects indefinitely, even if remedial action is taken.	A large local, or notable regional benefit to related to commercial fishing and for-hire recreational fishing could occur.

3.14.3 Impacts of Alternative A - No Action on Commercial Fisheries and For-Hire Recreational Fishing

When analyzing the impacts of the No Action Alternative on commercial fisheries and for-hire recreational fishing, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for commercial fisheries and for-hire recreational fishing. 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 E *(Planned Activities Scenario)*.

3.14.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for commercial fisheries and for-hire recreational fishing described in Section 3.14.1, Affected Environment would continue to follow current regional trends and respond to IPFs introduced by ongoing non-offshore wind and offshore wind activities.

Ongoing non-offshore wind activities within the GAA that have impacts on commercial and for-hire recreational fisheries are generally associated with climate change and fisheries use and management and also activities that limit areas where fishing can occur. These activities include things such as tidal energy projects, military uses, and dredging activities. Dredging, port improvements, marine transportation, oil and gas activities, and offshore construction activities can increase risk for collisions or allisions to occur. Additionally, gear entanglement can occur from activities such as undersea transmission lines, gas pipelines, and other submarine cables.

Ongoing impacts of climate change include increased magnitude or frequency of storms, shoreline changes, ocean acidification, and water temperature changes. Risks to fisheries associated with these events include the ability to safely conduct fishing operations (e.g., because of storms) and climate-related habitat or distribution shifts in targeted species. Fish and shellfish species are expected to exhibit variation in their responses to climate change, with some species benefiting from climate change and others being adversely affected (Hare et al. 2016). To the extent that impacts of climate change on targeted species result in a decrease in catch or increase in fishing costs, the profitability of businesses engaged in commercial fisheries and for-hire recreational fishing would be adversely affected. Ongoing activities of NMFS and fishery management councils affect commercial and for-hire recreational fisheries through stock assessments, setting quotas, and implementing FMPs to ensure the continued existence of species at levels that would allow commercial and for-hire recreational fisheries to occur. Fishery management measures affect fishing operations differently for each fishery and are intended to achieve long-term sustainable fisheries populations which should have long-term benefits to fisheries and fishing communities.

Ongoing offshore wind activities within the GAA that contribute to impacts on commercial fisheries and for-hire recreational fishing include:

- Continued O&M of the Block Island project (5 WTGs) installed in State waters;
- Continued O&M of the CVOW project (2 WTGs) installed in OCS-A 0497; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of the Block Island and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect commercial fisheries and for-hire recreational fishing through the primary IPFs of noise, presence of structures, port utilization, anchoring, and vessel traffic. Ongoing offshore wind activities would have the same type of impacts from these IPFs that are described in detail in the following section for planned offshore wind activities, but the impacts would be of lower intensity.

3.14.3.2 Cumulative Impacts of the No Action Alternative

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

Planned non-offshore wind activities within the GAA that contribute to cumulative impacts on commercial fisheries and for-hire recreational fishing include new submarine cables and pipelines, oil and gas activities, marine minerals extraction, port expansions, and future marine transportation and fisheries use. Some of these activities may result in disruptions to fishing vessel traffic, bottom disturbance or habitat conversion, and injury or mortality of fish and shellfish that are targeted in fisheries.

Fishery management measures that are likely to be implemented in the future include measures to reduce the risk of interactions between fishing gear and the North Atlantic right whale by 60 percent (McCreary and Brooks 2019). This measure would likely have an adverse impact on fishing effort in the lobster and Jonah crab fisheries in the GAA. See Table E1-6 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for commercial and for-hire recreational fisheries.

Planned offshore wind activities include offshore wind energy development activities on the Atlantic OCS other than the Proposed Action determined by BOEM to be reasonably foreseeable (see Section E-1 and Attachment 2 in Appendix E for a complete description of planned offshore wind activities). BOEM expects planned offshore wind activities to affect commercial and for-hire recreational fisheries through the following primary IPFs.

Anchoring: Excluding the Proposed Action, BOEM estimates that approximately 7,494 ac (3,033 ha) of seabed would be disturbed by anchoring associated with all other offshore wind activities in the GAA. Anchoring vessels used in the construction of offshore wind energy projects would pose a navigational hazard to fishing vessels. All impacts would be localized (within a few hundred meters of anchored vessel) and short-term (hours to days in duration). Although anchoring impacts would occur primarily during Project construction, some impacts could occur during O&M and conceptual decommissioning. Therefore, the adverse effects of offshore wind energy-related anchoring on commercial fisheries and for-hire recreational fishing are expected to be long-term and moderate, though periodic in nature.

Noise: Future offshore wind activities that would generate noise include G&G surveys, pile driving, cable laying, vessels, and WTG operations. These noise sources have the potential to temporarily affect fish and shellfish, which may indirectly affect commercial and for-hire recreational fisheries. The potential impacts associated with each noise source are discussed separately in the following paragraphs.

G&G surveys would be conducted for site assessment and characterization activities associated with offshore wind facilities and are expected to occur intermittently over a 2- to 10-year period at locations throughout the GAA. Site characterization surveys for offshore wind farms typically use sub-bottom profiler technologies that generate sound waves that are similar to common deepwater echosounders. These survey methods produce less intense sound waves compared to seismic surveys used in oil and gas exploration. Noise from G&G surveys may cause localized and short-term behavioral changes in some fish species, which could affect the catch efficiency of some fishing gears (e.g., hook and line). However, the noise from G&G surveys is not anticipated to affect reproduction and recruitment of fish stocks. Although schedules for many future offshore wind activities are still being developed, noise impacts on fish and shellfish might be minimized by sequentially scheduling site assessment and characterization surveys to avoid overlapping noise from different surveys.

Future offshore wind activities would generate impulsive pile-driving noise during foundation installation. Pile driving is expected to occur for 2 to 3 hours per foundation as additional WTGs and OSS/ESPs are constructed between 2023 and 2030 (see Appendix E). One or more projects may install more than one foundation per day, either concurrently or sequentially over the 6- to 10-year construction period. Noise transmitted through water and the seabed can cause injury to or mortality of fish over a small area around each pile and can cause short-term stress and behavioral changes over a larger area. Because of the relatively small footprint of injurious sound and the ability for most fish to swim away from noise sources, injurious noise from pile driving is not expected to cause stock-level changes that would adversely affect fisheries. It is expected that behavioral responses to noise may cause some displacement of fish, thereby temporarily reducing the quality of fishing in affected areas and causing fishers to seek alternative fishing areas (Skalski et al. 1992). Displacement of fishing activity may result in increased conflict among the fishing industry, increased operating costs for vessels, and lower revenue. Furthermore, pile-driving noise may cause spawning behavior changes. To the extent that changes in spawning behavior result in reduced reproductive success and subsequent recruitment, this could potentially result in long-term effects on populations and harvest levels. However, the risk of reduced recruitment from pile-driving noise is low because the behavioral impacts would only occur over the duration of noise. Behavioral impacts would be localized to the ensonified area and short-term, as fish behavior is expected to return to pre-construction levels following the completion of pile driving (Jones et al. 2020; Stanley et al. 2020).

Several activities associated with cable laying would produce noise, including route identification surveys, trenching, jet plowing, backfilling, and installation of cable protection. Modeling based on noise data collected during cable laying for European wind farms has estimated that underwater noise levels would exceed 120 dB in a 98,842-ac (400 km^2) area surrounding the source (Bald et al. 2015; Nedwell and Howell 2004; Taormina et al. 2018), which is well below the 150-dB threshold for behavioral responses in fish (Andersson et al. 2007; Mueller-Blenkle et al. 2010; Purser and Radford 2011; Wysocki et al. 2007). As was described for pile-driving noise above, fish that are exposed to cable-laying noise may experience short-term stress and behavioral changes, which could indirectly cause displacement of fishing activity. However, because the cable-laying vessel and equipment would be continually moving and the ensonified area would move with it, a given area would not be ensonified for more than a few hours. Therefore, any behavioral responses to cable-laying noise are expected to be short-term and localized and are not expected to result in fishery-level impacts.

Vessels generate low-frequency, non-impulsive noise that could cause short-term stress or behavioral responses in fish. Vessel activity from future offshore wind activities is expected to peak in 2024 (BOEM 2019). This increase in vessel activity could cause repeated, intermittent behavioral responses in fish, which could indirectly cause displacement of fishing activity. Because behavioral responses to vessel noise would be localized and short-term, dissipating once the vessel leaves the area, they are not expected to result in fishery-level impacts.

Operating WTGs generate non-impulsive underwater noise that is audible to some fish. However, operating WTGs are expected to produce noise levels that are below recommended thresholds for fish injury and behavioral effects, and noise levels are expected to reach ambient levels within a short distance of turbine foundations. Therefore, noise from operating WTGs is not expected to result in fishery-level impacts.

BOEM expects that underwater noise associated with future offshore wind activities would cause short-term, localized, minor to moderate impacts on commercial and for-hire recreational fisheries, depending on the timing and overlap of construction activities. Impacts are expected to primarily result from pile-driving noise during the installation of foundations for WTGs and OSS. Section 3.10.5 provides a full description of noise impacts on fish and invertebrates.

Port utilization: Construction of offshore wind energy projects would require port facilities for staging and installation vessels, including crew transfer, dredging, cable lay, pile driving, survey vessels, and, potentially, feeder lift barges and heavy lift barges. All of these activities would add vessel traffic to port facilities and would require berthing. Port expansion would likely be needed to accommodate the increased vessel traffic and increased vessel sizes associated with future offshore wind activities. At least two proposed offshore wind projects are considering port expansion, and other ports along the Atlantic coast may be expanded as well. Major fishing ports in the GAA (see Table 3.6.1-3 in Appendix Q) that have been identified as potential ports to support offshore wind energy construction and operations include Atlantic City, Hampton Roads, Montauk, and New Bedford (BOEM 2021a). Port expansions would likely occur over the next 6 to 10 years and would result in increased vessel traffic, which would peak during construction. Increased vessel traffic may cause delays or restrictions in access to ports for commercial and for-hire fishing vessels. Furthermore, maintenance dredging of shipping channels may be required to support port expansion, which could cause additional delays or restrictions in access to port for fishing vessels, as well as increased vessel noise and increased suspended sediment concentrations, two factors that may cause short-term and localized displacement of fish. Port expansions could also increase competition for dockside services, which could affect fishing vessels. Port expansion is expected to have impacts on commercial and for-hire fishing vessels that are localized to ports used for both fishing and offshore wind projects and are short-term, with impacts primarily occurring during the construction period. BOEM expects that increased port utilization associated with future offshore wind activities would cause localized, minor impacts on commercial and for-hire recreational fisheries resulting from increased vessel traffic at ports and increased competition for dockside services.

Vessel traffic: The installation of offshore components for offshore wind energy projects and the presence of construction vessels could temporarily restrict fishing vessel movement and thus transit and harvesting activities within offshore wind lease areas and along the cable routing areas. To safeguard mariners from the hazards associated with installation of these offshore components, it is expected that most, if not all, offshore wind energy projects would create safety zones around construction areas. For example, for the Block Island Wind Farm, a 500-yard (457-meter) safety zone around the individual wind turbine locations was implemented during construction (BOEM 2018). When safety zones are in effect, fishing vessels could either forfeit fishing revenue or relocate to other fishing locations and continue to earn revenue. However, vessels that chose to relocate could incur increased operating costs such as increased fuel costs due to longer transit times to and from more distant fishing grounds and additional crew compensation due to more days at sea, among other factors. Commercial and for-hire recreational vessel operators could experience lower revenue due to fishing potentially less productive fishing grounds, potentially having to switch to less-valuable species, and potentially encountering more competition for a given resource.

Once offshore wind projects are completed, some commercial fishermen may avoid the offshore wind lease areas if large numbers of recreational fishermen are drawn to the areas by the prospect of higher catches. WTG foundations and associated scour protection may produce an artificial reef effect, potentially increasing fish and invertebrate abundance within a facility's footprint (refer to Section 3.10, *Finfish, Invertebrates, and Essential Fish Habitat*). According to ten Brink and Dalton (2018), the influx of recreational fishermen into the BIWF caused some commercial fishermen to cease fishing in the area because of vessel congestion and gear conflict concerns. If these concerns cause commercial fishermen to shift their fishing effort to areas not routinely fished, conflict with existing users could increase as other areas are encroached. In general, the potential for conflict among commercial fishermen due to fishing displacement may be higher for fishermen engaged in fisheries that have regulations that constrain where fishermen can fish, such as the lobster fishery. However, the potential for vessel congestion and gear conflict may increase if mobile species targeted by commercial fishermen, such as Atlantic herring, Atlantic mackerel, squid, tuna, and groundfish, are attracted to offshore wind energy facilities by the artificial reef effect, and fishermen targeting these species concentrate their fishing effort in offshore wind lease areas as a result. Overall, the adverse impacts from vessel traffic would be long-term and moderate.

Presence of structures: The presence of structures can lead to impacts on commercial fisheries and for-hire recreational fishing through allisions, entanglement or gear loss/damage, fish aggregation, habitat conversion, navigation hazards (including transmission cable infrastructure), and space-use conflicts. These impacts may arise from buoys, meteorological towers, foundations, scour/cable protection, and transmission cable infrastructure. Using the assumptions in Appendix E, future offshore wind energy projects under the No Action Alternative would include up to 3,096 WTGs, 5,574 ac (22.5 km^2) of seabed disturbance due to foundation and scour protection, and 3,165 ac (12.8 km^2) of new hard protection atop export and IAC cables. Projects may install more buoys and meteorological towers. BOEM anticipates that structures would be added intermittently over an assumed 10-year period and that they would remain until decommissioning of each facility is complete.

The presence of the WTG foundations and associated scour protection would convert existing sand or sand with mobile gravel habitat to hard bottom, which, in turn, would reduce the habitat for target species that prefer soft-bottom habitat (e.g., surfclams, sea scallops, squid, summer flounder) and increase the habitat for target species that prefer hard-bottom habitat (e.g., lobster, striped bass, black sea bass, Atlantic cod). Where WTG foundations and associated scour protection produce an artificial reef effect and attract finfish and invertebrates, the aggregation of species could increase the catchability of target species (Kirkpatrick et al. 2017). Although species that rely on soft-bottom habitat would experience a reduction in favorable conditions, the impacts from structures are not expected to result in population-level impacts (refer to Section 3.10, *Finfish, Invertebrates, and Essential Fish Habitat*). Decommissioning of each wind farm would then have the opposite impact, wherein the species dependent on hard-bottom or reef habitat would experience a reduction in favorable conditions, although some hard-bottom protection measures would remain, while removal of WTGs and their foundations would favor the increase of targeted species that prefer soft-bottom habitat.

The USCG stated that it does not plan to create exclusionary zones around offshore wind facilities during their operation (BOEM 2018). However, because of the height of wind turbines above the ocean surface, the turbines would be visually detectable at a considerable distance during the day and easily detected by vessels equipped with radar regardless of the time of day. To further ensure navigational safety, all structures would have appropriate markings and lighting in accordance with USCG, BOEM and IALA guidelines, and NOAA would chart wind turbine locations and could include a physical or virtual AIS at each turbine. Some fishing vessels operating in or near offshore wind facilities may experience radar clutter and shadowing. Most instances of interference can be mitigated through the proper use of radar gain controls (DNV-GL 2021). Refer to Section 3.19, *Navigation and Vessel Traffic*.

Notwithstanding these safety measures, some fishermen have commented that, because of safety considerations, they would not enter an offshore wind array during inclement weather, especially during low-visibility events (Kirkpatrick et al. 2017); during interviews with commercial fishermen, ten Brink and Dalton (2018) found that fishermen had concerns that low visibility, wind, or crew exhaustion could lead to vessels hitting WTGs. Moreover, mechanical problems, such as loss of steerage, could result in an allision with a WTG as the vessel drifts during repair (DNV-GL 2021).

In addition, a potential effect of the presence of the offshore cables and wind turbines associated with offshore wind energy development is the entanglement and damage or loss of commercial and recreational fishing gear. Economic impacts on fishing operations associated with gear damage or loss include the costs of gear repair or replacement, together with the fishing revenue lost while gear is being repaired or replaced. In addition, comments from the fishing industry have included concerns that fishing vessel insurance companies may not cover claims for incidents within a WEA resulting in gear damage or loss, or they may increase premiums for vessels that operate within these areas, although no specific instances have yet been identified. Given that mobile fishing gear is actively pulled by a vessel over the seafloor, the chance of snagging this gear type on project infrastructure is much greater than if—as in the case of fixed gear—the gear was set on the infrastructure or waves or currents pushed the gear into the infrastructure. The risk of damage or loss of deployed gear as a result of offshore wind development could affect mobile and fixed gear commercial fisheries and for-hire recreational fishing. While the depth to which offshore power cables are buried is specific to individual projects, standard commercial practice is to bury cables 3 to 10 ft (0.9 to 3.0 m) deep in waters shallower than 6,562 ft (2,000 m) to protect them from external hazards such as fishing gear and anchors (BOEM 2018). Fishing gear does not typically penetrate that deep into the sediment and would normally not snag or become entangled in the cable. However, due to underlying geology, cables may not be able to be buried to the minimum target depth along their entire distance. It is assumed that where feasible, cables would be installed at adequate depths to avoid long-term interactions with bottom-tending gears and that the use of secondary cable protection along the export cable route would be limited or as needed. Cable burial depth of less than 3 ft (1 m) would increase the probability of gear interactions. BOEM assumes less than 10 percent of the cables may not achieve the target burial depth and would require cable protection in the form of rock placement, concrete mattresses, or half-shell (BOEM 2021a). While cables are typically marked on nautical charts to aid in avoidance, mobile bottom-tending gear (trawl and dredge gear) could get snagged on these cable protection measures and cause damage or gear loss. Economic impacts on fishing operations associated with gear damage or loss include the costs of gear repair or replacement plus the fishing revenue lost while gear is being repaired or replaced, although the cost of these impacts would vary depending on the extent of damage to the fishing gear. To avoid these economic impacts, some vessel operators may not trawl or dredge over inter-array or export cables, but this could result in increased operating costs (e.g., additional fuel to arrive at more distant locations; additional crew compensation due to more days at sea) or lower revenue (e.g., fishing in a less productive area or for a less-valuable species).

With respect to fishing vessel maneuverability restrictions (including risk of allisions) within offshore wind lease areas, fishermen have expressed concerns about fishing vessels operating trawl gear that may not be able to safely deploy and operate in an offshore wind lease area given the size of the gear, the spacing between the WTGs, and the space required to safely navigate, especially with other vessels present and during poor weather conditions. Trawl and dredge vessel operators have commented that less than 1 nm (1.9 km) spacing between WTGs may not be enough to operate safely due to maneuverability of fishing gear and gear not directly following in line with vessel orientation. Clam industry representatives (Atlantic surfclam and ocean quahog fisheries) state that their operations require a minimum distance of 2 nm (3.7 km) between WTGs, in alignment with the bottom contours, for safe operations (BOEM 2021b; RODA 2021). Navigating through the offshore wind lease areas would not be as problematic for for-hire recreational fishing vessels, which tend to be smaller than commercial vessels and do not use large external fishing gear (other than hook and line) that makes maneuverability difficult. However, trolling for highly migratory species (e.g., bluefin tuna, swordfish) may involve deploying many feet of lines and hooks behind a vessel and then following large pelagic fish once they are hooked, which poses additional navigational and maneuverability challenges around WTGs (BOEM 2021b).

Fishing vessel operators unwilling or unable to travel through areas where offshore wind facilities are located or to deploy fishing gear in those areas may be able to find suitable alternative fishing locations and continue to earn revenue. This could result in increased operating costs (e.g., additional fuel to arrive at more distant locations; additional crew compensation due to more days at sea), lower revenue (e.g., fishing in a less productive area, fishing for a less-valuable species, or increased competition for the same resource), or both. However, if, at times, a fishery resource is only available within the offshore wind lease area, some fishermen, primarily those using mobile gear, may lose the revenue from that resource for the time that the resource is inaccessible. These impacts could remain until decommissioning of each facility is complete, although the magnitude of the impacts would diminish over time if fishing practices adapt to the presence of structures.

An accurate assessment of the extent of the effects of planned offshore wind energy projects on commercial fisheries and for-hire recreational fishing would depend on project-specific information that is unknown at this time, such as the actual location of offshore activities within offshore wind lease areas and the arrangement of WTGs. However, it is possible to estimate the amount of commercial fishing revenue that would be “exposed” as a result of offshore wind energy development. Estimates of revenue exposure quantify the value of fishing that occurs in the footprint areas of individual offshore wind farms. Therefore, these estimates represent the fishing revenue that would be foregone if fishing vessel operators opt to no longer fish in these areas and cannot capture that revenue in a different location. Revenue exposure estimates should not be interpreted as measures of actual economic impact. Actual economic impact would depend on many factors—foremost, the potential for continued fishing to occur within the footprint of the wind farm, together with the ecological impact on target species residing within the project areas. Economic impacts depend on a vessel operator’s ability to adapt to changing where fishing could occur. For example, if alternative fishing grounds are available nearby and could be fished at no additional cost, the economic impact would be lower. In addition, it is important to note that there may be cultural and traditional values to fishermen related to fishing in certain areas that go beyond expected monetary profit. For example, some fishermen may gain utility from fishing in locations that are known to them and fished by their peers; the presence of other boats in the area can contribute to the fishermen’s sense of safety.

Table 3.14-22 depicts the annual commercial fishing revenue exposed[27] to offshore wind energy development in GAA by FMP fishery from 2021 through 2030. The amount of revenue at risk increases

[27] Revenue exposed is the amount of revenue that could be potentially affected by WEA development.

as proposed offshore wind energy projects are constructed and come online according to the timeline set forth in Appendix E and would continue beyond 2030 during the continued operational phases of the offshore wind energy projects. Please note that many of the project areas are outdated and do not reflect the most recent project areas under consideration. NOAA Fisheries is working with BOEM and developers to acquire the most accurate project areas to update these reports. These updated reports as soon as updated project areas are available and can be analyzed. NOAA Fisheries recommends caution when interpreting these reports and does not recommend using them for any quantitative analysis until they can be updated. The largest impacts in terms of percentage of exposed revenue are expected to be in the Sea Scallop, Other FMPs, non-disclosed species and non-FMP fisheries, Surfclam/Ocean Quahog, Mackerel/Squid/Butterfish, and Summer Flounder/Scup/Black Sea Base FMPs. In general, fisheries do not have a high relative revenue intensity within the offshore wind lease areas compared with nearby waters because offshore wind lease areas were chosen to reduce potential use conflicts between the wind energy industry and fishermen (Ecology and Environment, Inc. 2013).

With respect to impacts on individual fishing operations, long-term, minimal, adverse impacts would occur for vessels that derive a small percentage of their total revenue from areas where offshore wind facilities would be located or are able to find suitable alternative fishing locations. Long-term, considerable adverse impacts would occur for fishing vessels that derive a large percentage of their total revenue from areas where offshore wind facilities would be located, if they choose to avoid these areas once the facilities become operational and are unable to find suitable alternative fishing locations. NMFS (2021c) determined, for each federally permitted commercial fishing vessel that fished in New England/Mid-Atlantic offshore wind lease areas, the percentage of the vessel's total fishing revenue that was derived from within each area during the 2008–2019 period. It is estimated that over that period, only 0.9 percent of the vessels that fished in one or more of the offshore wind lease areas generated more than 50 percent of their total fishing revenue for the year from one or more of the areas. According to the data presented, in each offshore wind lease area there was one or more vessels that earned a substantial (more than 5 percent) portion of their revenue from fishing in the area. Some vessels derived more than half of their revenue from fishing in a particular offshore wind lease area. However, 75 percent of the vessels fishing in any given offshore wind lease area derived less than 0.9 percent of their total revenue from the area. Given that a majority of fishing vessels derive a small percentage of their total revenue from any one offshore wind lease area or that they would relocate to other fishing locations, the overall adverse impact of offshore wind energy development on fishing access by commercial fishing vessels is expected to be long-term and moderate.

Table 3.14-22. Annual Commercial Fishing Revenue Exposed to Offshore Wind Energy Development in the Geographic Analysis Area Under the No Action Alternative by Fishery Management Plan (2021-2030)

Fishery Management Plan (FMP) Group	Total Annual Revenue Exposed ($1,000s) 2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Mackerel, Squid, and Butterfish	$0.1	$0.1	$309.6	$552.6	$755.3	$1,121.4	$1,274.7	$1,408.5	$1,542.4	$1,542.4
Summer Flounder, Scup, Black Sea Bass	$0.1	$0.1	$181.1	$350.9	$550.7	$822.0	$1,007.9	$1,172.8	$1,337.8	$1,337.8
Northeast Multispecies (small-mesh)	$0.0	$0.0	$86.8	$128.7	$218.8	$309.8	$338.2	$355.0	$371.9	$371.9
Skates	$0.0	$0.0	$111.8	$150.9	$211.7	$306.7	$358.0	$390.2	$422.5	$422.5
American Lobster	$0.0	$0.0	$228.6	$274.2	$347.1	$503.5	$603.1	$657.8	$712.5	$712.5
Monkfish	$0.0	$0.0	$141.4	$214.6	$321.7	$486.1	$589.9	$672.4	$755.0	$755.0
Sea Scallop	$0.0	$0.0	$302.7	$2,546.9	$2,821.5	$7,764.7	$12,632.0	$17,472.2	$22,312.4	$22,312.4
Jonah Crab	$0.0	$0.0	$33.4	$71.0	$216.7	$303.3	$327.7	$348.2	$368.7	$368.7
Other FMPs, non-disclosed species and non-FMP fisheries	$0.4	$0.4	$328.0	$491.1	$688.4	$1,288.7	$1,702.3	$2,084.1	$2,466.0	$2,466.0
Golden and Blueline Tilefish	$0.0	$0.0	$2.9	$8.4	$54.6	$75.2	$80.3	$85.2	$90.2	$90.2
Northeast Multispecies (large-mesh)	$0.0	$0.0	$56.6	$71.2	$88.9	$138.1	$160.5	$174.7	$189.0	$189.0
Bluefish	$0.0	$0.0	$3.2	$5.9	$10.1	$13.6	$15.6	$17.1	$18.7	$18.7
Spiny Dogfish	$0.0	$0.0	$10.1	$17.3	$22.1	$28.1	$32.2	$34.3	$36.4	$36.4
Surfclam, Ocean Quahog	$0.0	$0.0	$132.5	$169.3	$792.7	$1,191.9	$1,591.1	$1,990.3	$2,389.6	$2,389.6
Atlantic Herring	$0.0	$0.0	$47.9	$80.0	$99.3	$151.7	$193.1	$225.5	$257.9	$257.9
Highly Migratory Species	$0.0	$0.0	$0.1	$0.2	$0.7	$1.0	$1.2	$1.4	$1.6	$1.6
All FMP and non-FMP Fisheries	**$0.7**	**$0.7**	**$1,976.8**	**$5,133.4**	**$7,200.4**	**$14,505.8**	**$20,907.6**	**$27,090.1**	**$33,272.5**	**$33,272.5**

Source: (NMFS 2021e) Developed using FMP Revenue Exposure Analysis 2020 - 2030 calculations based on OCS offshore wind schedule as of March 2022 and NMFS landings and revenue data for Wind Energy Areas, 2008 - 2019, accessed October 2021 (https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/WIND/ALL_WEA_BY_AREA_DATA.html). The analysis excludes the Proposed Action.

[1] This column represents the total average revenue exposed in 2030 in order to give a value reference for the percentage of revenue exposed in 2030. Includes revenues from all species not assigned to an FMP including American lobster and Jonah crab fisheries.

Notes: Revenue is in nominal dollars using the monthly, not seasonally, adjusted Producer Price Index by Industry for Fresh and Frozen Seafood Processing provided by the U.S. Bureau of Labor Statistics. The data represent the revenue-intensity raster developed using fishery-dependent landings' data. To produce the data set, Vessel Trip Report information was merged with data collected by at-sea fisheries observers, and a cumulative distribution function was estimated to present the distance between Vessel Trip Report points and observed haul locations. Resolution of the data does allow estimates to be made on a small enough scale to differentiate impacts along wind farm export cable corridors. Therefore, estimates only pertain to individual offshore wind lease areas. This provided a spatial footprint of fishing activities by FMPs. The percentages are expected to continue after 2030 until facilities are decommissioned. Slight differences in totals are due to rounding.

“$0” indicates the value is positive but less than $100.

Offshore wind development and the presences of structures could also influence regulated fishing effort by affecting NMFS's scientific surveys on which management measures are based. If NMFS's scientific survey methodologies are not adapted to sample within WEAs, there could be increased uncertainty in scientific survey results, which would increase uncertainty in stock assessments and quota-setting processes. Future spatial management measures may change in response to changes in fishing behavior due to the presence of structures. Impacts on management processes would in turn have short-term or long-term impacts on commercial and for-hire recreational fisheries' operations.

New cable emplacement/maintenance: Displacement of fishing vessels and disruption of fishing activities could occur, though this disruption would not occur all at the same time. Installation of offshore cables for each offshore wind energy facility would require short-term rerouting of all vessels, including commercial and for-hire recreational fishing vessels, away from areas of active construction.

Construction activities related to offshore wind energy development that disturb the seabed, together with activities that reduce water quality, increase underwater noise, or introduce artificial lighting, could result in a behavioral response from some target species. In turn, these responses could decrease catchability for a fishery, due to factors such as fish not biting at hooks or changes in swim height. For any given offshore wind energy project, the impacts of behavioral responses on target species catch in commercial and for-hire recreational fisheries are expected to be confined to a small area, and to end shortly after construction activities end. Benthic species such as sea scallops and ocean quahogs would be expected to repopulate cable areas once the offshore cables are installed and buried. Cable inspection and repair activities would result in types of impacts similar to those resulting from construction activities, such as short-term displacement or other behavioral responses of target species. The impacts are expected to be small and short-term in nature, only occurring during cable placement or maintenance activities. Impacts related to gear entanglement from interactions with cables is discussed in Presence of Structures. Details regarding potential lighting and noise impacts on finfish and invertebrates are described in Section 3.10.

Climate change: Impacts on 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 the ability to safely conduct fishing operations (e.g., due to storms) and habitat or distribution shifts in targeted species, disease incidence, and risk of invasive species. If these risk factors result in a decrease in catch or 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. The catch potential for the temperate northeast Atlantic is projected to decrease between now and the 2050s (Barange et al. 2018). Hare et al. (2016) predict that climate change would affect northeast fishery species differently. For approximately half of the 82 species assessed, the authors report that overall climate vulnerability is high to very high; diadromous fish and benthic invertebrate species, including surfclam, ocean quahog, and scallops, exhibit the greatest vulnerability. In addition, most species included in the assessment have a high potential for a change in distribution in response to projected changes in climate. Adverse effects of climate change are expected for approximately half of the species assessed, while Hare et al. (2016) anticipate that, for approximately 17 percent of the species, including inshore longfin squid, butterfish, and Atlantic croaker, fisheries would see some beneficial impacts. The intensity of the impacts of climate change on commercial fisheries and for-hire recreational fishing is anticipated to qualify as minor to major for fishing operations that target species adversely affected by climate change, and the beneficial impacts are anticipated to qualify as minor to major for fishing operations targeting fishery species that may benefit fishing operations due to climate change effects.

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 fish 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 (Colburn et al. 2016; Rogers at al. 2019). Because offshore wind facilities would produce lower GHG emissions than fossil fuel powered generating facilities with similar capacities, the reduction in GHG emissions per kW of electricity produced from other offshore wind projects, as opposed to equivalent energy production powered by fossil fuels, would result in long-term, beneficial impacts on fishing operations that target species adversely affected by climate change. However, the benefits would be negligible. Section 3.4, *Air Quality*, describes the expected contribution of offshore wind development to climate change.

Regulated fishing effort: "Regulated fishing effort" refers to fishery management measures necessary to maintain maximum sustainable yield under the MSFCMA. This includes quota and effort allocation management measures. Future offshore wind development could influence fishery management by affecting fisheries' independent surveys used to inform management measures and by changing patterns of fishing activity. Fisheries managers may need to revise the sampling design of fisheries surveys to include sampling within WEAs to account for uncertainty in stock assessments that may accompany offshore wind development. Increased uncertainty in stock assessments could lead to more conservative quotas and resulting revenue losses in the fishing industry, which was also discussed under the presence of structures IPF. Changes in fishing behavior from offshore wind development may necessitate new management measures, which would in turn have short-term or long-term impacts on commercial and for-hire recreational fisheries. BOEM expects that changes in regulated fishing effort in response to future offshore wind activities would cause long-term, widespread, major impacts on commercial and for-hire recreational fisheries as management adapts to changing fishing patterns, data availability, and management options.

3.14.3.3 Conclusions

Impacts of the No Action Alternative

Under the No Action Alternative, ongoing activities would have continuing impacts on commercial fisheries and for-hire recreational fishing, primarily through port use, vessel activity, other offshore development, climate change, and fisheries use and management. BOEM anticipates that the impacts of ongoing activities on commercial fisheries would be **minor** to **major**, and on for-hire recreational fishing would be **minor** to **moderate**, depending on the fishery or fishing operation. The major impact rating for some fisheries and fishing operations is primarily driven by regulated fishing effort and climate change associated with ongoing activities. Regulated fishing effort should result in long-term beneficial impacts to fisheries and communities due to long-term sustainable levels of fishery resources; however, the impact to commercial fisheries from changes to regulated fishing effort would cause major impacts as management efforts adapt. The impacts could also include long-term **minor beneficial** impacts for certain commercial fisheries and some for-hire recreational fishing operations, due to the artificial reef effect.

Cumulative Impacts of the No Action Alternative

Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and planned non-offshore wind activities, including port expansions, new cable emplacement and maintenance, and future marine transportation and fisheries use, would contribute to impacts on commercial fisheries and for-hire recreational fishing. Planned offshore wind activities would affect commercial fisheries and for-hire recreational fishing through the primary IPFs of anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures, and traffic.

BOEM anticipates that the cumulative impact of the No Action Alternative would result in **minor** to **major** adverse impacts on commercial fisheries and **minor** to **moderate** adverse impacts on for-hire recreational fishing, depending on the fishery or fishing operation. This impact rating would primarily result from regulated fishing effort, climate change, and the increased presence of offshore structures (cable protection measures and foundations), primarily those associated with planned offshore wind projects. The extent of adverse impacts would vary by fishery and fishing operation because of differences in target species, gear type, and predominant location of fishing activity. The impacts could also include long-term **minor** to **moderate beneficial** impacts for certain commercial fisheries and some for-hire recreational fishing operations due to the artificial reef effect.

3.14.4 Relevant Design Parameters and Potential Variances in Impacts

This Final EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in Appendix C would result in impacts similar to or less than those described in the sections below. The following is a summary of proposed relevant design parameters and potential variances (details provided in Appendix C) that would influence the magnitude of the impacts to commercial fisheries and for-hire recreational fishing:

- The number, size, and location of WTGs;
- Per turbine characteristics, such as the minimum lower and maximum upper blade tip heights and maximum rotor diameter;
- Turbine foundation characteristics, such as the diameter of structure, scour protection, drill spoil volume, seabed penetration and installation – both per turbine and maximum total impacts;
- The location of the export cable landfall may affect nearshore fishing areas during construction;
- Offshore converter substation characteristics, including the number and dimensions of the substations and the number and size of the foundation structures, as well as the number of piles and seabed disturbance and the piled jacket foundations associated with the substations;
- Array cable characteristics, including the total length, voltage, burial depth, as well as the corridor dimensions and associated disturbance to the seabed;
- Converter substation interconnector cable characteristics, including the number of cables, cable size, and voltage, along with associated seabed disturbance and cable protection;
- Offshore export cable characteristics, including the cable size and voltage, along with the maximum impacts of seabed disturbance associated with clearing the corridor, cable protection, and crossings;

- Wind turbine vessel trips associated with construction of both the wind turbine foundation and structure installation;
- Vessels required for converter substation installation, array cable installation, substation interconnection cable installation, and offshore export cable installation;
- O&M activities related to wind turbine foundation and OCS-DC painting, cleaning, repair and replacement; and
- O&M activities related to offshore array cable, substation interconnector cable, offshore export cable and Holbrook export cable remedial burial and cable fault maintenance.

Sunrise Wind has committed to measures to minimize impacts on commercial fisheries and for-hire recreational fishing such as developing and implementing a Fisheries Communication and Outreach Plan (COP V1 October 28, 2021 Appendix B – Fisheries Communication Plan; Ørsted Offshore North America 2021) and working with commercial and recreational fishing entities to ensure the Project would minimize potential conflict.

Sunrise Wind has also committed to collaborative science with commercial and recreational fishing industries prior to, during, and following construction of the proposed Project, including development of a Fisheries and Benthic Monitoring Plan (COP V2 April 2022 Appendix AA1 – Fisheries and Benthic Monitoring Plan; Sunrise Wind 2022) to assess the impacts associated with the proposed Project on economically and ecologically important fisheries resources.

3.14.5 Impacts of Alternative B - Proposed Action on Commercial Fisheries and For-Hire Recreational Fishing

The following text summarizes the potential impacts of the Proposed Action (Alternative B) on commercial fisheries and for-hire recreational fishing during the various phases of the proposed Project. Routine activities would include construction and installation, O&M, and conceptual decommissioning of the onshore and offshore components of the proposed Project, as described in Chapter 2, *Alternatives*.

3.14.5.1 Construction and Installation

3.14.5.1.1 Onshore Activities and Facilities

The primary impacts relative to commercial fisheries and for-hire recreational fishing by their nature are associated with offshore activities and facilities. However, changes in, or the availability of, certain onshore infrastructure could have an impact on commercial fishing and for-hire recreational fishing. This could include port changes, port expansion and construction activities, impacts to the cost or availability of shoreside support services that could disrupt offloading, provisioning, repair services, and seafood distribution. Therefore, some onshore activities related to offshore wind development could adversely impact commercial fishing and for-hire recreational fishing; however, the majority of impacts are related to offshore activities.

3.14.5.1.2 Offshore Activities and Facilities

Anchoring: Anchoring involves both anchoring of a vessel involved in the Project and the attachment of a structure to the sea bottom by use of an anchor or mooring. Anchoring vessels and other structures used in construction of the Project would pose a navigational hazard to fishing vessels. All impacts would be localized (within a few hundred meters of anchored vessels) and short-term (hours to days in duration). Although anchoring impacts would primarily occur during Project construction, some impacts could occur during O&M and conceptual decommissioning. Therefore, the adverse effects of offshore wind energy-related anchoring on commercial fisheries and for-hire recreational fishing are expected to be long-term though periodic in nature, and minor.

Noise: Noise impacts associated with offshore construction activities for 94 WTGs within 102 overall potential positions, including pile driving, trenching for cable placement, O&M activities, G&G investigations, and vessels, could cause indirect impacts on commercial and for-hire recreational fisheries within the proposed Project Area through their direct impacts on species targeted by the commercial and for-hire fisheries. Section 3.10 provides a full description of noise impacts on fish and invertebrates. Most noise impacts on species would be short-term and behavioral in nature, with most finfish species avoiding the noise-affected areas, while invertebrates may exhibit stress and behavioral changes such as discontinuation of feeding activities. The greatest impact would be from pile driving and the impulse noise impacts it would create, as pile driving is the only human-made, non-blasting sound source that has killed or caused hearing loss in fish in the natural environment (Kirkpatrick et al. 2017). Impulse noise from pile driving may exceed physiological sound thresholds for some species, resulting in injury or mortality, especially for affected species in the immediate vicinity (less than 164 ft [50 m]), although many studies found no statistically significant change in direct mortality, even at distances of less than 33 ft (10 m) (Kirkpatrick et al. 2017).

Behavioral responses from pile driving may occur at distances of 11 kilometers or greater, such that construction activities in adjacent projects could affect fish and fisheries beyond the boundaries of an individual project. While most finfish species are expected to avoid the noise-affected areas, invertebrates may exhibit stress and behavioral changes, such as discontinuation of feeding activities (Roberts and Elliott 2017). Behavioral responses to pile-driving noise may cause displacement of fishing activity and resulting increased conflict among fishers, increased operating costs for vessels, and lower revenue. Furthermore, pile-driving noise may cause spawning behavior changes. To the extent that changes in spawning behavior result in reduced reproductive success and subsequent recruitment, this could potentially result in long-term effects on populations and harvest levels. However, the risk of reduced recruitment from pile-driving noise is low because the behavioral impacts would only occur over the duration of noise. Behavioral impacts would be localized to the ensonified area and temporary, as fish behavior is expected to return to pre-construction levels following the completion of pile driving (Jones et al. 2020; Stanley et al. 2020).

To reduce potential impacts from pile driving, Sunrise Wind has committed to APMs which include using ramp-up/soft-start procedures to allow mobile species to leave the area prior to experiencing the full noise impact of pile driving, time-of-year in-water restrictions would be employed to the extent feasible to avoid or minimize direct impacts to species, and available noise attenuation technologies would be employed to further reduce impacts of construction in-water (Sunrise Wind 2023).

Noise from trenching of inter-array and export cables would occur during construction and would likely be limited to dispersal of species, including commercially targeted species, from the area. These disturbances would be short-term and localized and extend only a short distance beyond the emplacement corridor but would have only minor fishery-level impacts.

Port utilization: Construction of the proposed Project would require a range of both construction and support vessels, including vessels for transferring crew, transporting heavy cargo, and conducting heavy lifts, as well as multipurpose vessels and barges. All of these vessels would add traffic to port facilities and would require berthing. For the proposed Project, construction vessels would travel between the SRWF and the following ports that are expected to be used during construction: Albany and/or Coeymans, New York, as foundation scope, Port of New London, Connecticut, as WTG scope, and Port of Davisville-Quonset Point, Rhode Island, as construction management base. Other back-up options for construction support include Port of New York-New Jersey, New York, the New Bedford Marine Commerce Terminal, Massachusetts, Sparrow’s Point, Maryland, Paulsboro Marine Terminal, New Jersey, Port of Providence, Rhode Island, and Port of Norfolk, Virginia. It should also be noted that there may be indirect impacts to ports not specifically being used as a construction mobilization port for the proposed Project, as other ports that are in relatively close proximity may experience an influx of vessels relocating due to traffic in the ports listed above.

Based on information provided by Sunrise Wind, construction activities (including offshore installation of WTGs, substations, array cables, interconnection cable, and export cable) would require a variety of vessels and helicopters, as noted in COP Table 3.3.10-3. In total, the Proposed Action would generate approximately 126 vessel trips during the construction and installation phase (Appendix C). The construction vessels to be used for Project construction are described in Section 3.3.10.1 and Tables 3.3.10-2 and 3.3.10-3 of the COP (Sunrise Wind 2023). Typical large construction vessels used in this type of project range from 325 to 350 ft (99 to 107 m) in length, from 60 to 100 ft (18 to 30 m) in beam, and draft from 16 to 20 ft (5 to 6 m) (Denes et al. 2021).

Some of the ports that would be used by Sunrise Wind are also used by commercial fishing vessels and for-hire recreational fishing vessels. Of the main ports considered, Port of New London averaged $7,000 in annual revenue over the period of 2008-2021 from commercial fishing in the Lease Area, which is tenth among those listed in Table 3.14-9. However, other back-up ports such as New Bedford have a much higher average annual revenue of $817,000 from commercial fishing in the Lease Area, which ranked highest among those listed in Table 3.14-9. The additional vessel volume in the ports associated with Project operations could cause vessel traffic congestion, difficulties with navigating, and an increased risk for collisions, together with reduced access to high-demand port services (e.g., fueling and provisioning) by existing port users, including commercial and for-hire recreational fishing vessels. However, Sunrise Wind developed a Fisheries Communication and Outreach Plan (COP V1 October 28, 2021 Appendix B, Ørsted Offshore North America 2021) as well as several other APMs to inform all mariners, including commercial and recreational fishing vessel, of construction-related activities and Project-related vessel movements. Communication would be facilitated through a Project website, public notices to mariners and vessel float plans, and a Fisheries Liaison. Sunrise Wind would submit information to the USCG to issue Local Notice to Mariners during offshore installation activities. The adverse impact on commercial fisheries and for-hire recreational fishing would be short-term during the construction period, which would include more vessel traffic than during the O&M phase.

Traffic: The installation of offshore components for the Project and the presence of construction vessels and O&M vessels could temporarily restrict fishing vessel movement and thus transit and harvesting activities within the Project Lease Area and along the cable routing areas. It could lead to traffic congestion and an increased risk for collisions. Sunrise Wind would request, and it is expected the USCG would establish, short-term safety zones around each WTG, the OSC-DC and each cable-laying vessel during construction. Regardless of whether safety zones are in effect, fishing vessels would likely steer clear of construction vessels to avoid potential collisions and damage to their fishing gear. In doing so, fishing vessels could either forfeit fishing revenue or relocate to other fishing locations and continue to earn revenue. However, vessels that choose to relocate could incur increased operating costs such as increased fuel costs due to longer transit times to and from more distant fishing grounds, wear on equipment and additional crew compensation due to more days at sea, among other factors. They could also experience lower revenue due to fishing potentially less productive fishing grounds, potentially having to switch to less-valuable species, and potentially encountering more competition for a given resource.

After construction is complete, WTG foundations and associated scour protection may produce an artificial reef effect, potentially increasing fish and invertebrate abundance within a facility’s footprint (refer to Section 3.10, *Finfish, Invertebrates, and Essential Fish Habitat*), as well as recreational fishing use. Some commercial fishermen may avoid the SRWF if large numbers of recreational fishermen are drawn to the area by the prospect of higher catches (ten Brink and Dalton 2018). If these congestion concerns cause commercial fishermen to shift their fishing effort to areas outside of the SRWF to areas not routinely fished, conflict with existing users could increase as other areas are encroached upon. In general, the potential for conflict among commercial fishermen due to fishing displacement may be higher for fishermen engaged in fisheries that have regulations that constrain where fishermen can fish, such as the lobster fishery. However, the potential for vessel congestion and gear conflict may increase if mobile species targeted by commercial fishermen, such as Atlantic herring, Atlantic mackerel, squid, tuna, and groundfish, are attracted to offshore wind energy facilities by the artificial reef effect, and fishermen targeting these species concentrate their fishing effort in the SRWF as a result. Overall, the adverse effects of vessel traffic on commercial and for-hire fishing vessels are expected to be moderate and long-term.

Presence of structures: The presence of structures could lead to impacts on commercial fisheries and for-hire recreational fishing through navigation hazards (including transmission cable infrastructure) and allisions (collisions with stationary objects), entanglement or gear loss/damage, fish aggregation, habitat conversion, and space-use conflicts.

Impacts and considerations relative to the presence of structures is discussed thoroughly under O&M for offshore activities and facilities.

During the construction of the Project, up to two wave buoys would be deployed to support the SRWF installation stage with one wave buoy within the SRWF proximate to the WTGs in the eastern region of the windfarm and one wave buoy deployed nearshore along the SRWEC-NYS near the HDD exit pit location. The wave buoys would be temporary during construction and would collect information about the wave and current information to be transmitted in real time to the installation vessel(s) for monitoring the safety of operations and also to feed into a forecasting system for real time calibration and accuracy improvement of the local forecast. Impacts related to the presence of the wave buoys would be short-term and negligible. Additional details related to the wave buoys is presented in Section 2.1.2.2.4.

Cable emplacement and maintenance: The Proposed Action would install approximately 286 mi (460 km) of new submarine cable, including 180 mi (305.8 km) of inter-array cables and 106 mi (290 km) of offshore export cables. As described in the COP (Sunrise Wind 2023) and summarized in Appendix E, Sunrise Wind proposes to bury all cables to a target depth of 4 to 6 ft (1.2 to 1.8 m). Cable burial depth of less than 3 ft (1 m) would increase the probability of gear interactions. Cable-laying activities, including preparatory boulder and sand wave clearance activities, would directly disrupt commercial and for-hire recreational fishing activities in areas of active construction, although disruption in any given area would be short-term. Boulder removal would be performed using a combination of a boulder grab or boulder plow, while sand wave leveling would potentially be undertaken through use of a suction hopper dredger (Sunrise Wind 2023).

Boulder clearance, sand wave clearance, utilization of pre-lay grapnel runs, and cable laying disturbs the seabed and can reduce water quality through resuspension of sediment, increase underwater noise, or introduce artificial lighting, and can result in a behavioral response from mobile finfish species and injury or death of less-mobile species or benthic infauna such as scallops, surfclams, and ocean quahogs, as well as alter the seabed profile (Section 3.10). In turn, these responses could decrease catchability for a fishery, such as by changing the species composition where seabed profiles are changed or due to disturbances causing fish to not bite at hooks or changing swim height. The maximum impacts for boulder and sand wave clearance would be 1,259 ac (5.1 km^2), assuming a 98-ft- (30-m-) wide corridor along 100 percent of the cable route within both the SRWF and the export cable route (Appendix C), even though the actual clearance area is likely to be less than the assumed maximum area. New cable emplacement and maintenance are estimated to affect up to 1,259 ac (5.1 km^2) of seafloor within the export cable route. The relocation of boulders also could increase the risk of gear snags, as uncharged or unknown obstructions could result in damage to equipment, lost revenue and potential safety impacts. Behavioral responses of target species in commercial and for-hire recreational fisheries are expected to be confined to a small area at any one time, and to end shortly after construction activities end. Benthic species such as sea scallops and ocean quahogs would be expected to readily repopulate cable areas once the offshore cables are installed and buried. Cable inspection and repair activities would result in types of impacts similar to those of construction activities, with short-term disturbance, displacement, injury, or mortality of target species. To mitigate impacts to commercial and for-hire recreational fisheries, Sunrise Wind would install mobile gear-friendly cable protection measures (i.e., not introduce new hangs for mobile fishing gear, meaning new features could have tapered/sloped edges). This APM would ensure that seafloor cable protection does not introduce new hangs for mobile fishing gear. Areas of impact would be expected to be minor and the duration of impacts to be short-term during the time of construction and/or repair and maintenance. The area around the Lease Area as well as the cable corridor is a very diverse area in terms of the types of fishing as well as the species found in the area – generally speaking, the areas to the west of the Lease Area would have more skates and monkfish, as well as ground fish species. In addition, the skate bait fishery primarily operates in the area where the cable corridor is generally located and includes harvesting larger volumes of low-value fish typically used for lobster bait.

Climate change: Impacts and considerations relative to climate change are discussed under O&M for offshore activities and facilities.

Regulated fishing effort: Impacts and considerations relative to regulated fishing effort are discussed under O&M for offshore activities and facilities.

3.14.5.2 Operations and Maintenance

3.14.5.2.1 Onshore Activities and Facilities

As noted in Section 3.14.6.1., the primary impacts relative to commercial fisheries and for-hire recreational fishing by their nature are associated with offshore activities and facilities. However, changes in, or the availability of, certain onshore infrastructure could have an impact on commercial fishing and for-hire recreational fishing. This could include port changes, port expansion and construction activities, impacts to the cost or availability of shoreside support services that could disrupt offloading, provisioning, repair services, and seafood distribution. Therefore, some onshore activities related to offshore wind development could adversely impact commercial fishing and for-hire recreational fishing; however, the majority of impacts are related to offshore activities.

3.14.5.2.2 Offshore Activities and Facilities

Anchoring: Anchoring involves both anchoring of a vessel involved in the Project and the attachment of a structure to the sea bottom by use of an anchor or mooring. As noted under construction and installation, anchoring vessels and other structures would pose a navigational hazard to fishing vessels; however, all impacts would be localized (within a few hundred meters of anchored vessels) and short-term (hours to days in duration). Although anchoring impacts would primarily occur during Project construction, some impacts could occur during O&M. Therefore, the adverse effects of offshore wind energy-related anchoring on commercial fisheries and for-hire recreational fishing are expected to be long-term, though periodic in nature, and minor.

Noise: While noise associated with operational WTGs may be audible to some finfish and invertebrates, this would only occur at relatively short distances from the WTG foundations, and there is no information to suggest that such noise would negatively affect commercial fisheries (English et al. 2017). Therefore, impacts on commercial and for-hire recreational fisheries would be unlikely.

Sunrise Wind would conduct G&G surveys to inspect or monitor cable routes during the construction and O&M phases of the Project, or both. Noise from G&G surveys of the cable route could disturb finfish and invertebrates in the immediate vicinity of the investigation and could cause short-term behavioral changes; however, the noise is not anticipated to affect reproduction and recruitment of commercial fish stocks into the fishery. Noise impacts from surveys could have short-term, localized impacts during the short-term survey period. Impacts on commercial fisheries and for-hire recreational fishing are anticipated to be short-term and minor given the small impact area and short-term nature of the impact.

Throughout the construction and O&M phases, vessel traffic associated with the Project would likely result in behavior responses from several species, including species targeted by fisheries. However, noise from vessels would be considered low intensity and would not be expected to affect species on a fisheries level; therefore, impacts on commercial and for-hire recreational fisheries would be minor.

For all of the above noise-generating activities, once the activity ceases, most fish and invertebrate species would be expected to return to or recolonize the affected area. Therefore, impacts from noise-generating activities on commercial and for-hire recreational fisheries would be short-term and minor.

Port utilization: The O&M phase of the proposed Project would require a range of equipment, vehicles and vessels, including vessels for transferring crew, transporting heavy cargo, and conducting heavy lifts, as well as multipurpose vessels and barges. All of these vessels would add traffic to port facilities and would require berthing. Although no final decision has been made on which port(s) would be used for O&M activities, the following ports are being considered: Brooklyn, New York, Montauk, New York, Port Jefferson, New York, Port Galilee, Rhode Island, and Quonset, Rhode Island. The vessels utilizing ports would be less in number than during the construction phase but do have the potential to disrupt regular users of these port facilities, potentially causing certain commercial fishing and for-hire recreational vessels to relocate to different ports. Utilizing a different port that is potentially farther from their desired fishing grounds could increase costs incurred by these vessels.

The Project would use a variety of vessels to support O&M, including CTVs, service operation vessels, jack-up vessels, and supply vessels (including helicopters).

Traffic: Safety zones may be established around O&M activities on a case-by-case basis in coordination with the USCG. In context of reasonably foreseeable environmental trends, the incremental contributions of the Proposed Action to the combined vessel traffic impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities would likely cause an increase in vessel traffic during the O&M activities, resulting in short-term and long-term moderate impacts.

Presence of structures: The presence of structures can lead to impacts on commercial fisheries and for-hire recreational fishing through navigation hazards (including transmission cable infrastructure) and allisions (collisions with stationary objects), entanglement or gear loss/damage, fish aggregation, habitat conversion, displacement, and space-use conflicts.

Under current regulations, USCG is responsible for determining any type of safety or exclusionary zone around any structure placed in the open ocean. USCG stated that it does not plan to create exclusionary zones around offshore wind facilities, with the exception of possibly implementing safety zones during construction and conceptual decommissioning, to be determined on a project-by-project basis (BOEM 2018). However, the presence of the Project's WTGs could result in the area essentially becoming an exclusion area for fishing if fishing vessel operators are not—or perceive that they are not—able to safely navigate the area around the WTGs.

Under the Proposed Action, Sunrise Wind proposes to install up to 94 WTGs at 102 potential locations, extending up to 787 ft (240 m) above MLLW with spacing of 1.15-mi by 1.15-mi, or 1-nm by 1-nm (1.85-km by 1.85-km) between WTGs in a uniform east-west/north-south grid.

The presence of WTG arrays may restrict fishing vessel maneuverability (including risk of allisions) within the SRWF. Fishermen have expressed specific concerns about fishing vessels operating trawl gear that may not be safely deployed and operated in an offshore wind lease area given the size of the gear, the spacing between the WTGs, and the space required to safely navigate, especially with other vessels present and during poor weather conditions. Trawl and dredge vessel operators have commented that spacing less than 1 nm (1.9 kms) between WTGs may not be enough to operate safely due to maneuverability of fishing gear and gear not directly following in line with vessel orientation. Clam industry representatives (Atlantic Surfclam and Ocean Quahog Fisheries) state that their operations require a minimum distance of 2 nm (3.7 km) between WTGs, in alignment with the bottom contours, for safe operations (BOEM 2021a; RODA 2021). Navigating through the SRWF would not be as problematic for the for-hire recreational fishing vessels, which tend to be smaller than commercial vessels and do not use large external fishing gear (other than hook and line) that makes maneuverability difficult. However, trolling for highly migratory species (e.g., bluefin tuna, swordfish) may involve deploying many feet of lines and hooks behind the vessel and then following large pelagic fish once they are hooked, which poses additional navigational and maneuverability challenges around WTGs (BOEM 2021a).

Sunrise Wind's *Navigation Safety Risk Assessment* (NSRA) (COP V1, June 2021, Appendix X, DNV-GL 2022) examined many aspects of the proposed Project's WTG layout. Using their analysis along with feedback received from commercial fishing stakeholders, the Project plans an array with three lines of orientation, east/west, north/south and diagonals in intercardinal directions, and a minimum of 1 nm (1.85 km) separation between towers to provide the ability to transit the Lease Area in multiple directions as safely as possible. BOEM is cognizant that maneuverability within the SRWF may vary depending on many factors, including vessel size, fishing gear or method used, and environmental conditions such as wind, sea state, current, and visibility. In addition, BOEM recognizes that even when it is feasible to fish within the SRWF, some fishermen may not consider it safe to do so. Furthermore, operating within the SRWF with other vessels and gear types present may restrict vessel maneuverability.

Because of the height of WTGs above the ocean surface, they would be visually detectable at a considerable distance during the day and easily detected by vessels equipped with radar regardless of the time of day. To further ensure navigational safety, all WTGs and OCS-DC would be lit and marked in accordance with USCG, BOEM, and IALA guidelines, and WTG locations would be charted by NOAA and could include protocols for sound signals, radar beacons, and AIS, which would be finalized with consideration for other such Private Aids to Navigation in the area (i.e., foghorns) in coordination with USCG. Some fishing vessels operating in or near the SRWF may experience radar clutter and shadowing. Most instances of interference could be mitigated through the proper use of radar gain controls (DNV-GL 2021) refer to Section 3.19, *Navigation and Vessel Traffic*.

Notwithstanding these safety measures, some fishermen have commented that, because of safety considerations, they would not enter an offshore wind array during inclement weather, especially during low-visibility events (Kirkpatrick et al. 2017). During interviews with commercial fishermen, ten Brink and Dalton (2018) found that fishermen had concerns that low visibility, wind, or crew exhaustion could lead to vessels hitting WTGs. Moreover, mechanical problems, such as loss of steering, could result in an allision with a WTG as the vessel drifts during repair (DNV-GL 2021). Aside from these potential navigational issues, some commercial fishermen may avoid the SRWF if large numbers of recreational fishermen are drawn to the area by the prospect of higher catches. According to ten Brink and Dalton (2018), the influx of recreational fishermen into the BIWF in Rhode Island caused some commercial fishermen to cease fishing in the area because of vessel congestion and gear conflict concerns. In addition, if these concerns cause commercial fishermen to shift their fishing effort to areas not routinely fished, conflict with existing users could increase as other areas are encroached. In general, the potential for conflict among commercial fishermen due to fishing displacement may be higher for fishermen engaged in fisheries that have regulations that constrain where fishermen can fish, such as the lobster fishery. However, the potential for vessel congestion and gear conflict may increase if mobile species targeted by commercial fishermen, such as Atlantic herring, Atlantic mackerel, squid, tuna, and groundfish, are attracted to the SRWF, and fishermen targeting these species concentrate their fishing effort in the proposed Project Area as a result.

Whether fishermen continue to fish in the SRWF is determined by cultural and traditional values that go beyond expected profit. For example, it is advantageous for fishermen to fish in locations that are known to them and fished by their peers. In addition, the presence of other boats in the area can contribute to the fishermen’s sense of safety. Some fishermen may choose to not fish in the area due to their perception of risk. Impacts on commercial fisheries may affect the economic health, the cultural identity, and values, and therefore the wellbeing, of individuals and communities that identify as “fishing” communities. Impacts on cultural and traditional values are not quantifiable, but are qualitatively considered when assessing the impacts of the Proposed Action.

Fishing vessel operators unwilling or unable to travel through or deploy fishing gear in the SRWF would be displaced. They may find suitable alternative fishing locations and continue to earn revenue, although it is difficult to predict the ability of fishing operations displaced by the Project to locate alternative fishing grounds that would allow them to maintain revenue targets while continuing to minimize costs. Not all fishermen would seek alternative fishing grounds and there are many factors that determine how a fisherman may adapt; while some may switch the species they target, some may also leave the fishery altogether (Murray et al. 2010; O’Farrell et al. 2019). These behaviors are like those of fishers experiencing reduced access to fisheries resulting from fishing regulations and shifting species composition resulting from climate change (Papaioannou et al. 2021). Each of these scenarios requires adaptive behavior and risk tolerance, traits that are not universally shared by all fishers. For example, O’Farrell et al (2019) observed that some fishers have low vessel mobility and less explorative behavior, are risk averse, and take shorter trips, whereas other fishers have high mobility and a greater explorative behavior, are tolerant of risk, and conduct longer trips. Similarly, Papaioannou et al. (2021) observed that smaller trawlers had a higher affinity for their fishing grounds and were less likely to switch fishing grounds than larger trawlers. Fishers willing to seek alternate fishing grounds may experience increased operating costs (e.g., additional fuel to arrive at more distant locations; additional crew compensation due to more days at sea), lower revenue (e.g., fishing in a less-productive area, fishing for a less-valuable species, or increased competition for the same resource), or both. Fishers that switch target species or gear types used may also lose revenue from targeting a less-valuable species and increased costs from switching gear type. Switching species could also cause fishers to land their catch in different ports (Papaioannou et al. 2021), which could result in increased operational costs depending on where the port is located.

However, the available data suggest the presence of alternative productive fishing grounds in proximity to the SRWF, especially for the two highest revenue-producing FMP species within the SRWF: surfclam/ocean quahog and monkfish. Section 2.2.2 of COP Appendix V (COP Appendix V1, June 2021 Inspire 2022) shows maps of vessel intensity associated with the SRWF and SRWEC Fisheries Study Corridor. Figures 2.2-7 in the COP, Appendix V1, shows vessel intensity for monkfish fishing from 2011 to 2014 and Figure 2.2-8 shows monkfish fishing vessel intensity for 2015 and 2016. Both figures show high to very high vessel intensity in the Lease Area, as well as areas to the north, northwest, west and south of the Lease Area. COP V1 June 2021 Appendix V Figure 2.2-17 provides a revenue-intensity raster map for monkfish fishing from 2013 to 2017, which shows high level of revenue is generated within the Lease Area. Similarly, for surfclam/ocean quahog, COP V1 June 2021 Appendix V, Figures 2.2-9 and 2.2-10 show vessel intensity for surfclam/ocean quahog fishing from 2012 to 2014 and 2015 and 2016, respectively, and indicate there are high concentrations of vessels in and around the Lease Area targeting surfclam/ocean quahog. Figure 2.2-19 shows a revenue-intensity raster map for clam dredge fishing from 2013 to 2017, which indicates concentrations of revenue generated within the Lease Area, but also large areas to the southwest where high concentrations of revenue are generated.

The location of the proposed wind project may affect the accessibility and availability of fish for commercial and for-hire recreational fishing. In particular, the location of the proposed infrastructure and the Lease Area could impact transit corridors and access to preferred fishing locations. Although the figures in the COP (Sunrise Wind 2023) indicate that there is high vessel intensity and revenue generated within the Lease Area, it shows that there are many surrounding areas where the fishing level efforts and revenue generated are comparable or higher than those within the Lease Area and the SRWEC Fisheries Studies Corridor. While comparable fishing grounds may exist in proximity to the SRWF, shifting locations could result in increased operating costs operating costs (e.g., additional fuel to arrive at more distant locations; additional crew compensation due to more days at sea), lower revenue (e.g., fishing in a less productive area, fishing for a less-valuable species, or increased competition for the same resource), or both. Fishers that switch target species or gear types used may also lose revenue from targeting a less-valuable species and increased costs from switching gear type. Switching species could also cause fishers to land their catch in different ports (Papaioannou et al. 2021), which could result in increased operational costs depending on where the port is located.

In addition, if, at times, a fishery resource is only available within the SRWF, some fishermen, primarily those using mobile gear, may lose the revenue from that resource for the time the resource is inaccessible. These impacts could remain until decommissioning of the Project is complete, although the magnitude of the impacts would diminish over time if fishing practices adapt to the presence of structures. In addition, there may be some additional expense incurred on fishing vessels that choose to detour around the SRWF to other fishing areas. However, instead of transiting in the most direct route and alternative route is used that may result in additional time, fuel usage and equipment/vessel wear and potential safety hazards.

It is acknowledged that proposing fishermen find alternative fishing grounds to earn revenue is a complex issue with many factors, including the familiarity of traditional fishing grounds. Fishing communities may also have a difficult time with climate adaptation. Historically, warming (and cooling) events have affected the abundance of species targeted, prevalence of invasives, and physical access to target species. Fishing communities historically viewed cooling waters twice as negatively as warming waters, as they were associated with a decrease in fishing opportunity due to storms, while warmer waters were associated with the potential for new fisheries. However, recent warming trends were viewed as strongly negative, associated with disease, reductions in target species and shifts of fish distributions across jurisdictional lines (McClenachan et al. 2019). To evaluate the potential costs associated with reduced fishing revenues that may result from construction and O&M activities in the SRWF, BOEM obtained information from NMFS on fisheries revenue sourced from within the Lease Area. From these data, it is possible to estimate the amount of commercial fishing revenue that would be exposed as a result of the Proposed Action. The estimate of revenue exposure quantifies the value of fishing that occurs in the Lease Area. Therefore, these estimates represent the fishing revenue that would be foregone if fishing vessel operators opt to no longer fish in these areas and cannot capture that revenue in a different location. Revenue exposure estimates should not be interpreted as measures of actual economic impact. Actual economic impact would depend on many factors—foremost, the loss of the potential for continued fishing to occur within the SRWF, together with the ecological impact on target species residing within the Project Area. Economic impacts of these factors are lessened with a vessel's ability to adapt to changing where it fishes. For example, if alternative fishing grounds are available nearby and could be fished at no additional cost, the economic impact would be lower. There is the potential to fish the boundary of the SRWF. If fish stocks increase within the SRWF due to reduced fishing efforts, stocks may increase in areas immediately adjacent to the SRWF and, if fished, these adjacent areas may generate revenue similar to that of the SRWF. In addition, it should be noted, as mentioned within the Climate Change IPF under Alternative A, ocean acidification driven by climate change is projected to change the northeast fishery species and where they may be present in the future. Therefore, the estimated revenue noted within this analysis is based upon historic data but could in fact change over time as the water temperature increases. Adverse effects of climate change are expected for approximately half of the species assessed, while Hare et al. (2016) anticipate that, for approximately 17 percent of the species, including inshore longfin squid (*Doryteuthis pealeii* [formerly *Loligo pealeii*]), butterfish, and Atlantic croaker, fisheries would see some beneficial impacts.

To evaluate the potential loss of commercial fishing revenue that may result from the Proposed Action, BOEM estimated the amount of commercial fishing revenue that would be exposed in the Lease Area. However, these estimates of revenue exposure should not be interpreted as measures of actual economic impact, which would depend on many factors, including the potential for continued fishing to occur within the footprint of the WEAs, the ecological impact on target species residing within the Project Area, and the ability of fishers to find alternative fishing grounds. Table 3.14-23 depicts the average annual revenue exposure in the Lease Area by FMP fishery based upon data from 2008 through 2021. The amount of commercial fishing revenue that would be exposed annually for the life of the

Project is estimated to be $1.98 million across all FMP and non-FMP fisheries on average and represents approximately 0.11 percent of the total average annual revenue of the FMP and non-FMP fisheries in the GAA. The largest impacts in terms of exposed revenue as a percentage of total revenue in GAA would be in the Monkfish FMP and All Others categories.

The amount of fishing activity that could be affected within the Lease Area is a small fraction of the amount of fishing activity in the GAA as a whole. However, for fishing vessels that choose to avoid the SRWF, have historically derived a large percentage of their total revenue from the area, and are unable to find suitable alternative fishing locations, the adverse impacts would be long-term and major. While a small number of commercial fishing vessels fish heavily in the Lease Area, the highest percentage of total annual revenue attributed to catch within the Lease Area was 85 percent in multiple years from 2008 to 2021. However, three-quarters of the vessels fishing in the area derived 1 percent or less of their total revenue from the area in 2008 through 2021 (refer to Table 3.14-11, Figure 3.14-2 and associated text). In short, some vessels depend very heavily on the Lease Area, but most vessels derive a small percentage of their total annual revenue from the area. In both cases, the impacts could be long-term if the respective vessels choose to avoid the Lease Area, but the level of impact for vessels deriving only a small percentage of their revenue from the area would be substantially less than for vessels that derive a large portion of their revenue from the Lease Area. Considering the low revenue risk across ports, together with the small number of vessels and fishing activity that would be affected by the Project, the impacts on other fishing industry sectors, including seafood processors and distributors and shoreside support services, would be long-term and minor to moderate, depending on the fishery in question.

Table 3.14-23. Annual Average Commercial Fishing Revenue Exposed to the SRWF by FMP Fishery Based on Annual Average Revenue 2008–2021

Fishery Management Plan (FMP) Fishery	Peak Annual Revenue	Average Annual Revenue	Average Annual Exposed Revenue as a Percentage of Total Revenue from the Geographic Analysis Area
Atlantic Herring	$86,624	$18,503	0.00%
Bluefish	$11,075	$3,547	0.00%
Tilefish	$8,220	$2,383	0.00%
Highly Migratory Species	$4,809	$916	0.00%
Mackerel/Squid/Butterfish	$415,339	$101,607	0.01%
Monkfish	$562,560	$300,475	0.02%
Northeast Multispecies	$336,448	$121,527	0.01%
Multispecies Small-Mesh	$203,669	$60,198	0.00%
Sea Scallop	$560,995	$258,997	0.01%
Skate	$305,192	$168,405	0.01%
Spiny Dogfish	$27,043	$11,095	0.00%
Summer Flounder/Scup/Black Sea Bass	$270,859	$155,303	0.01%
SERO FMP	$197	$38	0.00%
ASMFC FMP	$253,439	$151,552	0.01%
No Federal FMP: Unmanaged[1]	$27,155	$8,157	0.00%
All Others [2]	$1,736,322	$437,675	0.02%
All FMP and non-FMP Fisheries	**$3,542,586**	**$1,980,843**	**0.11%**

Sources: Developed using FMP Revenue Exposure Analysis – 2020 to 2030 calculations data provided by BOEM (2022).

Notes: Revenue is in nominal dollars and is estimated based on the annual average revenue by FMP from 2008 through 2021. Resolution of the data does allow estimates to be made on a small enough scale to differentiate impacts along wind farm export cable corridor. Therefore, estimates only pertain to the Lease Area itself. Peak annual revenue and average annual revenue are calculated independently for all rows, including the All FMP and non-FMP Fisheries row.

[1] Includes revenues from all species not assigned to an FMP.

[2] "All Others" is for data that have been aggregated for confidentiality purposes.

Annual exposure of revenue for for-hire recreational fishing in the Lease Area is not available. Based on the information provided in Table 3.14-16 and Table 3.14-17 the vast majority of for-hire recreational fishing in the SRWF originates from New York or Rhode Island ports—namely, Montauk and "other ports" in New York, or Point Judith and "other ports" in Rhode Island, with other ports having fewer than three permits.

As provided in Table 3.14-15, there is a wide range of annual for-hire recreational fishing revenue for the SRWF from 2008 through 2018, with the data from many years being suppressed. However, based upon the total, an average annual revenue would be approximately $115,000; therefore, the exposed revenue as it relates to the SRWF would be smaller than the noted percentages.

A potential effect of the offshore cables and WTGs is the entanglement and damage or loss of commercial and recreational fishing gear. Economic impacts on fishing operations associated with gear damage or loss include the costs of gear repair or replacement, together with the fishing revenue lost while gear is being repaired or replaced.

The Proposed Action would install approximately 286 mi (460 km) of new submarine cable, including 180 mi (305.8 km) of inter-array cables and 106 mi (290 km) of offshore export cables. As described in the COP (Sunrise Wind 2023) and summarized in Appendix E, Sunrise Wind proposes to bury all cables to a target depth of 4 to 6 ft (1.2 to 1.8 m)), well below the typical depth to which bottom trawls penetrate the ocean floor. In a study of seabed depletion and recovery from bottom trawl disturbance, Hiddink et al. (2017) determined that hydraulic dredges penetrated the ocean floor the deepest at 6.3 in (16.1 cm). However, it is common practice for dredging vessels to fish the same or similar tow path on multiple occasions during the same fishing trip. This could increase the overall depth penetration beyond the 6.3 in (16.1 cm) from one dredge tow. Therefore, while it is possible that cables could become uncovered during extreme storm events or other natural processes, burial to the target depth would reduce the risk of exposure and potential damage to fishing gear and a burial depth of less than 3 ft (1 m) would increase the probability of gear interactions.

In areas where seabed conditions might not allow for cable burial, other methods of cable protection would be employed, such as rock placement, concrete mattress placement, front mattress placement, rock bags, or seabed spacers. It is anticipated that up to 5 percent of the offshore cable may require additional cable protection where burial depth may be less than 3 ft (1 m). In addition to cable armoring, the Project would install approximately 106 ac (0.43 km^2) of scour protection for the 95 installed foundations (WTGs and OCS-DC). The scour protection would have a radial extension of approximately five times the monopile radius and a height of approximately 6.5 ft (2 m) and, similar to cable armoring, would pose a risk to entanglement and gear loss for commercial fishers, as well as gear loss for for-hire recreational fishers because trolling, bait fishing, and shark fishing could be more challenging, as the fish could use foundations and the scour protection to break free.

Cable, WTG, and OCS-DC locations would be indicated on nautical charts, helping to reduce the potential for fishing gear interactions. Additionally, while Sunrise Wind does not currently plan to establish formal exclusion/safety zones around construction vessels during the laying of cables, USCG may implement safety zones. In addition, Sunrise Wind developed a Fisheries Communication and Outreach Plan (COP V1 October 28, 2021 Appendix B; Ørsted Offshore North America 2021) as well as several other APMs to inform all mariners, including commercial and recreational fishing vessel, of construction-related activities and Project-related vessel movements. Communication would be facilitated through a Project website, public notices to mariners and vessel float plans, and a Fisheries Liaison. Sunrise Wind would submit information to the USCG to issue Local Notice to Mariners during offshore installation activities. The adverse impact on commercial fisheries and for-hire recreational fishing would be short-term during the construction period, which would include more vessel traffic than during the O&M phase, and would help reduce potentially moderate adverse impacts for commercial fisheries to minor impacts.

Impacts due to entanglement and gear damage/loss would persist for the duration of Project operations. During conceptual decommissioning of the Project, all foundations for WTGs and OCS-DC would be removed to 15 ft- (4.6 m) below the mudline. BOEM would most likely require that the scour protection be removed in accordance with 30 *CFR* 285.902(a), eliminating the opportunities for entanglement and gear damage/loss. However, if left in place, the scour protection would continue to pose an indefinite threat for entanglement and gear damage/loss. Offshore cables may be either left in place or removed depending on the regulatory requirements at the time of decommissioning, although it is assumed that all inter-array cables would be removed. Any scour protection or materials (e.g., concrete mattresses) that were used to protect exposed cables permitted to be left in-situ would continue to affect bottom-trawl fisheries as well as for-hire recreational fishing due to possible entanglement and gear loss.

In addition to posing hazards to fishing gear, the presence of the WTG foundations and associated scour protection, as well as cable protection, would convert existing sand or sand with mobile gravel habitat to hard bottom, which, in turn, would reduce the habitat for target species that prefer soft-bottom habitat (e.g., surfclams, sea scallops, squid, summer flounder) and increase the habitat for target species that prefer hard-bottom habitat (e.g., lobster, striped bass, black sea bass, Atlantic cod). Where WTG foundations, scour, and cable protection produce an artificial reef effect and attract finfish and invertebrates, the aggregation of species could increase the catchability of target species (Kirkpatrick et al. 2017). Although species that rely on soft-bottom habitat would experience a reduction in favorable conditions, the impacts from structures are not expected to result in population-level impacts (refer to Section 3.10, *Finfish, Invertebrates, and Essential Fish Habitat*) and changes to species biomass are not expected to be significant enough to affect total quotas.

The habitat changes would likely benefit for-hire recreational fishing due to increased fishing opportunities around the infrastructure, which is what ten Brink and Dalton (2018) found occurred at the BIWF. Impacts from habitat conversion would last throughout the life span of the Project and, in areas where scour and cable protection are left in place after decommissioning, would last indefinitely, although the scale of impact would not be known until decommissioning and the actual acreage of scour and cable protection to be left in place is known. The presence of structures would also prohibit existing NMFS marine resource survey operations from being conducted within the Lease Area, likely leading to increased uncertainty in stock assessments, which would result in lower fishery quotas based on existing fishery management council control rules. The types of impacts described for the No Action Alternative would occur under the Proposed Action (Section 3.14.5) and include precluding NMFS's scientific surveys from the approximately 113,079-ac (458-km^2) SRWF. If NMFS's scientific survey methodologies are not adapted to sample within wind energy facilities, the Proposed Action could increase uncertainty in scientific survey results, which would increase uncertainty in stock assessments and quota setting. This uncertainty could lead to changes in quotas, resulting in impacts on commercial and for-hire recreational fisheries, although the exact nature of any changes is not known at this time. While the direct impact on NMFS's surveys and the resultant uncertainty in data would be relatively small given the footprint of the Project Area in the larger context of the overall area managed by MAFMC and NEFMC, it would contribute to the overall impacts resulting from the 30-plus proposed offshore wind projects along the east coast (Appendix E), resulting in more substantial short- and long-term impacts on management processes and, subsequently, impacts on commercial and for-hire recreational fisheries' operations, as fishing regulations may have less flexibility in area-based management due to the Proposed Action, and offshore wind may change the distribution of fishing effort in ways not considered in FMPs.

Upon decommissioning of the Project, NMFS's and other scientific surveys could resume, as surface navigation obstacles would be removed from within the SRWF. Upon decommissioning, all foundations for WTGs and OCS-DC would be removed to 15-ft- (4.57-m) below the mudline (Sunrise Wind 2023), BOEM would most likely require that the scour protection be removed in accordance with 30 *CFR* 285.902(a), eliminating surface navigation obstacles. This would allow NMFS and other scientific surveys to resume unimpeded. However, if left in place, the scour protection would continue to pose a long-term impact on the ability to perform bottom-trawl surveys in the Lease Area.

The Proposed Action is expected to add up to 95 foundations and 106 ac (0.43 km^2) of scour/cable protection. Foundations and scour/cable protection would remain for the life of the Project. This could tend to slow migration. However, water temperature is expected to be a bigger driver of habitat occupation and species movement (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018). Migratory animals would likely proceed from structures unimpeded. Therefore, the introduction of hard-bottom habitat may result in long-term, adverse, beneficial, or mixed impacts, depending on the species and location.

The previously described impacts from the presence of structures under the Proposed Action, including navigational hazards and increased risk of damage or loss of fishing gear, are likely to cause some displacement of fishing activity from traditional fishing grounds. Commercial fishing vessels have well-established and mutually recognized traditional fishing locations, and the displacement of fishing activity outside of the Project Area may result in space-use conflicts among those in the fishing industry as other areas are encroached upon. BOEM expects that space-use conflicts would be higher in fisheries that target less-mobile species, such as crab, lobster, scallop, and surfclam, and in fisheries where regulations constrain where vessels can fish. Because of constraints on these fisheries, economic losses caused by displacement from traditional fishing grounds would not necessarily be compensated for by revenue earned on alternative fishing grounds. However, although important fisheries, other than scallops, these less-mobile species were not among the top fisheries by revenue in the SRW Lease Area (Table 3.14-4). Finally, as described above, fish aggregation around the vertical habitat provided by the WTGs and resulting increases in recreational fishing effort around the WTGs could contribute to space-use conflicts with the commercial fisheries within these WEAs. Collectively, space-use conflicts that would result from the Proposed Action are expected to have long-term, adverse impacts on commercial and for-hire recreational fisheries, depending on the fishery and fishing operation.

Cable emplacement and maintenance: Impacts and considerations relative to the cable emplacement and maintenance are discussed under *Construction and Installation for Offshore Activities and Facilities*.

Climate change: The types of impacts from global climate change on commercial fisheries and for-hire recreational fisheries described for the No Action Alternative would occur under the Proposed Action (refer to Section 3.14.5). The Proposed Action could contribute to a long-term net decrease in GHG emissions due to its use of renewable energy. While this decrease may not be measurable, it would be expected to help reduce climate change to some degree, although any negligible benefit would only last until the Project is decommissioned.

Regulated fishing effort: Regulated fishing effort refers to fishery management measures necessary to maintain maximum sustainable yield under the MSFCMA. The types of impacts described for the No Action Alternative would occur under the Proposed Action (Section 3.14.5) and include potentially precluding NMFS's scientific surveys from the approximately 113,079-ac (458-km^2) SRWF. Based on existing fishery quota control rules and risk policies by the New England Mid-Atlantic Fishery Management Councils, reduced access by survey vessels that increase uncertainty in stock assessments would result in reduced quotas. If NMFS's scientific survey methodologies are not adapted to sample within wind energy facilities, the Proposed Action could increase uncertainty in scientific survey results. This would increase uncertainty in stock assessments and reduced quotas, resulting in impacts on commercial and for-hire recreational fisheries. While the direct impact on NMFS's surveys and the resultant uncertainty in data would be relatively small given the footprint of the Project Area in the larger context of the overall area managed by MAFMC and NEFMC, it would contribute to the overall impacts resulting from the 30-plus proposed offshore wind projects along the east coast (Appendix E), resulting in more substantial short- and long-term impacts on management processes and, subsequently, impacts on commercial and for-hire recreational fisheries' operations, as fishing regulations may have less flexibility in area-based management due to the Proposed Action, and offshore wind may change the distribution of fishing effort in ways not considered in FMPs.

Upon decommissioning of the Project, NMFS's and other scientific surveys could resume, as surface navigation obstacles would be removed from within the SRWF. Upon decommissioning, all foundations for WTGs and OCS-DC would be removed to 15-ft- (4.57-m) below the mudline (Sunrise Wind 2023), BOEM would most likely require that the scour protection be removed in accordance with 30 *CFR* 285.902(a), eliminating surface navigation obstacles. This would allow NMFS and other scientific surveys to resume unimpeded. However, if left in place, the scour protection would continue to pose a long-term impact on the ability to perform bottom-trawl surveys in the Lease Area.

3.14.5.3 Conceptual Decommissioning

3.14.5.3.1 Onshore Activities and Facilities

As noted in Section 3.14.6.1., the primary impacts relative to commercial fisheries and for-hire recreational fishing by their nature are associated with offshore activities and facilities. However, changes in, or the availability of, certain onshore infrastructure could have an impact on commercial fishing and for-hire recreational fishing. This could include port changes, port expansion and construction activities, impacts to the cost or availability of shoreside support services that could disrupt offloading, provisioning, repair services, and seafood distribution. Therefore, some onshore activities related to offshore wind development could adversely impact commercial fishing and for-hire recreational fishing; however, the majority of impacts are related to offshore activities.

3.14.5.3.2 Offshore Activities and Facilities

Anchoring: Anchoring involves both anchoring of a vessel involved in the Project and the attachment of a structure to the sea bottom by use of an anchor or mooring. As noted under construction and installation, anchoring vessels and other structures would pose a navigational hazard to fishing vessels; however, all impacts would be localized (within a few hundred meters of anchored vessels) and short-term (hours to days in duration). Although anchoring impacts would primarily occur during Project construction, some impacts could occur during conceptual decommissioning. Therefore, the adverse effects of offshore wind energy-related anchoring on commercial fisheries and for-hire recreational fishing are expected to be long-term, though periodic in nature, and minor.

Noise: Noise impacts during decommissioning of the Project would be similar to those during the construction and O&M phases, although there would be no pile-driving activities (refer to Section 3.14.1 for additional details on anticipated impacts).

Port utilization: Port utilization impacts during decommissioning of the Project would be similar to those during the construction phase, as similar ports are being considered for supporting decommissioning activities (refer to Section 3.14.1 for additional details on anticipated impacts).

Traffic: It is likely that short-term safety zones would be established during conceptual decommissioning activities in the same fashion as during original construction of the proposed Project and would be performed in coordination with the USCG. Therefore, similar impacts would occur during decommissioning of the Project. Once fully decommissioned, vessel traffic impacts would likely revert to current conditions.

Presence of structures: The presence of structures is discussed within the O&M offshore activities and facilities, as that is the period during which they would have the most impact on commercial fisheries and for-hire recreational fishing. The associated impacts would be present through the activities related to conceptual decommissioning; however, once Project infrastructure is removed from the Project Area the area would return to its original state. As noted in Section 2.1.2.3.2, all foundations would be removed to 15 ft (below the mudline, which although would disturb the seafloor during decommissioning, would ultimately remove the presence of structures associated with the project.

Cable emplacement and maintenance: Impacts and considerations relative to the cable emplacement and maintenance is discussed under O&M for offshore activities and facilities. Upon conceptual decommissioning, once Project infrastructure is removed from the Project Area, the area would return to its original state.

Climate change: Impacts and considerations relative to climate change is discussed under O&M for offshore activities and facilities. Upon decommissioning, climate change related beneficial impacts related to reduction in GHG emissions would not be present.

Regulated fishing effort: Impacts and considerations relative to regulated fishing effort is discussed under O&M for offshore activities and facilities. Upon conceptual decommissioning, it is assumed the area would return to its original state and regulated fishing impacts would return to pre-Project conditions.

3.14.5.4 Cumulative Impacts of the Proposed Action

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

In context of reasonably foreseeable environmental trends, the incremental contributions of the Proposed Action to the combined anchoring impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities would result in localized, short-term, minor impacts on commercial fisheries and for-hire recreational fishing, including navigational hazards to fishing vessels, especially if projects overlap in the same area as fishing or transiting fishing vessels.

The incremental contributions of the Proposed Action to the combined noise impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities would depend on the timing and overlap of disturbance areas and could rise to a moderate level, with a vast majority of the contribution coming from pile-driving activities.

In the context of reasonably foreseeable environmental trends, the incremental contributions of the Proposed Action to the combined port utilization impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities would be minor.

The Proposed Action would contribute a noticeable increment to the combined presence of structure impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities including offshore wind. The increased number of structures would increase the risk of highly localized and periodic impacts on commercial fisheries that could be major, and impacts on for-hire recreational fishing that could be minor for those trolling for highly migratory species or beneficial due to the increase fishing opportunities for other for-hire recreational fisheries.

The incremental contributions of the Proposed Action to the combined vessel traffic impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities would likely cause an increase in vessel traffic during the construction timeframe resulting in short-term and moderate impacts.

For new cable emplacement and maintenance, in context of reasonably foreseeable environmental trends, the incremental contributions of the Proposed Action on commercial fisheries and for-hire recreational fishing from ongoing and planned activities would be localized, short-term and minor.

In context of reasonably foreseeable environmental trends, the incremental contributions of the Proposed Action to the combined regulated fishing effort impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities including offshore wind would be minor during the life of the Project.

3.14.5.5 Conclusions

Impacts of the Proposed Action

Project construction and installation, O&M, and conceptual decommissioning could affect port and fishing access, as well as transit and harvesting activities, fishing gear interactions, and target species catch. BOEM anticipates that the adverse impacts of the Proposed Action on commercial fisheries and for-hire recreational fishing would vary by fishery and fishing operation due to differences in target species abundance in the Project Area, gear type, and predominant location of fishing activity. It is conceivable that some of the small number of fishing operations that derive a large percentage of their total revenue from areas where Project facilities would be located would choose to avoid these areas once the facilities become operational. In the event that these specific fishing operations are unable to find suitable alternative fishing locations, they could experience long-term, major disruptions. However, it is estimated that the majority of vessels would only have to adjust somewhat to account for disruptions due to impacts. In addition, the impacts of the Proposed Action could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect. Therefore, BOEM expects that the impacts resulting from the Proposed Action would be range from

minor to **major** for commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation.

Cumulative Impacts of the Proposed Action

Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action to the impacts from ongoing and planned activities would result in **major** cumulative impacts on commercial fisheries and for-hire recreational fishing because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely, even with APMs. This impact rating is primarily driven by climate change and the presence of offshore structures. The majority of offshore structures in the GAA would be attributable to the offshore wind industry. However, given the array of measures available to mitigate impacts of offshore wind projects on commercial fisheries and for-hire recreational fishing, this impact rating is driven mostly by reduced stock levels from ongoing fishing mortality because of regulated fishing effort, changes in the abundance and distribution of fish and invertebrates associated with ongoing climate change, and permanent impacts from the presence of structures associated with planned offshore wind projects.

3.14.6 Alternative C-1 - Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions

3.14.6.1 Construction and Installation

3.14.6.1.1 Onshore Activities and Facilities

Under Alternative C-1, for the construction and installation of onshore facilities, the potential impacts to commercial fisheries and for-hire recreational fishing are anticipated to be the same as described under the Proposed Action (Alternative B).

3.14.6.1.2 Offshore Activities and Facilities

Under Alternative C-1, for the construction and installation of offshore facilities, the potential impacts to commercial fisheries and for-hire recreational fishing would be the same or very similar to those described under the Proposed Action (Alternative B). There would be the same overall number of WTGs installed (94 WTGs); however, in an effort to provide fisheries habitat impact minimization, the layout would remove potential locations from Priority Areas. Therefore, this is discussed in more detail under the presence of structures IPF under O&M. There is not expected to be a significant difference under the anchoring, noise, port utilization, traffic, cable emplacement and maintenance, climate change or regulated fishing effort IPFs.

3.14.6.2 Operations and Maintenance

3.14.6.2.1 Onshore Activities and Facilities

Under Alternative C-1, for the O&M of onshore facilities, the potential impacts to commercial fisheries and for-hire recreational fishing are anticipated to be the same as described under the Proposed Action (Alternative B).

3.14.6.2.2 Offshore Activities and Facilities

Under Alternative C-1, for the O&M of offshore facilities, the potential impacts to commercial fisheries and for-hire recreational fishing relative to most IPF are anticipated to be similar to those described under the Proposed Action (Alternative B). There would be the same overall number of WTGs installed (94 WTGs); however, in an effort to provide fisheries habitat impact minimization, the layout would remove potential locations from Priority Areas. Therefore, this is discussed in more detail under the presence of structures IPF, and there is not expected to be a significant difference under the anchoring, noise, port utilization, traffic, cable emplacement and maintenance, climate change or regulated fishing effort IPFs.

Presence of structures: The main differentiation between Alternative B (Proposed Action) and Alternative C-1 is the removal of 8 WTG positions from Priority Areas. The overall number of WTGs and size of the Lease Area would not change.

However, the Lease Area is in a dynamic fisheries area and it is noted to be in a transition zone between various fisheries with many FMPs are represented. There are noted differences between the areas within and immediately surrounding the Lease Area in terms of the types and quantities of fish species found. Skates and monkfish are the predominant species found, but can be found in slightly higher concentrations to the western portion of the Lease Area. However, even within that generalization, there are nuanced differences within the Lease Area, such as in Priority Area 3 there would most likely be more monkfish than skates. There are even differences within the same fishery – such as skates. There is the winged skate fishery that are larger and destined for the seafood market, and then there is a smaller skate fishery that is cut up and used as bait (NMFS 2022b).

Areas to the west and north (around Cox Ledge) would have more northeast multispecies. Lobsters are spread out and can most likely be found throughout the Lease Area. Scallops and surfclams would be more to the south and eastern portion of the Lease Area (NMFS 2022b).

Therefore, the removal of eight potential WTG locations from Priority Areas 1, 2, 3, or 4 would most likely have a beneficial effect on certain fisheries – namely monkfish, skate and surfclam/ocean quahog, as well as reducing the potential impacts to Atlantic cod spawning habitat.

Minimizing impacts to even certain select fisheries would have a beneficial impact to both commercial fisheries and for-hire recreational fishing. The extent of this benefit would depend on and vary between the many fisheries present, along with the which potential WTG locations were removed from consideration from development. In addition, commercial fishing access to the interior areas of the Lease Area would still be dependent on many factors and despite certain potential WTG locations not being developed, certain vessels may choose to not fish within the Lease Area for other reasons, while it is more likely that for-hire recreational fishing activities would occur within the Lease Area due to smaller vessels being utilized and no concerns about deployment of mobile gear.

3.14.6.3 Conceptual Decommissioning

3.14.6.3.1 Onshore Activities and Facilities

Under Alternative C-1, for the conceptual decommissioning of onshore facilities, the potential impacts to commercial fisheries and for-hire recreational fishing are anticipated to be the same as described under the Proposed Action (Alternative B).

3.14.6.3.2 Offshore Activities and Facilities

Under Alternative C-1, for the conceptual decommissioning of offshore facilities, the potential impacts to commercial fisheries and for-hire recreational fishing would be the same or very similar to those described under the Proposed Action (Alternative B). There would be the same overall number of WTGs installed (94 WTGs); however, in an effort to provide fisheries habitat impact minimization, the layout would remove potential locations from Priority Areas. Therefore, this is discussed in more detail under the presence of structures IPF under O&M. There is not expected to be a significant difference under the anchoring, noise, port utilization, traffic, cable emplacement and maintenance, climate change or regulated fishing effort IPFs.

3.14.6.4 Cumulative Impacts of Alternative C-1

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-1 to the cumulative impacts on commercial fisheries and for-hire recreational fishing would be similar to or slightly less than those described under the Proposed Action, which were noticeable to moderate, depending on the IPF.

3.14.6.5 Conclusions

Impacts of Alternative C-1

Project construction and installation, O&M, and conceptual decommissioning under Alternative C-1 could affect port and fishing access, as well as transit and harvesting activities, fishing gear interactions, and target species catch, similar to the Proposed Action (Alternative B). Alternative C-1 proposes installing the same number of WTGs as the Proposed Action (Alternative B); however, the layout would locate certain WTG positions away from Priority Areas in an effort to minimize habitat impacts. Therefore, the impacts to commercial fishing and for-hire recreational fishing would be expected to be similar to those discussed under Alternative B; however, slightly less due to the habitat minimization layout.

BOEM also anticipates that the adverse impacts of Alternative C-1 on commercial fisheries and for-hire recreational fishing would vary by fishery and fishing operation due to differences in target species abundance in the Project Area, gear type, and predominant location of fishing activity. It is conceivable that some of the small number of fishing operations that derive a large percentage of their total revenue from areas where Project facilities would be located would choose to avoid these areas once the facilities become operational. In the event that these specific fishing operations are unable to find suitable alternative fishing locations, they could experience long-term, major disruptions. However, it is estimated that the majority of vessels would only have to adjust somewhat to account for disruptions due to impacts. In addition, the impacts of Alternative C-1 could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect. Therefore, BOEM expects that the impacts resulting from Alternative C-1 would be range from **minor** to **major** for commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation.

Cumulative Impacts of Alternative C-1

In context of reasonably foreseeable environmental trends in the area, the contribution of Alternative C-1 to the adverse impacts of individual IPFs resulting from ongoing and planned activities would range from minor to moderate. Considering all the IPFs together, BOEM anticipates that the contribution of Alternative C-1 to the impacts from ongoing and planned activities would result in **major** cumulative impacts on commercial fisheries and for-hire recreational fishing because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely, even with APMs. This impact rating is primarily driven by climate change and the presence of offshore structures. The majority of offshore structures in the GAA would be attributable to the offshore wind industry. However, given the array of measures available to mitigate impacts of offshore wind projects on commercial fisheries and for-hire recreational fishing, BOEM expects that climate change would continue to be the most impactful IPFs controlling the sustainability of commercial and for-hire recreational fisheries in the area.

3.14.7 Alternative C-2 - Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions and Relocation of up to 12 WTG Positions to the Eastern Side of the Lease Area

3.14.7.1 Construction and Installation

3.14.7.1.1 Onshore Activities and Facilities

Similar to Alternative C-1, under Alternative C-2, for the construction and installation of onshore facilities, the potential impacts to commercial fisheries and for-hire recreational fishing are anticipated to be the same as described under the Proposed Action (Alternative B).

3.14.7.1.2 Offshore Activities and Facilities

Under Alternative C-2, the potential impacts from construction and installation activities to commercial fisheries and for-hire recreational fishing are anticipated to be similar to, but slightly less adverse than those described under Alternative C-1. Both Alternative C-1 and C-2 include the exclusion of up to 8 WTGs from Priority Areas and the only difference between the alternatives is the relocation of up to an additional 12 WTGs to the eastern side of the Lease Area under Alternative C-2. By relocating up to an additional 12 WTGs away from Priority Areas, it would have a benefit to the local fisheries in the area where these WTGs are being removed. This would create less obstruction and a more open area that would facilitate transiting and fishing by both commercial fishing and recreational fishing vessels because there would be fewer obstructions. Overall, this could result in an incremental improvement to overall commercial fisheries and for-hire recreational fishing industries.

3.14.7.2 Operations and Maintenance

3.14.7.2.1 Onshore Activities and Facilities

Similar to Alternative C-1, under Alternative C-2, for the O&M of onshore facilities, the potential impacts to commercial fisheries and for-hire recreational fishing are anticipated to be the same as described under the Proposed Action (Alternative B).

3.14.7.2.2 Offshore Activities and Facilities

Under Alternative C-2, the potential impacts from O&M to commercial fisheries and for-hire recreational fishing are anticipated to be similar to, but slightly less adverse than those described under Alternative C-1. Both Alternative C-1 and Alternative C-2 include the exclusion of up to 8 WTGs from Priority Areas and the only difference between the alternatives is the relocation of up to an additional 12 WTGs to the eastern side of the Lease Area under Alternative C-2. By relocating up to an additional 12 WTGs away from Priority Areas, it would have a benefit to the local fisheries in the area where these WTGs are being removed. This would create less obstruction and a more open area that would facilitate transiting and fishing by both commercial fishing and recreational fishing vessels because there would be fewer obstructions. Overall, this could result in an incremental improvement to overall commercial fisheries and for-hire recreational fishing industries.

3.14.7.3 Conceptual Decommissioning

3.14.7.3.1 Onshore Activities and Facilities

Similar to Alternative C-1, under Alternative C-2, for the conceptual decommissioning of onshore facilities, the potential impacts to commercial fisheries and for-hire recreational fishing are anticipated to be the same as described under the Proposed Action (Alternative B).

3.14.7.3.2 Offshore Activities and Facilities

Under Alternative C-2, the potential impacts from conceptual decommissioning to commercial fisheries and for-hire recreational fishing are anticipated to be similar to, but slightly less adverse than those described under Alternative C-1. Both Alternative C-1 and C-2 include the exclusion of up to 8 WTGs from Priority Areas and the only difference between the alternatives is the relocation of up to an additional 12 WTGs to the eastern side of the Lease Area under Alternative C-2. There would be the same overall number of WTGs installed (94 WTGs). The conceptual decommissioning and removal of all WTGs from the Lease Area along with associated facilities and Project features would eventually return the Lease Area to pre-existing conditions and it is presumed that there would be an overall improvement to commercial fisheries and for-hire recreational fishing industries due to the removal of structures.

3.14.7.4 Cumulative Impacts of Alternative C-2

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-2 to the cumulative impacts on commercial fisheries and for-hire recreational fishing would be similar to or slightly less than those described under the Proposed Action, which were noticeable to moderate, depending on the IPF. The relocation of up to 12 WTG positions to the eastern portion of the SRWF Lease Area for the purposes of habitat impact minimization would lessen the impacts under certain IPFs but would not substantially change the incremental contribution to cumulative impacts.

3.14.7.5 Conclusions

Impacts of Alternative C-2

Alternative C-2 would exclude up to 8 WTGs from Priority Areas and relocate up to an additional 12 WTG positions to the eastern portion of the SRWF Lease Area for the purposes of habitat impact minimization; however, the same overall number of WTGs (94) would be installed and operated. In addition, there would be no change to the onshore facilities and components. The impacts resulting from individual IPFs associated with Alterative C-2 would be similar to, but slightly less adverse than those described under Alternative C-1 (as well as Alternative B). The overall impact magnitudes under Alternative C-2 are anticipated to range from **minor** to **major** for commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation. Although impacts related to Alternative C-2 are anticipated to be slightly less adverse than Alternative B or C-1, the actual difference is dependent on many variables, as discussed above, and has not been quantified. In addition, the impacts of Alternative C-2 could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect.

Cumulative Impacts of Alternative C-2

Impacts related to Alternative C-2 combined with ongoing and planned activities would result in similar, but slightly less adverse impacts than as described in the Proposed Action (and Alternative C-1), which would range from minor to moderate. Considering all the IPFs together, BOEM anticipates that the contribution of Alternative C-2 to the impacts from ongoing and planned activities would result in **major** cumulative impacts on commercial fisheries and for-hire recreational fishing because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely, even with APMs.

3.14.8 Alternative C-3 - Reduced Layout from Priority Areas Considering Feasibility Due to Glauconite Sands

Under the Fisheries Habitat Impact Minimization Alternative C-3, the construction, O&M, and eventual decommissioning of the 11-MW WTGs and an OCS within the proposed Project Area and associated inter-array and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, Alternative C-3 was developed to address concerns regarding pile refusal due to glauconite sands in the southeastern portion of the Lease Area while still minimizing impacts to benthic and fisheries resources. Alternative C-3a, C-3b, and C-3c described in Section 3.7.8, *Benthic Resources*, consider different WTG configurations to avoid sensitive habitats and engineering constraints while still meeting the NYSERDA OREC. This alternative only considered removal of WTGs from Priority Area 1 based on consultation with NMFS. Areas with high density of boulder, complex habitat, and data suggesting Atlantic cod aggregation and spawning was considered when determining which WTGs to remove.

3.14.8.1 Construction and Installation

3.14.8.1.1 Onshore Activities and Facilities

Similar to Alternative C-1 and C-2, under Alternative C-3, for the construction and installation of onshore facilities, the potential impacts to commercial fisheries and for-hire recreational fishing are anticipated to be the same as described under the Proposed Action (Alternative B).

3.14.8.1.2 Offshore Activities and Facilities

Under Alternative C-3, the potential impacts from construction and installation activities to commercial fisheries and for-hire recreational fishing are anticipated to be similar to, but slightly less adverse than those described under Alternative C-1 and C-2. Both Alternative C-1 and C-2 include more potential WTGs than Alternative C-3, and therefore, the reduction in potential WTGs would have a slight benefit to local fisheries in the area where these WTGs are being removed. In addition, the presence of glauconite sands would have an ancillary habitat impact minimization benefit as the alternative would remove WTGs from Priority Areas 2 and 3, as well as Priority Area 1 for Alternative C-3c. The south and eastern portion of the Lease Area (i.e., Priority Area 3) has a higher potential for scallops and surfclams; and therefore, could have a benefit on those particular species and fishing for those species. This would create less obstruction and a more open area that would facilitate transiting and fishing by both commercial fishing and recreational fishing vessels because there would be fewer obstructions. Overall, this could result in an incremental improvement to overall commercial fisheries and for-hire recreational fishing industries.

Alternative C-3a includes up to 87 WTGs, Alternative C-3b includes up to 84 WTGs, and Alternative C-3c includes 80 WTGs, and the potential impacts would reduce incrementally based on the number of WTGs; however, the overall impact conclusions would remain the same.

3.14.8.2 Operations and Maintenance

3.14.8.2.1 Onshore Activities and Facilities

Similar to Alternative C-1 and C-2, under Alternative C-3, for the O&M of onshore facilities, the potential impacts to commercial fisheries and for-hire recreational fishing are anticipated to be the same as described under the Proposed Action (Alternative B).

3.14.8.2.2 Offshore Activities and Facilities

Under Alternative C-3, the potential impacts from O&M activities to commercial fisheries and for-hire recreational fishing are anticipated to be similar to, but slightly less adverse than those described under Alternative C-1 and C-2. Both Alternative C-1 and C-2 include more potential WTGs than Alternative C-3, and therefore, the reduction in potential WTGs would have a slight benefit to local fisheries in the area where these WTGs are being removed. In addition, the presence of glauconite sands would have an ancillary habitat impact minimization benefit as the alternative would remove WTGs from Priority Areas 2 and 3 as well as Priority Area 1 for Alternative C-3c. The south and eastern portion of the Lease Area (i.e., Priority Area 3) has a higher potential for scallops and surfclams; and therefore, could have a benefit on those particular species and fishing for those species. This would create less obstruction and a more open area that would facilitate transiting and fishing by both commercial fishing and recreational fishing vessels because there would be fewer obstructions. Overall, this could result in an incremental improvement to overall commercial fisheries and for-hire recreational fishing industries.

Alternative C-3a includes up to 87 WTGs, Alternative C-3b includes up to 84 WTGs, and Alternative C-3c includes 80 WTGs, and the potential impacts would reduce incrementally based on the number of WTGs; however, the overall impact conclusions would remain the same.

3.14.8.3 Conceptual Decommissioning

3.14.8.3.1 Onshore Activities and Facilities

Similar to Alternative C-1 and C-2, under Alternative C-3, for the conceptual decommissioning of onshore facilities, the potential impacts to commercial fisheries and for-hire recreational fishing are anticipated to be the same as described under the Proposed Action (Alternative B).

3.14.8.3.2 Offshore Activities and Facilities

Under Alternative C-3, the potential impacts from conceptual decommissioning activities to commercial fisheries and for-hire recreational fishing are anticipated to be similar to, but slightly less adverse than those described under Alternative C-1 and C-2. Both Alternative C-1 and C-2 include more potential WTGs than Alternative C-3, and therefore, the reduction in potential WTGs would have a slight benefit to local fisheries in the area where these WTGs are being removed. In addition, the presence of glauconite sands would have an ancillary habitat impact minimization benefit as the alternative would remove WTGs from Priority Areas 2 and 3 as well as Priority Area 1 for Alternative C-3c. The south and eastern portion of the Lease Area (i.e., Priority Area 3) has a higher potential for scallops and surfclams; and therefore, could have a benefit on those particular species and fishing for those species. This would create less obstruction and a more open area that would facilitate transiting and fishing by both commercial fishing and recreational fishing vessels because there would be fewer obstructions. Overall, this could result in an incremental improvement to overall commercial fisheries and for-hire recreational fishing industries.

Alternative C-3a includes up to 87 WTGs, Alternative C-3b includes up to 84 WTGs, and Alternative C-3c includes 80 WTGs, and the potential impacts would reduce incrementally based on the number of WTGs; however, the overall impact conclusions would remain the same.

3.14.8.4 Cumulative Impacts of Alternative C-3

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-3 to the cumulative impacts on commercial fisheries and for-hire recreational fishing would be similar to but slightly less than those described under the Proposed Action, which were noticeable to moderate, depending on the IPF. The removal of between 7 and 14 WTGs positions, primarily in the southern and eastern portion of the SRWF Lease Area for the purposes of avoiding glauconite sands would lessen the impacts under certain IPFs but would not substantially change the incremental contribution to cumulative impacts.

3.14.8.5 Conclusions

Impacts of Alternative C-3

Alternative C-3 would remove between 7 and 14 WTGs primarily in the southern and eastern portion of the SRWF Lease Area for the purposes of avoiding glauconite sands. In addition, there would be no change to the onshore facilities and components. The impacts resulting from individual IPFs associated with Alternative C-3 would be similar to, but slightly less adverse than those described under Alternative C-1, C-2 (as well as Alternative B) due to less overall WTGs being installed. Therefore, there would be less disturbance and less structures that would produce potential impacts. The overall impact magnitudes under Alternative C-3 are anticipated to range from **minor** to **major** for commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation. Although impacts related to Alternative C-3 are anticipated to be slightly less adverse than Alternatives B, C-1 and C-2, the actual difference is dependent on many variables, as discussed above, and has not been quantified. In addition, the impacts of Alternative C-3 could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect.

However, the overall reduction in the number of WTGs that would be installed and operated would result in a slight incremental reduction in impacts to commercial fisheries and for-hire recreational fishing, depending on the IPF.

Cumulative Impacts of Alternative C-3

Impacts related to Alternative C-3 combined with ongoing and planned activities would result in similar, but slightly less adverse impacts than as described in the Proposed Action (and Alternatives C-1 and C-2), which would range from minor to moderate. Considering all the IPFs together, BOEM anticipates that the contribution of Alternative C-3 to the impacts from ongoing and planned activities would result in **major** cumulative impacts on commercial fisheries and for-hire recreational fishing because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely, even with APMs.

3.14.9 Comparison of Alternatives

As noted above, most alternatives alone are similar in terms of the level of impact on commercial fisheries and for-hire recreational fishing. The relocation of WTG positions associated with Alternatives C-1 and C-2 could have fewer adverse impacts to certain fisheries and fishing operations that utilize those portions of the Lease Area. In addition, Alternative C-3 includes a reduction of 7 to 14 WTGs that would be installed and operated, which would have an additional reduction in adverse impacts to certain fisheries and fishing operations. Despite these slightly varied impacts across alternatives and sub-alternatives, BOEM anticipates that impacts to commercial fisheries would range from adverse **minor** to **major** across all evaluated action alternatives depending on the fishery and fishing operation. For for-hire recreational fishing, BOEM anticipates the impacts would range from **minor** to **moderate** across all evaluated action alternatives. These adverse impacts for both commercial fisheries and for-hire recreational fishing are primarily due to the disruption during project activities and the presence of structures that could displace certain fishing operations. There could also be a long-term **minor beneficial** for recreational fishing due to the artificial reef effect. Table 3.14-24 provides a comparison for each alternative, discussed individually for commercial fisheries and for-hire recreational fishing.

Table 3.14-24. Comparison of Alternative Impacts on Commercial Fisheries and For-Hire Recreational Fishing

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility Due to Glauconite Sands (Alternative C-3)
No Action Alternative: BOEM anticipates that the impacts of ongoing activities on commercial fisheries would be **minor** to **major** and on for-hire recreational fishing would be **minor** to **moderate**, depending on the fishery or fishing operation. The major impact rating for some fisheries and fishing operations is primarily driven by regulated fishing effort and climate change associated with ongoing activities. The impacts could also include long-term **minor** **beneficial** impacts for certain commercial fisheries and some for-hire recreational fishing operations, due to the artificial reef effect. *Cumulative Impacts of the No Action Alternative:* BOEM anticipates that the cumulative impact of the No Action Alternative would result in a **minor** to **major** adverse impact on commercial fisheries and **minor** to	*Proposed Action*: In the event that these specific fishing operations are unable to find suitable alternative fishing locations, they could experience long-term, major disruptions. However, it is estimated that the majority of vessels would only have to adjust somewhat to account for disruptions due to impacts. Therefore, BOEM expects that the impacts resulting from the Proposed Action would be range from **minor** to **major** on commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation. In addition, the impacts of the Proposed Action could include long-term, **minor** **beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect. *Cumulative Impacts of the Proposed Action:* In the context of reasonably	*Alternative C-1*: BOEM expects that the impacts resulting from Alternative C-1 would be range from **minor** to **major** for commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation. In addition, the impacts of Alternative C-1 could include long-term, **minor** **beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect. *Cumulative Impacts of Alternative C-1*: In context of reasonably foreseeable environmental trends in the area, the contribution of Alternative C-1 to the cumulative impacts of individual IPFs resulting from ongoing and planned activities would range from minor to moderate. Considering all the IPFs together, BOEM anticipates that the contribution of	*Alternative C-2*: The impacts resulting from individual IPFs associated with Alterative C-2 would be similar to, but slightly less adverse than those described under Alternative C-1 (as well as Alternative B). The overall impact magnitudes under Alternative C-2 are anticipated to range from **minor** to **major** for commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation. Although impacts related to Alternative C-2 are anticipated to be slightly less adverse than Alternative B or C-1. In addition, the impacts of Alternative C-2 could include long-term, **minor** **beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect. *Cumulative Impacts of Alternative C-2*: Impacts related to Alternative C-2 combined with	*Alternative C-3*: The impacts resulting from individual IPFs associated with Alterative C-3 would be similar to, but slightly less adverse than those described under Alternative C-1 and C-2 (as well as Alternative B). The overall impact magnitudes under Alternative C-3 are anticipated to range from **minor** to **major** for commercial fishing and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing operation. Although impacts related to Alternative C-3 are anticipated to be slightly less adverse than Alternatives B, C-1 and C-2, the actual difference is dependent on many variables, as discussed above, and has not been quantified. In addition, the impacts of Alternative C-3 could include long-term, **minor** **beneficial** impacts for some for-hire recreational fishing

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility Due to Glauconite Sands (Alternative C-3)
moderate adverse impacts on for-hire recreational fishing. This impact rating would primarily result from future fisheries use and management, the increased presence of offshore structures and climate change. The impacts could also include long-term **minor** to **moderate beneficial** impacts for certain commercial fisheries and some for-hire recreational fishing operations due to the artificial reef effect.	foreseeable environmental trends in the area, the contribution of the Proposed Action to the cumulative impacts of individual IPFs resulting from ongoing and planned activities would result in **major** adverse impacts on commercial fisheries and for-hire recreational fishing. This is because some commercial fishing and for-hire recreational fishing operations would experience substantial disruptions indefinitely, even with APMs.	Alternative C-1 to the impacts from ongoing and planned activities would result in **major** impacts on commercial fisheries and for-hire recreational fishing. This is because some commercial fishing and for-hire recreational fishing operations would experience substantial disruptions indefinitely, even with APMs.	ongoing and planned activities would result in similar, but slightly less adverse cumulative impacts than as described in the Proposed Action (and Alternative C-1), which would range from minor to moderate. Considering all the IPFs together, BOEM anticipates that the contribution of Alternative C-2 to the cumulative impacts from ongoing and planned activities would result in **major** impacts on commercial fisheries and for-hire recreational fishing. This is because some commercial fishing and for-hire recreational fishing operations would experience substantial disruptions indefinitely, even with APMs.	operations due to the artificial reef effect. *Cumulative Impacts of Alternative C-3*: Impacts related to Alternative C-3 combined with ongoing and planned activities would result in similar, but slightly less adverse impacts than as described in the Proposed Action (and Alternatives C-1 and C-2). Considering all the IPFs together, BOEM anticipates that the cumulative impacts from ongoing and planned activities would result in **major** adverse impacts on commercial fisheries and for-hire recreational fishing. This is because some commercial fishing and for-hire recreational fishing operations would experience substantial disruptions indefinitely, even with APMs.

3.14.10 Summary of Impacts of the Preferred Alternative

BOEM has identified Alternative C-3b as the Preferred Alternative as depicted in Figure 2.1-10. Alternative C-3b would include installation of up to 84 WTGs, which is 10 fewer WTGs than the maximum WTGs proposed under the PDE of the Proposed Action. As a result, it is expected that there would be a disruption to commercial fisheries and for-hire recreational fishing vessels during construction, O&M and conceptual decommissioning. The amount of disruption and impact would vary based upon several factors but could include long-term major disruptions to certain operators; however, it is expected that the majority of vessels would only need to adjust somewhat to account for these disruptions. There could be long-term, **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect. Overall, BOEM expects that the impacts resulting from Alternative C-3b would be **minor** to **major** on commercial fishing, but less than that of the Proposed Action (Alternative B) and **minor** to **moderate** on for-hire recreational fishing.

3.14.11 Proposed Mitigation Measure

The mitigation measures listed in Table 3.14-25 are recommended for inclusion in the Preferred Alternative.

Table 3.14-25. Proposed Mitigation Measures: Commercial Fisheries and For-Hire Recreational Fishing

Measure	Description	Effect
Compensation for gear loss and damage	The Lessee shall implement a gear loss and damage compensation program consistent with BOEM's draft guidance for Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR 585 or as modified in response to public comment.	This measure would reduce negative impacts from gear loss.
BOEM-Proposed Fisheries Mitigation Measure	No later than 1 year after the approval of the COP, the Lessee shall establish a compensation / mitigation fund (Fund) consistent with BOEM's draft[1] Guidance for Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf. The Fund would compensate commercial and for-hire recreational fishermen for loss of income due to unrecovered economic activity resulting from displacement from fishing grounds due to project construction and operations and to shoreside businesses for losses indirectly related to the Project. For losses to commercial and for-hire recreational fishermen, the Fund shall be based on the revenue exposure for fisheries based out of ports listed in Table 3.14-9. For losses to shoreside businesses, the Lessee shall analyze the impacts to shoreside seafood businesses nearby ports listed in Table 3.14-9. Shoreside business impacts may include (but are not limited to): • Fishing gear suppliers and repair services; • Vessel fuel and maintenance services; • Ice and bait suppliers; • Seafood processors and dealers; and • Wholesale distributors.	If adopted, this measure would reduce negative impacts associated with revenue exposure for commercial and for-hire recreational fishermen, as well as shoreside businesses impacted indirectly by the project.

Measure	Description	Effect
	The Lessee will be required to provide BOEM their analysis (including any model outputs, such as an IMPLAN model or other economic report) verifying the exposed impacts to shoreside businesses and services. 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 a 45-day review and comment period at least 90 days prior to establishment of the Fund. The Lessee must resolve all comments on the report to BOEM's satisfaction before implementation of the Fund. 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. *[1] Draft Guidance shall be superseded by final Guidance, if final Guidance is published by the Project Record of Decision.*	
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.	This measure would reduce the risk of gear damage or loss associated with cable protection measures.

Measure	Description	Effect
Boulder Relocation Plan	Prior to inter-array cable corridor preparation and cable installation (e.g., boulder relocation, pre-cut trenching, cable crossing installation, cable lay and burial) and foundation site preparation (e.g., scour protection installation), Sunrise Wind would provide BOEM with a boulder relocation plan for implementation. The plan would include the following: • Identification of areas of active (within last 5 years) bottom trawl fishing, areas where boulders >2 m in diameter are anticipated to occur, and areas where boulders are expected to be relocated for project purposes. • Methods to minimize the quantity of seafloor obstructions from relocated boulders in areas of active bottom trawl fishing, as identified in #1, as technically or economically feasible. • Identification of locations of boulders that would be moved and approximately where they would be place, method(s) for moving boulders, and measures to minimize impacts as technically and economically feasible. • Outreach conducted regarding the boulder relocation plan (e.g., notifications to mariners).	This measure would reduce impacts on habitat of species targeted in fisheries and reduce the risk of gear damage or loss associated with relocated boulders.

[1] Draft Guidance shall be superseded by final Guidance, if final Guidance is published by the Project ROD.

3.14.11.1 Effect of Measures Incorporated into the Preferred Alternative

The mitigation measures listed in Table 3.14-25 are recommended for inclusion in the Preferred Alternative. These include compensation for gear loss and damage, BOEM-Proposed Fisheries Mitigation Measure, mobile gear friendly cable protection measures, and a Boulder Relocation Plan. These additional mitigation measures all would provide a benefit to commercial fisheries and for-hire recreational fishing by either reducing risk of gear interaction with introduced structures (i.e., cables or relocated boulders) and/or compensation related to direct and indirect losses as a result of the construction and operation of the Sunrise Wind Project. These measures, if adopted, would have the effect of further reducing the overall impact from the Proposed Action; however, the impact from the Proposed Action would remain **minor** to **major** for commercial fisheries and **minor** to **moderate** for for-hire recreational fishing operations, depending on the fisher or fishing operation being considered.

3.15 Cultural Resources

This section evaluates the potential impacts on cultural resources from the Proposed Action, alternatives, and future offshore wind activities in the geographical analysis area (Appendix D, Figure D-12). Cultural resources include a wide variety of heritage resources defined in federal laws, such as NEPA and the NHPA, and Executive Orders. Based on the definitions provided in the NEPA, NHPA, and their respective implementing regulations, for the purpose of this analysis, cultural resources have been divided into three broad categories: terrestrial and marine archaeological sites, historic above-ground resources, and Traditional Cultural Properties (TCPs).

Terrestrial and marine archaeological sites are areas where past human activity has occurred and contain the physical remains of past human activity (e.g., artifacts). Examples of terrestrial archaeological sites include the remains of a pre-contact Native American village site or a post-contact grist mill ruin. Marine archaeological sites include shipwrecks, downed aircraft, or submerged pre-contact Native American sites on the OCS. Historic above-ground resources include districts, buildings, structures, objects, and sites possessing historic or architectural significance. TCPs are places, landscape features, or locations associated with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community.

Both NEPA and the NHPA require Federal agencies to "stop, look, and listen" before making decisions that could negatively impact cultural resources (CEQ and ACHP 2013). NEPA requires Federal agencies to assess the impacts or effects of a proposed Federal action to the human environment, including historic and cultural effects/impacts (40 *CFR* 1500-1508). Historic and cultural impacts/effects are assessed by determining the significance of potential impacts to cultural resources. Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on historic properties (36 *CFR* 800.1). BOEM has determined that approval, approval with modification, or disapproval of the Sunrise Wind Project constitutes an undertaking as defined in 36 *CFR* 800.16 (y) and is therefore subject to an NHPA Section 106 review. For the purposes of the NHPA Section 106 review, the undertaking is defined as a combination of NEPA Alternative B (the Proposed Action), and the Fisheries Habitat Impact Minimization Alternative C. A detailed description of the Proposed Action and Alternatives can be found in Section 2.1.

For the purposes of Section 106 of the NHPA, historic properties are defined as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (NRHP), including artifacts, records, and remains that are related to and located within such properties and properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization that meet the National Register criteria (36 *CFR* 800.16 [l][1]). To be listed in or eligible for listing in the NRHP, a property must meet criteria of age and significance and also retain sufficient integrity to convey its significance. Generally, a cultural resource must be 50 years of age or older to be considered for NRHP eligibility and must meet one or more of the National Register Criteria for Evaluation A through D:

- Criteria A: That are associated with events that have made a significant contribution to the broad patterns of our history; or
- Criteria B: That are associated with the lives of significant persons in our past; or

- Criteria C: That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- Criteria D: That have yielded or may be likely to yield, information important in history or prehistory.

In addition to meeting the age and significance criteria, a property must also retain sufficient historic integrity to convey its significance. A property's integrity is based on the property's physical features and how they relate to the property's significance. Integrity is characterized in seven aspects: association, location, setting, feeling, design, materials, and workmanship. A property does not need to retain high levels of integrity in every aspect, but rather those aspects that are key to conveying its significance.

Both the implementing regulations for NEPA (40 *CFR* 1500-1508) and the NHPA (36 *CFR* 800) encourage federal agencies to integrate/coordinate NEPA and NHPA compliance reviews and consultations. 36 *CFR* 800.8 I authorizes federal agencies to use the procedures and documentation required for the preparation of an EIS and ROD to comply with Section 106 in lieu of the procedures in 36 *CFR* 800.3 through 800.6 of the Section 106 regulations (i.e., Initiation of the Section 106 Process, Identification of Historic Properties, Assessment of Adverse Effects, and Resolution of Adverse Effects). This process, referred to as the "NEPA substitution process" allows certain NEPA process, meetings, and documentation to substitute for various aspects of review otherwise required under the NHPA.

In the Notice of Intent (NOI) to Prepare an EIS for the proposed Sunrise Wind Project on the northeast Atlantic OCS (86 *FR* 48763), BOEM stated it had chosen to use the NEPA substitution process to fulfill its obligations under the NHPA. This decision was taken to improve the efficiency of its reviews, promote transparency and accountability, and support a broadened discussion of potential effects that a project could have on the human environment. As a result, this section and Appendices H, J, and O are intended to fulfill the majority of BOEM's NHPA Section 106 compliance responsibilities for documentation under 36 *CFR* 800.8(c), including the following:

- The definition of the undertaking and its APEs;
- A description of the steps taken to identify historic properties;
- A description of the affected historic properties, including information on the characteristics that qualify them for the National Register of Historic Places;
- A discussion of the undertaking's effects on historic properties;
- An explanation of why the criteria of adverse effect were found applicable or inapplicable; and
- Future actions to avoid, minimize, or mitigate adverse effects on historic properties.

3.15.1 Description of the Affected Environment and Future Baseline Conditions

The cultural resources NEPA affected environment is defined in terms of the existing cultural resources that could be affected by the Proposed Action as well as the alternatives. A description of the Proposed Action and Alternatives can be found in Section 2.1 of this document. The geographic area analyzed (Appendix D, Figure D-12) to identify existing cultural resources for the NEPA review, the affected environment, is equivalent to the proposed Project APEs. 36 *CFR* 800.16(d) defines the APE as "the geographic area or areas within which an undertaking may directly or indirectly cause alteration in the character or use of historic properties, if any such properties exist." Based on this definition, BOEM (2020) has defined three APEs for offshore renewable energy projects:

- Terrestrial APE: the depth and breadth of terrestrial areas potentially impacted by any ground-disturbing activities;
- Marine APE: the depth and breadth of the seabed potentially impacted by any bottom-disturbing activities; and
- Visual APE: the viewshed from which renewable energy structures, whether located offshore or onshore, would be visible.

Detailed descriptions of the terrestrial, marine, and visual APEs can be found in the terrestrial archaeological resource assessment (COP, Appendices S1 [EDR 2021b] and S2 [EDR 2023a]), marine archaeological resources assessment (COP, Appendix R; RCG&A 2023) and historic resources visual effects assessment (COP, Appendices T [EDR 2023b] and U [EDR 2021a]) submitted as part of the Sunrise Wind COP.

The significance of cultural resource types is best understood and evaluated within their regional cultural-historical context. Table 3.15-1 provides a summary of the pre-Contact and post-Contact cultural-historical context of southern New England and Long Island.

Table 3.15-1. Southern New England Cultural Context

Period	Description
Paleoindian Period (prior to 10,000 B.P.)	Earliest scientifically documented evidence of human occupation of southern New England. Small highly nomadic family groups of hunter-gatherers inhabited both southern New England and portions of the Outer Continental Shelf which were exposed land at this time due to lower sea levels associated with the last Ice Age.
Archaic Period (10,000-3,000 B.P.)	The Archaic Period is typically divided into three sub-periods: Early (10,000–8,000 B.P.), Middle (8,000–6,000 B.P.), and Late Archaic (6,000–3,000 B.P.). During the Early Archaic, archaeological evidence suggests populations in southern New England continued to practice a highly mobile, nomadic hunter-gather lifestyle. During the Archaic Period, the climate shifted toward modern conditions, becoming more stable and reducing the need for Archaic peoples to be as mobile as their Paleoindian ancestors evidenced by an increase in semi-nomadic settlements concentrated on locations near tidal bays and the increased shellfish procurement. A Middle Archaic expansion of site distributions throughout Rhode Island and Massachusetts suggests a large population increase during this period. The Late Archaic marked by stabilization in both sea level rise and climate, which aided the development of social structures suggested by the repeated reoccupying of site locations. Archaeologists believe tribal-level societies emerged at this time with a capacity for labor organization and long distance trade.
Woodland Period (3,000-400 B.P.)	The Woodland/Ceramic period is traditionally marked by the adoption of ceramic technology, evidence of small-scale horticultural activities, the establishment of sedentary life, including palisaded and un-palisaded villages, and increased sociocultural complexity and ceremonialism. The archaeological record suggests increasing site density and presumably population through the Woodland period. Late Woodland peoples actively exploited riverine ecosystems and waterways and were skilled seafarers. Native American oral traditions demonstrate that the Tribes relied heavily on the Atlantic

Period	Description
	Ocean, numerous rivers, and small tributaries for seafood and trade. The coastal waters surrounding southern New England, and the passage between Block Island and Martha's Vineyard, was heavily used and revered by Native Americans. Local marine resources remained important to local peoples even after the introduction of crops such as maize, beans, and squash during the Late Woodland.
European Exploration (A.D. 1000-1692)	Viking settlement in Newfoundland, Canada at L'Anse aux Meadows in A.D. 1021. Concerted European exploration of the waters off the coast of southern New England in the mid-16th through 17th centuries. The Native American population was drastically reduced during the early seventeenth century as European fisherman introduced diseases that spread throughout the indigenous populations. Europeans began to colonize southern New England in the first half of the seventeenth century. The Dutch established a trading post at Bourne in the early 1620s, and the English followed suit at Plymouth. These were followed by settlements at Barnstable (1638), Yarmouth (1639), and Eastham (1644). In the late seventeenth and early eighteenth centuries, merchants along the Cape Cod region of Massachusetts sold fish across the Atlantic in Europe, as well as down the coast and in the West Indies.
European Colonial Period (A.D. 1692-1775)	New towns were founded during the eighteenth century southern New England due to the expanding maritime economy based on fishing, whaling, and coastal trading. Commercial fishing, and the production and distribution of dried Atlantic cod was the single most valuable export in New England between 1768 and 1772. Maritime traffic connected the seaside towns of the region with Salem, Boston, Newport, and New York. European colonization of interior New England progressed throughout the period resulting in the removal, forced migration, and/or extermination of Native American populations across the region. European colonial powers fought numerous wars in North America during the 18th century, culminating in the Seven Years' War between England, France, and their respective colonies.
Early National Period (A.D. 1775-1815)	The period is marked by the American Revolution (1775-1783) which ended English colonial rule in southern New England and led to the founding of the United States of America. At the beginning of the American Revolutionary War, the British blockaded Massachusetts Bay, which forced blockade running by colonial privateers to transport outgoing or incoming supplies. The commercial fishery transitioned to serve the American war effort. Fishing routes became military supply lines, fishing vessels became warships, and fishermen joined the ranks of America's first navy. Following the war, the maritime economy expanded to include more land-based industries, such as fish processing and shipbuilding, leading many inland inhabitants to abandon agriculture. Whaling came to dominate Nantucket Island from the main port of Nantucket Harbor in the late 18th through early 19th centuries. The War of 1812 disrupted maritime activity across southern New England due to British disruption of American trade and impressment of American sailors into the British Navy.
Early Industrial Period (A.D. 1815-1865)	The 19th century is marked by population growth and rapid industrialization across New England as well as the continued growth and success of maritime-related industries. Ship fitting, salt making, and whale oil processing employed many inhabitants of the region, while fishing voyages continued to operate from the ports of the region. The 19th century was also the "Golden Age" of Southern New England whaling industry with ports such as New Bedford, New London, and Nantucket the centers of the global whale oil industry. Industrial output increased during the mid-19th century and through the Civil War.

Period	Description
Late Industrial and Modern Periods (A.D. 1865-1960)	The late 19th and early 20th centuries were a period of decline in the merchant marine and whaling industries across Southern New England. In addition, American westward expansion and the rise of mid-west industrial centers precipitated a general decline in the industrial output and population of New England. The tourism industry on Martha's Vineyard, Nantucket, Cape Cod, and across southern New England expanded rapidly during the early and mid-20th century, including the recreational fishing industry and maritime tourism.

BOEM was notified that construction of onshore components was initiated by Sunrise Wind in July 2023 prior to the conclusion of required Section 106 consultation activities. A summary of the ongoing construction of onshore components was presented in the third consulting parties' Section 106 meeting in November 2023. BOEM considers the Sunrise Wind Project a federal undertaking under review by BOEM. BOEM adheres to the Section 106 regulations' definition of an undertaking: *Undertaking means a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; and those requiring a Federal permit, license or approval* (36 CFR 800.16[Y]).

3.15.1.1 Marine Cultural Resources

Sunrise Wind conducted a marine archaeological resources assessment (MARA) to identify historic properties within the APE that might be impacted by project activities (Table 3.15-2). BOEM defines the APE for the marine resources GAA (or APE for marine resources) as the depth and breadth of the seabed potentially impacted by bottom-disturbing activities. The MARA, conducted by Sunrise Wind's Qualified Marine Archaeologist (QMA), consisted of an analysis of HRG data collected by Sunrise Wind's marine survey contractor (COP, Appendix R; RCG&A 2023). The HRG survey included collection of gradiometer, side-scan sonar, sub-bottom profiler, single-channel ultra-high-resolution seismic, and multi-beam echo sounder data within submerged portions of the APE. For purposes of the MARA, the APE consisted of the SRWEC, located in both federal and NYS waters; and the SRWF located in federal waters in Lease Area OCS-A 0487 and which includes up to 94 WTGs, an OCS-DC, and IACs.

The identification of potential marine archaeological resources was further informed by the Project's geotechnical investigations, which served to characterize the surface and subsurface of the marine APE. The MARA also included the collection and analysis of geoarchaeological cores in areas of the APE that exhibited potential to yield information on submerged ancient landforms. Copies of the report, redacted to remove confidential archaeological site location information, can be found in Appendix R of the SRWF COP (RCG&A 2023).

Table 3.15-2. Summary of Marine Archaeological Investigations

Type of Investigation	Survey Report Title	Report Date	Description and Key Findings
Phase I	Phase I Marine Archaeological Resources Assessment for the Sunrise Offshore Wind Farm (SRW01) Located on the Outer Continental Shelf Block OCS-A 487, and Offshore New York. Appendix R, Sunrise Wind Project COP.	January 2022	R. Christopher Goodwin & Associates, Inc. (RCG&A) performed a marine archaeological resources assessment (MARA) of the submerged portions of the Preliminary Area of Potential Effect (PAPE). The MARA utilized geotechnical and high-resolution geophysical data collected by Fugro USA Marine, Inc. and Gardline during survey campaigns from 2019 to 2021. The MARA also included a review of shipwreck databases and previous surveys. The analysis was conducted to identify potential marine archaeological resources that might be impacted by the project.

The MARA identified eight possible historic-period marine archaeological resources through analysis of HRG data. The HRG data suggest that the eight resources are potential shipwrecks or debris fields; six are located within the SRWEC corridor and two are located within the SRWF (Table 3.15-3). The historic resources may be older than 50 years and may thus be eligible for listing in the NRHP. The MARA also identified 43 preserved ancient submerged landforms (ASLF) within the APE; 13 are located within the SRWEC corridor and 30 are located within the SRWF (Table 3.15-3)(COP, Appendix R; RCG&A 2023). The ancient submerged landforms represent landscapes that may have supported human occupation before being submerged during marine transgression. The MARA indicated that the eight historic resources and all but one ancient submerged landform could be avoided by seabed disturbance during the various phases of the Project. To avoid or minimize impacts to marine archaeological resources, the authors referenced development of a Cultural Resource Avoidance Minimization Mitigation Plan, which would include implementation of an Unanticipated Discovery Plan for any unidentified archaeological resources encountered during dredging and/or construction activities (COP, Appendix R; RCG&A 2023). For additional details on the potential marine archaeological resources identified within the marine APE, please see Schmidt et al. (2022) in Appendix R to the COP (RCG&A 2023). A MARA addendum submitted to BOEM in May 2023 recommends that the ASLF previously found unavoidable by seabed disturbance would be avoided and is no longer considered to be subject to an adverse effect. This section reflects the recommendations in the May 2023 MARA addendum.

Table 3.15-3. Marine Archaeological Resources Summary Table

Contact Number	Project Component	Resource Type	Description
ERC01	SRWEC	Potential shipwreck	Cluster of four magnetic anomalies indicative of a potential shipwreck
ERC02	SRWEC	Potential shipwreck	High amplitude, long duration dipolar magnetic anomaly indicative of a potential shipwreck
ERC03	SRWEC	Potential shipwreck	Cluster of nine magnetic anomalies and three acoustic contacts representative of a marine archaeological resource
ERC04	SRWEC	Potential shipwreck	Cluster of three magnetic anomalies and one acoustic contact indicative of a deteriorated wooden hull
ERC05	SRWEC	Debris field	Two acoustic contacts representative of a marine archaeological resource
ERC06	SRWEC	Potential shipwreck	Single acoustic contact that is indicative of a potential historic watercraft
WEA01	SRWF	Potential shipwreck	Magnetic anomaly and acoustic contact representative of a marine archaeological resource
WEA02	SRWF	Potential shipwreck	Two magnetic anomalies and two acoustic contacts representative of a marine archaeological resource
ECR_P2	SRWEC	Ancient submerged landform	Preserved levee along channel margin
ECR_P3-A	SRWEC	Ancient submerged landform	Preserved levee along channel margin
ECR_P3-B	SRWEC	Ancient submerged landform	Preserved levee along channel margin
ECR_P4-A	SRWEC	Ancient submerged landform	Preserved levee along channel margin
ECR_P4-B	SRWEC	Ancient submerged landform	Preserved levee along channel margin
ECR_P4-C	SRWEC	Ancient submerged landform	Preserved levee along channel margin
ECR_P5-A	SRWEC	Ancient submerged landform	Preserved levee along channel margin
ECR_P5-B	SRWEC	Ancient submerged landform	Preserved levee along channel margin
ECR_P5-C	SRWEC	Ancient submerged landform	Preserved levee along channel margin
ECR_P5-D	SRWEC	Ancient submerged landform	Preserved levee along channel margin
ECR-P1	SRWEC	Ancient submerged landform	Preserved levee along channel margin
ECR-P6	SRWEC	Ancient submerged landform	Preserved levee along channel margin
ECR-P7	SRWEC	Ancient submerged landform	Preserved levee along channel margin
WEA_P-01-A	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-01-B	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-01-C	SRWF	Ancient submerged landform	Preserved levee along channel margin

Contact Number	Project Component	Resource Type	Description
WEA_P-01-D	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-02-A	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-02-B	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-02-C	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-02-D	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-03-A	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-03-B	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-04	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-05	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-06	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-07	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-08	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-09	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-10	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-11	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-12	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-13-A	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-13-B	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-14	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-15	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-16	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-17	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-18	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-19	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-20	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-21	SRWF	Ancient submerged landform	Preserved levee along channel margin
WEA_P-22	SRWF	Ancient submerged landform	Preserved levee along channel margin

Source: Schmidt et al. (2022); pp. 71-90; Tables VI-1 and VI-2 in Appendix R to the COP (RCG&A 2023).

3.15.1.2 Terrestrial Archaeological Resources

Sunrise Wind conducted two terrestrial archaeological investigations in support of the Sunrise Wind Project COP submission (Table 3.15-4). Summary information about these investigations can be found in *Sunrise Wind Farm Project: Phase IA Archaeological Survey, Sunrise Wind Onshore Facilities Report*, and the *Sunrise Wind Farm Project: Phase IB Archaeological Survey, Sunrise Wind Onshore Facilities Report*. Copies of these two reports, redacted to remove confidential archaeological site location information, can be found in Appendices S1 (EDR 2021b) and S2 (EDR 2023a) of the Sunrise Wind Project COP. Sunrise Wind also assessed the potential for impacts to cultural resources in the proposed Zorn Boulevard staging/laydown and the proposed Northville Staging/Laydown areas. The results of these assessments were submitted to the NY SHPO in two separate memos.

Table 3.15-4. Summary of Terrestrial Archaeological Investigations

Type of Investigation	Survey Report Title	Report Date	Description and Key Findings
Phase IA	Sunrise Wind Farm Project: Phase IA Archaeological Survey, Sunrise Wind Onshore Facilities	December 2020	The purpose of the Phase IA archaeological survey was to determine whether previously identified terrestrial archaeological resources were located in the terrestrial archaeology Preliminary Area of Potential Effect (PAPE), and to evaluate the potential for previously unidentified terrestrial archaeological resources to be located within the PAPE. This desktop study determined that the mapped boundaries of two Native American sites overlap with portions of the PAPE and an additional 10 sites have been previously recorded within 0.25 mi (0.4 km) of the Preliminary APE: four Native American sites, four historic-period sites, and two multiple component Native American and historic-period sites.
Phase IB	Sunrise Wind Farm Project: Phase IB Archaeological Survey, Sunrise Wind Onshore Facilities	May 2022	The purpose of the Phase IB Archaeological Survey was to determine the presence or absence of previously unidentified terrestrial archaeological resources located within the Project's PAPE through infield investigations, including the excavation of 1,575 shovel test pits covering a total of 39,036 ft (11,898 m) of Linear PAPE and 40.05 ac (16.21 ha) of non-linear or "block" PAPE. One archaeological resource, Native American site EDR-SRW-001, was identified but was determined to be located outside of the PAPE. No other archaeological sites or isolated archaeological artifacts were recovered from any of the other Project locations assessed as part of the Phase IB survey. Site EDR-SRW-001 would not be disturbed by Onshore Facilities and no mitigation or avoidance measures are proposed, and no further archaeological work is recommended. The report recommends the project develop and implement an Unanticipated Discoveries Plan (UDP) during construction activities.
Cultural Resources Assessment	Sunrise Wind Onshore Proposed Northville Staging/Laydown Area Town of Brookhaven, Suffolk County, New York Cultural Resources Assessment	March 2023	Desktop study and Phase IB Archaeological Survey to assess potential impacts to cultural resources from the proposed use of the Northville Staging/Laydown Area to house office trailers, equipment, and materials required for construction of the OnCS. Memo submitted to the NY SHPO in accordance with the New York State Historic Preservation Act of 1980 (Section 14.09 of the New York Parks, Recreation and Historic Preservation Law). The assessment concluded that the proposed temporary use of the site as a staging/laydown area had no potential to affect archaeological resources and no potential to affect the visual setting associated with the property and, as a result, no additional cultural resources investigations were recommended. In a letter dated March 30, 2023 the NY SHPO concurred with the memo's conclusion that no historic cultural resources would be impacted.

Type of Investigation	Survey Report Title	Report Date	Description and Key Findings
Cultural Resources Assessment	Sunrise Wind Onshore Proposed Zorn Boulevard Staging/ Laydown Area Town of Brookhaven, Suffolk County, New York Cultural Resources Assessment	December 2022	Desktop study to assess the potential impacts to cultural resources from the proposed use of the Zorn Staging/Laydown Area to support daily employee muster, materials and equipment storage, field office trailers, parking, dumpsters, and portable sanitation. Memo submitted to the NY SHPO in accordance with the New York State Historic Preservation Act of 1980 (Section 14.09 of the New York Parks, Recreation and Historic Preservation Law). The assessment concluded that the proposed temporary use of the site as a staging/laydown area had no potential to affect archaeological resources and little to no potential to affect the visual setting associated with the property and, as a result, no additional cultural resources investigations were recommended. In a letter dated March 6, 2023, the NY SHPO concurred with the memo's conclusion that no historic cultural resources would be impacted.

Source: New York State Department of Public Service

The Phase IA report determined that the APE for the onshore components of the project passed through the mapped boundaries of two Native American archaeological areas, NYSM 4897 and NYSM 7550 (COP Appendix S1, Section 2.3;EDR 2021b). The preferred onshore transmission cable corridor route passed through the boundaries of NYSM 4897 while the Montauk Highway off-route variation passed through the boundaries of NYSM 7550. In New York, Native American archaeological areas are considered areas of elevated archaeological sensitivity but are not considered equivalent to a formally tested and delineated archaeological site. In both areas the proposed onshore transmission cable corridor is co-located along existing paved roadways, the William Floyd Parkway (NYSM 4897) and the Montauk Highway (NYSM 7550). Subsequent Phase IB excavations adjacent to the William Floyd Parkway within the mapped boundaries of NYSM 4897 did not recover any archaeological materials.

The Phase 1B terrestrial archaeological investigations identified one previously undiscovered archaeological site located along the Montauk Highway off-route variation within the mapped boundaries of Native American archaeological area NYSM 7550. This site, referred to as EDR-SRW-001 in the Phase 1B report, is described as a medium density Native American lithic scatter (COP, Appendix S2, Section 3.3.1; EDR 2023a). A total of 52 artifacts, consisting of 39 pieces of quartz debitage, 12 pieces of thermally altered quartz, and one quartz cobble core were recovered from shovel test pits. The report authors interpreted the site as a short-term camp where the Native American occupants produced stone tools. After the Phase 1B investigations at the site the PDE was modified to exclude the Montauk Highway off-route variation from consideration for the onshore cable route. As a result, the site is located outside SRWF terrestrial APE and would not be impacted by the construction, operation, and/or decommissioning of the proposed Project. Due to the final route selection avoiding the site, no measures to avoid, minimize, or mitigate impacts were recommended.

The report authors recommended that the SRWF Project develop and implement an Unanticipated Discovery Plan (UDP) to address any previously undiscovered archaeological resources that could be encountered during ground-disturbing activities (COP Appendix S2, Section 4.0; EDR 2023a).

In December 2022 and March 2023, Sunrise Wind conducted cultural resource assessments of the Northville and Zorn Laydown/Staging Areas. The Northville Laydown/Staging Area is a 2-ac (0.8 ha) industrial site previously cleared and graded to support various activities at the Northville Industries Holtsville fuel terminal. The Zorn Laydown/Staging Area is a 12.5-ac (5.1 ha) site located within the Caithness Long Island Energy Center previously cleared and graded to support various activities during construction of the Caithness facility. The Northville and Zorn Laydown/Staging areas would be used for employee muster, materials and equipment storage, field office trailers, parking, dumpsters, and portable sanitation during construction of onshore components. The memos recommended that temporary use of these two laydown/staging areas would not impact any previously recorded historic properties. In letters dated March 6 and 30, 2023, the NY SHPO concurred with the recommendations in the memos stating that the NY SHPO had no concerns regarding potential impacts to historic cultural resources.

3.15.1.3 Above-ground Cultural Resources

In support of the Sunrise Wind Project COP submission, Sunrise Wind conducted identification and reconnaissance surveys of known and previously recorded above-ground cultural resources within the proposed Project viewshed that might be impacted by Project activities. Summary of these investigations is found in Table 3.15-5. These surveys consisted of online (desktop) searches of architectural and historic data bases maintained by the NRHP; state historic preservation offices (SHPOs) in New York, Connecticut, Rhode Island, and Massachusetts; and statewide/local historic preservation groups and were conducted by Sunrise Wind's historic resources contractor, Environmental Design & Research, Landscape Architecture, Engineering & Environmental Services, DPC (EDR) (COP, Appendix T; EDR 2023b).

BOEM defines the APE for viewshed historic resources as the geographic areas from which the onshore and offshore Project components could be seen. The APE was established using an initial study area of one (1)-mile radius around all onshore Sunrise Wind structures and a 40-mile radius around the 122 WTGs and an OCS-DC in Lease Area OCS-A 0487 (Figure 1.3.2 of Sunrise Wind Project COP Appendix T; EDR 2023b)[28]. The 1-mile and 40-mile radii represent the maximum limit of theoretical visibility for each respective Project component. Within these radii, a viewshed analysis was completed to define all geographic areas of visibility within the onshore and offshore study areas. The viewshed model considered screening by vegetation, buildings/structures, landscape features, and the curvature of the earth to delineate those areas from which the onshore and offshore Project components could be seen.

[28] The Project's proposed alternatives include a selection of up to 94 WTGs at 102 possible positions within the Lease Area. These 122 WTGs were extrapolated from a PDE that included 122 WTGs and a single OCS-DC or 120 WTGs and three OCS-DCs, as presented in the VIA. The VIA asserts that the distinction between the counts of WTGs and OCS-DCs is not anticipated to change the overall results of the VIA in this instance. BOEM considers the evaluation of these more numerous and larger WTGs to represent a reasonable and good faith effort to identify potential effects to cultural resources and historic properties, and that analysis based on these evaluations is sufficient for the purposes of evaluating impacts to cultural resources under NEPA and adverse effects to historic properties under the NHPA because it evaluates a larger, more impactful scenario, and as such, the PAPE described in the applicable studies encompasses and exceeds the APE for the NHPA undertaking or NEPA study area.

For the offshore components, a maximum WTG blade tip height of 968 ft (295 m) above mean sea level (AMSL) (blade tips in the upright position), which represent the tallest structures of the SRWF, was used in the viewshed analysis[29]. The viewshed analysis results determined that the visual APE for the offshore components was limited to areas within the coastal mainland and islands in New York, a small portion of Connecticut, Massachusetts, and Rhode Island. For the onshore components, the tallest structures within the OnCS-DC are anticipated to be the lightning masts with a maximum height of 100 ft (30 m). The viewshed analysis determined that the visual character within the OnCS-DC APE is generally made up of a mix of high-density development, ranging from industrial to residential, and major transportation facilities, which are anticipated to significantly screen potential views of the OnCS-DC beyond 1 mi (COP, Section 4.5.1; Appendices T [EDR 2023b] and U [EDR 2021a]).

In support of the COP, EDR prepared a Historic Resources Visual Effects Analysis (HRVEA) that assesses the proposed Project's potential visual effects on the qualities that qualify above-ground historic resources for the NRHP. Desktop research conducted for the HRVEA for the WTGs and OnCS-DC identified 307 previously identified above-ground historic resources within the APE for viewshed resources. Of these 307 resources, 10 are National Historic Landmarks (NHLs), 59 are NRHP-listed districts or individual properties, 179 properties considered potential above-ground historic properties without formal designations or determinations of NRHP eligibility, and three are TCPs. The geographic breakdown for these 307 historic properties includes seven resources in New York, three in Connecticut, 147 in Massachusetts, and 150 in Rhode Island. The 307 historic properties are summarized and enumerated by state in Table 3.1-1 of the HRVEA (COP, Appendix T; EDR 2023b).

Within the 307 previously identified historic properties in the APE, Sunrise Wind internally defined nine thematic/historic property types and their settings to support the viewshed analysis. These property types can be used to determine the potential for visual effects and develop an appropriate methodology to assess visual effects. Similarities among the identified above-ground historic properties in terms of historic setting, significance, and spatial relationship to the Atlantic Ocean and surrounding landscape provided a framework by which to define these thematic property types. The nine above-ground historic property types within the APE include: (1) Native American Sites, Historic Districts, and TCPs; (2) Historic Buildings and Structures; (3) Lighthouses and Navigational Aids; (4) Recreational Properties; (5) Historic Cemeteries and Burial Grounds; (6) Maritime Safety and Defense Facilities; (7) Estates and Estate Complexes; (8) Agricultural Properties; and (9) Historic Battlefields. A description of each of the internally defined above-ground historic property types and the characteristics that may qualify each property for listing in the NRHP is included in Section 3.2 of the HRVEA (COP, Appendix T; EDR 2023b

The identification of potential historic viewshed resources was further informed by an onsite field survey and visual analysis conducted by an SOI-qualified cultural resources investigator within the 1-mile APE of the Project's onshore facilities. These facilities include the onshore transmission cable, fiber optic cable co-located with the onshore transmission and onshore interconnection cables, and an OnCS-DC. The

29 The Project's proposed alternatives include the selection of an 11 MW WTG. The 11 MW turbine was selected as the Project's nameplate wind turbine size (see Alternative Considered but dismissed from further analysis table# for rationale) and consists of a nacelle height of 459 ft (140m), a rotor diameter of 656 ft (200 m), and a maximum blade tip height of 787 ft (240 m). Visual impacts described in the Cultural Resources section consider up to 122 WTGs with a nacelle height of 574 ft (175 m), a 787 ft (240 m) rotor diameter, and a maximum blade tip height of 968 ft (295 m). The WTG specifications evaluated in the visual impact analysis reports represent the Project's original Project Design Envelope dated August 2020, which included a wider range of turbine size (8- 15 MWs) and included up to 122 WTGs.

onshore facilities would be located in the Town of Brookhaven, Suffolk County, New York. Online research identified no NRHP-listed resources and one NRHP-eligible resource in the APE, the Waverly Cemetery located 0.7 miles away from the proposed OnCS-DC site in the hamlet of Holbrook. The field survey did not identify any additional NRHP-eligible resources. A description of the field survey methodology and results of the survey for the OnCS-DC site can be found in COP Appendix U (EDR 2021a).

Table 3.15-5. Summary of Above-ground Cultural Resources Investigations

Type of Investigation	Survey Report Title	Report Date	Description and Key Findings
Desktop Analysis	Environmental Design & Research, Landscape Architecture, Engineering & Environmental Services, DPC (EDR) (2023b). Sunrise Wind Farm Project: Appendix T, Historic Resources Visual Effects Assessment. Report prepared for Sunrise Wind by Environmental Design & Research. Appendix T, Sunrise Wind Project COP.	2023	Desktop research conducted for the Historic Resources Visual Effects Analysis (HRVEA) for the WTGs and OCS-DC identified 307 previously identified above-ground historic resources within the Preliminary Area of Potential Effect (PAPE) for viewshed resources. Of these 307 resources, 10 are National Historic Landmarks (NHLs), 59 are NRHP-listed districts or individual properties, 179 properties considered potential above-ground historic properties without formal designations or determinations of NRHP eligibility, and three are Traditional Cultural Properties. The geographic breakdown for these 307 resources includes 7 resources in New York, 3 in Connecticut, 147 in Massachusetts, and 150 in Rhode Island.
Desktop Analysis, Field Reconnaissance	Environmental Design & Research, Landscape Architecture, Engineering & Environmental Services, D.P.C (EDR) (2021a). Sunrise Wind Farm Project: Appendix U, Onshore Above-ground Historic Properties Report. Report prepared for Sunrise Wind by Environmental Design & Research. Appendix U, Sunrise Wind Project COP.	2021	Desktop research conducted for the OCS-DC confirmed there are no above-ground resources listed in or determined eligible for listing in the NRHP within the 1-mile PAPE for viewshed resources. The research identified one previously identified above-ground historic resource within the 1-mile PAPE. The Waverly Cemetery, located within the hamlet of Holbrook, Town of Brookhaven has not previously been evaluated for NRHP eligibility; for the purposes of the Project, BOEM considers the Waverly Cemetery NRHP-eligible under Criterion A. An SOI-qualified professional conducted an onsite field reconnaissance survey and viewshed analysis of the PAPE for the OnCS-DC on June 17, 2020. The survey evaluated any other historic-age (50 years or older) resources located in the PAPE for potential NRHP eligibility based on their visible exterior. No additional potential historic properties were identified during the field survey.

3.15.2 Impact Level Definitions for Cultural Resources

This Final EIS uses a four-level classification scheme to analyze potential impact levels on cultural resources from the alternatives, including the Proposed Action. Table 3.15-6 lists the definitions for both the potential adverse impact levels and potential beneficial impact levels for cultural resources. Table G-14 in Appendix G identifies potential IPFs, issues, and indicators to assess impacts to cultural resources. Impacts are categorized as beneficial or adverse and may be short-term or long-term in duration. Short-term impacts may occur over a period of a year or less. Long-term impacts may occur throughout the duration of a project.

Table 3.15-6. Definition of Potential Adverse and Beneficial Impact Levels for Cultural Resources

Impact Level	Definition of Potential Adverse Impact Levels	Definition of Potential Beneficial Impact Levels
Negligible	No historic properties affected, as defined at 36 *CFR* 800.4(d)(1).	N/A
Minor	No adverse effects on historic properties could occur, as defined at 36 *CFR* 800.5(b).	N/A
Moderate	Adverse effects on historic properties, as defined at 36 *CFR* 800.5(a)(1) could occur but would be avoided or minimized using a less impactful scenario contemplated under the PDE.	N/A
Major	Adverse effects on historic properties, as defined at 36 *CFR* 800.5(a)(1) could occur; at least some would require mitigation to resolve.	N/A

The cultural resources impact levels are linked to the determination of potential adverse effects to historic properties within the affected environment for each alternative being considered. Under Section 106, a federal agency determines whether an undertaking would have no effect, no adverse effect, or an adverse effect on historic properties. To determine whether effects to historic properties are adverse or not, the lead federal agency applies the Criteria of Adverse Effects as defined in 36 *CFR* 800.5 (a) (1). An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property’s location, design, setting, materials, workmanship, feeling, or association. Consideration is given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property’s eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative.

The NHPA includes additional federal agency responsibilities in Section 110(f) when an NHL may be directly and adversely affected by an undertaking. Specifically, the head of a Federal agency shall “to the maximum extent possible, undertake such planning and actions as may be necessary to minimize harm to such landmark, and ACHP a reasonable opportunity to comment on the undertaking.”

The following sections assess the impacts of the alternatives under consideration (Alternative A-No Action Alternative; Alternative B-Proposed Action; and Alternative C-Fisheries Habitat Impact Minimization Alternative). Impacts are assessed in terms of IPFs. These IPFs identify the cause-and-effect relationships between actions and relevant cultural resources, defining the ways in which an action or activity affects cultural resources. In addition to an assessment of impacts through the analysis of specific IPFs, the following sections include summary information regarding adverse effects on historic properties from each alternative being considered. More detailed information regarding BOEM's Finding of Adverse Effect on historic properties from the Proposed Action can be found in Appendix J (*Finding of Adverse Effect for Historic Properties and Draft Memorandum of Agreement*).

3.15.3 Impacts of Alternative A - No Action on Cultural Resources

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

3.15.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for cultural resources described in Section 3.15, *Affected Environment,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities.

Ongoing offshore wind activities within the GAA that contribute to impacts on cultural resources include:

- Continued O&M of the Block Island project (5 WTGs) installed in State waters.
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of the Block Island project and ongoing construction of the Vineyard Wind 1 and South Forks projects would affect cultural resources through the primary IPFs of accidental releases, gear utilization and dredging, new cable emplacement and maintenance, climate change, port utilization, land disturbance, light, presence of structures. Ongoing offshore wind activities would have the same type of impacts from of accidental releases, gear utilization and dredging, new cable emplacement and maintenance, climate change, port utilization, land disturbance, light, presence of structures that are described in the following section for planned offshore wind activities.

Under the No Action Alternative, cultural resources would continue to be affected by regional commercial, industrial, and recreational activities. Ongoing activities within the GAA that contribute to impacts on cultural resources include ground-disturbing activities and the introduction of intrusive visual elements, while the primary sources of offshore impacts include dredging, cable emplacement, and activities that disturb the seafloor. Onshore and offshore construction activities and associated impacts are expected to continue at current trends, range in severity from minor to major, and have the potential to affect cultural resources. Other future non-Project activities other than offshore wind development that may affect cultural resources include new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS (See Appendix E for a description of ongoing and planned activities). Appendix I provides additional information on seascape, landscape, and viewer impacts associated with ongoing and planned activities.

3.15.3.2 Cumulative Impacts of the No Action Alternative

BOEM assumes that each of the reasonably foreseeable offshore wind projects would be subject to NEPA and NHPA reviews and, as a result, the project proponents would conduct terrestrial and marine archaeological and above-ground historic resource investigations to identify historic properties within their respective APEs and assess potential adverse effects. The results of these investigations, however, are not yet available. As a result, the No Action Alternative assumes that the same types of cultural resources identified within the APEs for the Proposed Action are present within the APEs of the reasonably foreseeable projects.

The following section is an assessment of the potential impacts on these types of cultural resources from reasonably foreseeable offshore wind and other ongoing developments, excluding the Proposed Action. BOEM assumes that if project-specific cultural resource investigations identify historic properties within a given undertaking's APE and determines that the project would adversely affect those historic properties, the lead federal agency for the undertaking would require the project to develop treatment plans to avoid, minimize, and/or mitigate effects in order to comply with the NHPA.

Onshore cultural resource investigations in the northeastern United States have identified a wide variety of archaeological resources, historic structures, and TCPs that could be adversely affected by development projects, including future offshore wind projects. Terrestrial archaeological resources known to occur across the region include pre-Contact Period Native American campsites, villages, resource procurement sites, and ceremonial sites. Post-contact, European-American residential, agricultural, battlefield sites, fortifications, and industrial sites dating to the 17th through 20th century sites have been found throughout the region (BOEM 2019). A wide variety of historic standing structures dating from the 17th through 20th centuries are present across the northeastern United States, including residential, commercial, military, and industrial buildings, structures, infrastructure. Potential TCPs in the region include geographic landscape features and historic locations associated with the history, cultural practices, traditions, beliefs, lifeways, arts, crafts, and/or social institutions of Native American, European-American, and other living communities (BOEM 2019).

A similarly wide variety of marine archaeological resources have been identified in the waters off the coast of the eastern United States. Pre-Contact period formerly subaerially exposed landscapes on the OCS, which likely contain Native American archaeological sites, were inundated and buried as sea levels rose at the end of the last Ice Age have been identified along much of the Atlantic coast. All the proposed offshore wind lease areas off southern New England and New York are considered to be high probability areas for containing these submerged landform features (TRC 2012). In addition to their archaeological potential, Native American Tribes and/Tribal Nations in the region have repeatedly informed BOEM that they consider these submerged landscape features to be TCP resources, due to their cultural significance as the lands once occupied by their ancestors.

Post-Contact period European-American marine cultural resources known to be present off the coast of southern New England and New York include shipwrecks, downed aircraft, and related debris fields dating to the 16th through 20th centuries. Based on known historic and modern maritime activity in the region, all of the proposed offshore wind lease areas are in areas with a high probability for containing shipwrecks, downed aircraft, and related debris fields (TRC 2012).

The sections below summarize the potential impacts of planned offshore wind activities on cultural resources during construction, O&M, and decommissioning of the projects.

3.15.3.2.1 Marine Cultural Resources

Under the No Action Alternative, impacts to marine cultural resources could result from accidental releases, vessel anchoring, gear utilization and dredging, new cable emplacement/maintenance, and the effects of climate change. Construction and installation, O&M, and conceptual decommissioning activities of reasonably foreseeable offshore projects could adversely impact potentially significant submerged cultural resources. However, offshore energy developers are required by federal law to conduct cultural resource surveys and assess impacts to potential submerged cultural resources in areas of proposed seafloor disturbance. Based on the results of those surveys and assessments, future offshore wind activities could be designed to avoid impacting known submerged cultural resources or minimize impacts to varying degrees. Repeated or multiple impacts from a combination of reasonably foreseeable offshore projects to submerged cultural resources, or the larger submerged landforms within which they are identified, would result in cumulative impacts to these resources. Under the No Action Alternative, reasonably foreseeable future projects could result in minor to major impacts to these marine cultural resources. Offshore wind activities may affect marine cultural resources through the following primary IPFs.

Accidental releases: Submerged cultural resources could be impacted by accidental releases of fuel, fluids, and hazardous materials, as well as trash and debris. The No Action Alternative assumes the development of adjacent offshore wind farms, construction of which may result in accidental releases that impact cultural resources within the geographical area of analysis. However, most releases would not measurably contribute to resource impacts because of the low probability of occurrence, low persistence time, and EPMs implemented to prevent releases. Although not expected, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale impacts on marine archaeological resources.

Anchoring: Anchoring associated with ongoing commercial or recreational marine activities and development of offshore wind projects could cause adverse impacts on marine archaeological resources. Deploying and repositioning anchors and seafloor gear with associated wire rope, cable, and chain could impact the bottom surface and potentially disturb shipwrecks and other marine archaeological resources resulting in the irreversible loss of historical and archaeological data. BOEM estimates that development of offshore wind along the OCS along the eastern United States would result in 7,494 ac (3,032 ha) of seafloor disturbance due to anchoring activities, 943 ac (381 ha) would be disturbed within the cultural GAA.. Although BOEM would be able to employ EPMs for future offshore wind projects, the potential for permanent, minor to major impacts on submerged cultural resources to result from future commercial and/or recreational activities through anchoring remains.

Gear utilization and dredging: Gear utilization and dredging activities could similarly impact marine resources. The damage or destruction of submerged archaeological sites or other underwater cultural resources from these activities would result in the permanent and irreversible loss of scientific or cultural value and would be considered major impacts. The scale of impacts on shipwreck and debris field cultural resources would depend on the number of wreck and debris field sites within the offshore wind lease areas. The potential for impacts would be mitigated, however, by existing federal and state requirements to identify and avoid marine cultural resources. Specifically, as part of its compliance with the NHPA, BOEM requires offshore wind developers to conduct geophysical remote-sensing surveys of proposed development areas to identify cultural resources and implement plans to avoid, minimize, or mitigate impacts on these resources. As a result, impacts on marine cultural resources from gear utilization and dredging are considered unlikely and would only affect a small number of individual marine cultural resources if they were to occur, resulting in long-term, localized, adverse impacts. The scale of any impacts on individual resources (the proportion of the resource damaged or removed) would vary on a case-by-case basis and could range from minor to major.

New cable emplacement/maintenance: New offshore cable placement may impact marine resources within the geographical area of analysis. In addition to general horizontal acreage of seabed disturbance, the extent of potential impacts to marine resources increases with depth of disturbance into the seabed. Installation of new cables in conjunction with development of adjacent offshore wind farms could result in up to 1,108 ac (448 ha) of seabed disturbance from export and inter-array cable trenching. Additionally, reasonably foreseeable offshore wind projects located in adjacent offshore wind farms would add an estimated 1,000 in-water structures with foundations in the seabed. As described herein and Appendix E, the Lease Area and the APE for marine resources contain a number of shipwrecks, related debris fields, and ancient submerged landform features, which future offshore construction activities could impact. BOEM and relevant SHPOs would require projects to avoid known resources through the creation of avoidance buffers around identified shipwrecks or remote-sensing magnetic anomalies or acoustic targets that could represent shipwreck resources. These measures would avoid or minimize impacts to submerged cultural resources. However, in some cases, the number, extent, and dispersed character of ancient submerged landform features could make avoidance impossible. Consequently, offshore construction could result in permanent, minor to major impacts on sensitive ancient submerged landform features, if present.

Climate change: Factors related to climate change, including sea level rise, increased storm severity/frequency, increased sedimentation and erosion, and ocean acidification, could also result in long-term and permanent impacts on cultural resources. Some archaeological sites on the OCS have already experienced the effects of climate change because they were inundated when the last ice age ended (TRC 2012). Ocean acidification could accelerate the rate of decomposition and corrosion of shipwrecks, aircraft, and other marine archaeological resources on the seafloor. Conversely, the incremental contribution of offshore wind energy projects on reducing global warming and climate change related impacts could help minimize these climate change impacts.

3.15.3.2.2 Terrestrial Archaeological Resources

Under the No Action Alternative, impacts to terrestrial archaeological resources could result from ground-disturbing activities associated with port utilization/expansion projects, land disturbance as part of onshore construction activities, and climate change. Offshore wind activities may affect terrestrial archaeological resources through the following primary IPFs.

Port utilization/expansion: Ports along the east coast of the United States are being expanded and/or modified for a variety of reasons including to support the offshore wind industry. Major regional commercial hubs are being enlarged to accommodate increasing vessel traffic and larger vessel sizes as the maritime shipping industry adapts to ever expanding global supply chains. These larger ports as well as smaller, local port facilities may be expanded or modified to support a variety of maritime industry and projects such as 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; and fisheries use and management (BOEM 2019). Ports are also going through continual upgrades and maintenance such as building maintenance, demolition, building new structures, and dredging waterways to maintain port access or increase the size of vessels able to access the port. Without the development of the offshore wind industry, port expansion would follow historic trends and continue at current rates with major regional shipping ports expanding while development at smaller ports would remain static or be redeveloped for alternative uses (residential, commercial, industrial, etc.) (BOEM 2019).

The development of the offshore wind industry along the east coast of the United States has led to the proposed expansion and/or redevelopment of a number of small, medium, and large ports to support and attract the offshore wind industry. The Sunrise Wind COP indicates that ports such as the ports of Albany and Coeymans, NY; Port of New London, CT; Port of Davisville-Quonset Point, RI; Port of Providence, RI; Port of New Bedford, MA; Sparrows Point, MD; and the Port of Norfolk, VA are all undergoing some form of port expansion or modification to support the construction and operation of offshore wind facilities (COP Section 3.5.5; Sunrise Wind 2023a). Ground-disturbing activities associated with new construction or site redevelopment during port expansion projects could result in impacts to terrestrial archaeological resources and TCPs.

BOEM assumes that any port expansions to support ongoing actions or future offshore wind projects would adhere to applicable state and federal regulations for evaluating and addressing impacts on cultural resources. If historic properties are present and would be adversely affected by these projects, compliance with state and federal cultural laws and regulations would require the development of plans to avoid, minimize, and/or mitigate impacts to cultural resources, reducing the level of potential impacts. As a result, ongoing port expansion projects, both for ongoing activities and the development of the offshore wind industry, would likely result in a range of impacts, from no historic properties affected to adverse effects to historic properties requiring mitigation. As a result, BOEM anticipates that ongoing or offshore wind driven port expansion activities would result in impacts on localized, long-term, negligible to major impacts on terrestrial cultural resources.

Land disturbance/onshore construction: Onshore construction activities associated with residential, commercial, military and/or infrastructure development or redevelopment can impact archaeological and TCP resources by physically disturbing and/or removing resources. Without the development of the offshore wind industry, BOEM anticipates that onshore construction would follow historic trends and continue at current rates. Construction of the onshore components of offshore wind projects, such as underground or above-ground electrical transmission cables, DC/AC converter stations, interconnection points, substations, etc., could result in impacts on previously recorded and/or undiscovered cultural resources. The number of cultural resources and/or historic properties impacted, the scale and extent of impacts, and the severity of impacts would depend on the location of specific project components relative to recorded and undiscovered cultural resources and the scale and extent of direct impacts.

BOEM assumes that compliance with applicable state and federal requirements to identify, assess, avoid, and/or mitigate impacts on cultural resources as part of NEPA and the NHPA would limit the extent and scale of impacts on cultural resources. BOEM assumes that ongoing and future offshore wind construction activities would be subject to existing federal and state requirements to identify cultural resources, assess impacts/adverse effects, and implement measures to avoid, minimize, and/or mitigate impacts/adverse effects. While these actions would reduce the significance of impacts to specific resource, onshore construction under the No Action Alternative would likely result in a range of impacts to cultural resources, from no historic properties affected to adverse effects to historic properties requiring mitigation, resulting in localized, long-term, negligible to major impacts on terrestrial cultural resources.

Climate change: The effects of climate change could result in a wide range of impacts to cultural resources. Increased storm frequency and severity would result in damage to and/or destruction of coastal and inland archaeological sites and TCPs from increased erosion. Sea level rise would increase the frequency and intensity of erosion-related impacts to coastal archaeological and TCP resources as well as resources along rivers and streams as increased storm frequency and intensity leads to more frequent and intense flooding episodes and erosion. Sea level rise would inundate coastal archaeological and TCP resources leading to damage or the loss of these resources. The installation of protective measures such as barriers and sea walls to mitigate the effects of climate change could impact coastal and shallow water terrestrial/marine archaeological resources during associated ground/seafloor-disturbing activities. Altered habitats/ecological systems and changing migratory animal patterns related to warming seas, sea level rise, and global warming would impact the ability of Native Americans and other communities to use maritime TCPs for traditional subsistence practices such as fishing, shell fishing, and fowling activities. Impacts to or the loss of culturally sensitive marine mammal, fish, and shellfish species that play an important role in Native American traditions, cosmology, and history due to altered habitats/ecology caused by climate change could have significant impacts on Native Americans.

If climate change continues unabated, impacts to cultural resources would result in a range of impacts, from no historic properties affected to adverse effects to historic properties requiring mitigation, resulting in localized, long-term, negligible to major impacts on cultural resources. The effect of future offshore wind projects on slowing or stopping global warming and climate change would result in in beneficial impacts on terrestrial cultural resources by reducing or limiting sea level rise, storm severity/intensity, habitat/ecosystem changes, changes to migratory patterns, the need for protective measures, and sediment erosion/deposition.

3.15.3.2.3 Above-ground Cultural Resources

Under the No Action Alternative, impacts to above-ground cultural resources could result from activities associated with port utilization/expansion projects, lighting of vessels and structures, presence of structures within the viewshed, and climate change. Offshore wind activities may affect above-ground cultural resources through the following primary IPFs.

Port utilization/expansion: Port modification and expansion projects could affect historic structures within or near port facilities. Port expansion or redevelopment projects could result in modifications to or demolition of historic port buildings and infrastructure, resulting in adverse effects on above-ground historic properties. The construction of new infrastructure (docks, office buildings, loading/unloading cranes) could introduce new visual elements into historic port settings, resulting in adverse effects to the integrity of above-ground historic properties within or adjacent to ports. BOEM anticipates, however, that compliance with state and federal requirements to identify and assess impacts on cultural resources/historic properties as part of NEPA and the NHPA and the requirements to avoid, minimize, and/or mitigate adverse effects/impacts on cultural resources would ultimately result in localized, long-term, negligible to major impacts to cultural resources.

Light (vessels and structures): Development of future offshore wind projects would increase the amount of offshore anthropogenic light from vessels, area lighting during construction and decommissioning of projects (to the degree that construction occurs at night) and use of aircraft and vessel hazard/warning lighting on WTGs and OCS-DC during operation. Construction and decommissioning lighting would be most noticeable if construction activities occur at night. Construction lighting from any project would be short-term, lasting only during nighttime construction, and could be visible from shorelines and elevated locations. Aircraft and vessel hazard lighting systems would be in use for the entire operational phase of each future offshore wind project, resulting in long-duration impacts. The intensity of these impacts would be relatively low, as the lighting would consist of small, intermittently flashing lights at a significant distance from the resources. The impacts of construction and operational lighting would be limited to cultural resources on the coastline for which a dark nighttime sky is a contributing element to historical integrity. This excludes resources that are closed to stakeholders at night, such as historic buildings, lighthouses, and parks, as well as resources that generate their own nighttime light, such as historic districts. The intensity of lighting impacts would be limited by the distance between resources and the nearest lighting sources. The intensity of lighting impacts would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light. As a result, nighttime construction and decommissioning lighting would have short-term, intermittent, and localized adverse impacts on a limited number of cultural resources. Operational lighting would have longer-term, continuous, and localized adverse impacts on a limited number of cultural resources. Lighting impacts would be reduced if ADLS is used to meet FAA aircraft hazard lighting requirements. As such, lighting impacts on cultural resources would range from minor to major.

Presence of structures (viewshed): The development of future offshore wind projects would introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources along the coastlines of New York, Connecticut, Massachusetts, and Rhode Island. Impacts on above-ground cultural resources from the presence of structures would be limited to those cultural resources from which future offshore wind projects would be visible, which would typically be limited to historic buildings, structures, objects, districts, and TCPs relatively close to shorelines and on elevated landforms near the coast. The magnitude of impacts from the presence of structures would be greatest for cultural resources for which a maritime view, free of permanent modern visual elements, is an integral part of their historic integrity and contributes to their eligibility for NRHP listing. Due to the distance between the reasonably foreseeable wind development projects and the nearest cultural resources, WTGs of individual projects would appear relatively small on the horizon, and the visibility of individual structures would be further affected by environmental and atmospheric conditions such as vegetation, clouds, fog, sea spray, haze, and waves. While these factors would limit the intensity of impacts, the presence of visible WTGs from future offshore wind activities would have long-term, continuous, major impacts on cultural resources if the presence of the structures resulted in adverse effects to historic properties which required mitigation to be resolved.

Climate change: Increased storm frequency and severity would result in damage to and/or destruction of coastal and inland above-ground historic resources from increased erosion. Sea level rise would increase the frequency and intensity of erosion-related impacts to coastal architectural resources as well as resources along rivers and streams as increased storm frequency and intensity leads to more frequent and intense flooding episodes and erosion. The installation of protective measures such as barriers and sea walls may help to mitigate the effects of climate change on these resources. The effect of future offshore wind projects on slowing or stopping global warming and climate change would result in limited to no impacts and could result in minor beneficial impacts on cultural resources by reducing or limiting sea level rise and increases in storm severity and frequency which drastically impact above-ground resources sited on shorelines or exposed rock formations.

3.15.3.3 Conclusions

Impacts of the No Action Alternative

Under the No Action Alternative, BOEM expects ongoing activities to have continuing short-term, long-term, and permanent impacts on cultural resources. The geographic extent of impacts from ongoing activities would include southern New England and Long Island as well as the adjacent state and federal waters. The primary source of onshore impacts from ongoing activities would include ground-disturbing activities and the introduction of intrusive visual elements, while the primary source of offshore impacts or those activities that disturb the seafloor, such as anchoring, new cable emplacement, and installation/presence of structures. BOEM anticipates that the cultural resource impacts as a result of ongoing activities associated with the Alternative A - No Action would be **major**.

Cumulative Impacts of the No Action Alternative

The construction and operation of the reasonably foreseeable offshore wind projects could result in the same types of short-term, long-term, and permanent impacts on onshore and offshore cultural resources described for ongoing activities. The geographic extent of impacts from reasonably foreseeable offshore wind projects would be limited to the terrestrial, marine, and visual APEs of each offshore wind project. The duration of impacts would range from short-term to permanent, while the extent and frequency of impacts would be largely dependent on the unique characteristics of individual cultural resources. BOEM anticipates that the overall impacts associated with Alternative A, the No Action Alternative, when combined with all other planned activities (including offshore wind) in the GAA would result in overall **major** impacts on individual onshore and offshore cultural resources depending on the scale and extent of impacts and the unique characteristics of individual resources.

The construction and operation of reasonably foreseeable offshore wind projects would also have **minor beneficial** impacts on individual onshore and offshore cultural resources as these projects would make incremental contributions to arresting the pace of global warming and climate change and associated impacts on cultural resources from sea level rise, increased storm severity/frequency, and increased erosion/deposition of sediments.

While impacts on cultural resources could range from minor to major, BOEM anticipates that implementation of existing state and federal cultural resource laws and regulations would reduce the magnitude of overall impacts on cultural resources due to requirements to avoid, minimize, or mitigate Project-specific impacts on cultural resources. These state and federal requirements may not be able to reduce the severity of impacts on some cultural resources due to the unique character of specific resources but would reduce the severity of potential impacts in a majority of cases, resulting in overall moderate impacts (i.e., adverse effects on historic properties could occur but would be avoided or minimized using a less impactful scenario). In some cases, however, ongoing activities and reasonably foreseeable offshore wind projects would result in **major** impacts to cultural resources where activities result in adverse effects on historic properties requiring mitigation to resolve those effects.

3.15.4 Relevant Design Parameters and Potential Variances in Impacts

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

- Physical impacts on terrestrial cultural resources (e.g., archaeological sites), depending on the location of onshore ground-disturbing activities;
- Physical impacts to underwater cultural resources (e.g., shipwrecks and ASLF) would vary according to the areas in which bottom-disturbing activities would occur. Such variances include the sitting of the WTGs and OCS-DC within the Project and the ultimate route of the SRWEC; and
- Visual impacts on cultural resources (e.g., historic buildings, structures, sites, objects, and districts, which could include landscapes and TCPs), depending on the design, height, number, and distance of WTGs visible from these resources.

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

- WTG and OCS-DC number, size, and location: If marine cultural resources cannot be avoided, impacts can be minimized with fewer WTGs and substation footprints, smaller footprints, and the selection of footprint locations in areas of lower archaeological or ancient submerged landform sensitivity.
- WTG and substation lighting: Arrangement and type of lighting systems could affect the degree of nighttime visibility of WTGs onshore and decrease visual impacts on cultural resources for which a dark nighttime sky is a contributing element to historical integrity.
- Size of scour protection around foundations: If marine cultural resources cannot be avoided, a smaller size of scour protection around foundations can minimize disturbance or destruction of marine cultural resources.
- Offshore cable (inter-array, substation interconnector) burial location, length, depth of burial, and burial method: If marine cultural resources cannot be avoided entirely, specific location, length,

and depth of burial could minimize disturbance or destruction of marine cultural resources. Cable burial method such as jetting tool, vertical injection, pre-trenching, scare plow, trenching (including leveling, mechanical cutting), plowing, and controlled flow excavation could have varying degrees of potential to disturb or destroy marine cultural resources.

- Onshore export cable width and burial depth: Reduced width and burial depth to reduce overall volume of excavation in the export cable construction corridor could decrease potential for unanticipated disturbance of terrestrial archaeology.

3.15.5 Impacts of Alternative B – Proposed Action on Cultural Resources

The Proposed Action would result in the construction of the SRWF and SRWEC as described in Section 2.1.2 of this document. It would include the construction of up to 94 WTGs at 102 possible positions with a nameplate capacity of 11-MW, a single OCS-DC, and a system of inter-array cables to connect WTGs to the OCS-DC within federal water approximately 16.4 nm (18.9 miles, 30.4 km) south of Martha's Vineyard, Massachusetts; approximately 26.5 nm (30.5 miles, 48.1 km) east of Montauk, New York; and approximately 14.5 nm (16.7 miles, 26.8 km) from Block Island, Rhode Island. The SRWEC would consist of a single, 104.7 mi (168.5 km) long, 320-kV Dc export cable bundle buried to a target depth of 4 to 6 ft (1.2 to 1.8 m) under the seafloor which would connect the OCS-DC to the landfall site. Onshore project components would include construction of approximately 17.5 mi (28.2 km) of onshore transmission cable requiring a short-term disturbance corridor of 30 ft (9.1 m) and maximum duct bank target burial depth of 6 ft (1.8 m) to install the 6-in (152-mm) diameter cable; an OnCS-DC with an operational footprint of 6 ac (2.4 ha); and an onshore interconnection cable to connect to the Holbrook Substation.

3.15.5.1 Construction and Installation

3.15.5.1.1 Onshore Activities and Facilities

Under the Proposed Action Alternative, adverse construction and installation impacts to terrestrial archaeological resources could result from ground-disturbing activities associated with port utilization/expansion projects and land disturbance/onshore construction. Selection of the Proposed Action Alternative would, however, result in beneficial impacts on cultural resources by contributing to slowing or arresting the effects of climate change.

Port utilization/expansion: The project proponent is evaluating the potential use of several existing port facilities located in New York, Connecticut, and Rhode Island to support offshore construction, assembly and fabrication, crew transfer and logistics (COP Section 3.5.5; Sunrise Wind 2023a). At this time no final determination has been made concerning the specific locations of these activities. The project proponent has stated, however, that if port expansion or modifications occur at any of the port facilities under consideration, those works would either be permitted and undertaken by port owners/operators and/or governmental or private-public partnerships entities in conjunction with state economic development initiatives to attract and support elements of the U.S. offshore wind industry; evaluated as part of BOEM's review of other projects being developed by Sunrise Wind's fellow subsidiaries of North East Offshore LLC (i.e., the SRWF and/or the Revolution Wind Farm); or part of a separate government approval subject to an independent NHPA Section 106 review (Sunrise Wind 2023a). As a result, the

Proposed Action as defined would not result in or contribute to direct impacts on cultural resources due to port utilization/expansions.

The Proposed Action does not include any port expansion or modification activities and, as a result, would not contribute to any direct impacts to cultural resources when combined with present and reasonably foreseeable offshore wind activities. The development of the offshore wind industry, including the Proposed Action, would however, contribute cumulative indirect impacts on cultural resources. While the Proposed Action and individual, reasonably foreseeable offshore wind projects may not include port expansion projects as part of their COP, states, municipal governments, and private entities are redeveloping and expanding port facilities with the goal of attracting offshore wind construction jobs, supply chains, and associated economic activity. While these expansion projects are not a direct result of the Proposed Action or individual, reasonably foreseeable offshore wind projects, the development of the offshore wind industry as a whole is inducing or making these port expansion activities possible. As a result, the Proposed Action and reasonably foreseeable offshore wind projects would result in geographically extensive, long-term, negligible to major indirect impacts on cultural resources from port utilization/expansion projects.

Land disturbance/onshore construction: Ground-disturbing activities conducted during construction of onshore facilities have the potential to impact terrestrial archaeological resources. To avoid impacts to intact archaeological resources, the onshore facilities are primarily sited within previously disturbed and developed areas (e.g., roadways, ROWs, developed industrial/commercial areas) to the extent feasible, to minimize impacts to potential archaeological resources. In addition, facilities were sited using guidance from previous cultural resources surveys and input from Native American tribes to avoid or minimize impacts to historic properties. Desktop and infield archaeological investigations conducted in undisturbed portions of the project did not identify any previously known or undiscovered archaeological resources within the Proposed Action APE (COP Section 4.6.2, Sunrise Wind 2023a) or within the two proposed laydown/staging areas. As a result of these activities, BOEM anticipates that the Proposed Action would have negligible impacts on previously recorded terrestrial archaeological resources.

The potential exists for undiscovered archaeological resources to be present within the previously disturbed portions of the Project Area and areas previously investigated for cultural resources. BOEM is, however, of the opinion that based on the results of the project sponsored terrestrial archaeological investigations and NY SHPO concurrence with the cultural resource assessments for the laydown/staging areas, there is a low potential for encountering undiscovered archaeological sites within the terrestrial APE. If undiscovered archaeological resources are present, project impacts could range from negligible to major depending on the characteristics of individual resources and the scale and extent of any impacts. BOEM is of the opinion, however, that based on the results of the terrestrial archaeological resource assessments conducted for the COP and laydown/staging areas memos it is unlikely that significant undiscovered terrestrial archaeological resources would be encountered within the terrestrial APE.

Onshore construction associated with the Proposed Action would incrementally add to land disturbance relative to ongoing activities and reasonably foreseeable offshore wind projects. BOEM anticipates conducting NHPA Section 106 reviews for all of reasonably foreseeable offshore wind projects in federal waters, including requirements to identify historic properties within onshore project component areas, assess any potential adverse effects on any identified properties, and require project proponents to develop plans to avoid, minimize, and/or mitigate any adverse effects. Compliance with the NHPA Section 106 review process as described in its implementing regulations (36 *CFR* 800) should reduce the extent and scale of adverse effects to terrestrial archaeological resources from the reasonably foreseeable offshore wind projects with impacts to specific resources ranging from negligible to major. Based on the results of terrestrial archaeological investigations conducted by the project proponent, land disturbance caused by the Proposed Action would not impact any recorded terrestrial archaeological resources and therefore would not contribute to any cumulative impacts to these resources.

The Proposed Action could incrementally add to cumulative impacts on undiscovered archaeological sites if cultural resources are encountered during future phased identification efforts or as unanticipated discoveries during onshore construction. BOEM required the project proponents for the Vineyard Wind 1 and Sunrise Wind offshore wind farm projects to complete efforts to identify historic properties prior to construction and implement a Post-Review Discoveries Plan during project construction and operations as conditions of COP approval and anticipates requiring all of the reasonably foreseeable offshore wind projects to comply with similar conditions. BOEM expects that completion of the NHPA Section 106 review and implementation of unanticipated discovery/post-review discovery plans would reduce the potential number, scale, and extent of cumulative impacts from offshore wind projects on terrestrial archaeological resources. The resulting cumulative impacts to undiscovered terrestrial archaeological resources would range from negligible to major depending on the characteristics of individual resources and whether adverse effects can be avoided, minimized, or require mitigation.

Climate change: The Proposed Action would incrementally contribute to slowing or arresting global warming and associated climate change and sea level rise. These incremental benefits would contribute to avoiding or minimizing climate change induced impacts on cultural resources. As a result, the Proposed Action would have long-term, widespread, negligible to minor beneficial impacts on cultural resources.

The Proposed Action and other reasonably foreseeable offshore wind projects would incrementally contribute to slowing or arresting global warming and associated climate change and sea level rise. These incremental benefits would contribute to avoiding or minimizing climate change induced impacts on cultural resources. As a result, the Proposed Action and other reasonably foreseeable offshore wind projects would have long-term, widespread, negligible to minor beneficial impacts on cultural resources.

Future actions to avoid, minimize, or mitigate adverse effects: In order to address potential impacts to undiscovered archaeological historic properties in previously uninvestigated areas and/or undiscovered historic properties encountered during construction, Sunrise Wind has committed to the following APMs:

- Performing additional phased archaeological identification and evaluation investigations within previously inaccessible portions of the APE prior to any ground-disturbing activities. This process of phased identification and evaluation would be aligned with the requirements in 36 *CFR* 800.4 (b)(2). If historic properties are identified during these investigations, the project proponent would develop plans to avoid, minimize, and/or mitigate any adverse effects in consultation with NHPA Section 106 consulting parties. If impacts to historic properties cannot be avoided, the project proponent would develop a treatment plan to resolve adverse effects in consultation with BOEM, the relevant state historic preservation office, federally recognized Tribes, and other NHPA Section 106 consulting parties (COP Section 4.6.2.3, Sunrise Wind 2023a).

- Develop and implement an UDP, including stop-work and notification procedures, during all ground-disturbing activities associated with construction of the Proposed Action. If archaeological historic properties are discovered during construction, the project proponent would develop and implement treatment plans to avoid, minimize, and/or mitigate impacts that are aligned with relevant New York cultural resource standards and the NHPA. All treatment plans would be developed in consultation with BOEM, the New York State Historic Preservation Office (NYSHPO), federally recognized Tribes, and other NHPA Section 106 consulting parties (COP Section 4.6.2.3, Sunrise Wind 2023a).

The commitments to conduct archaeological investigations within the remaining uninvestigated portions of the APE and to implement a UDP would reduce the scale and extent of any impacts to undiscovered archaeological historic properties. These commitments would allow for the identification of historic properties, either through investigation or UDP implementation, and, if resources are identified, provide for the assessment of adverse effects and the development of measures to avoid, minimize, and/or mitigate effects aligned with the procedures outlined in 36 *CFR* 800. If because of these actions, no historic properties are affected the Proposed Action would have negligible to minor impacts on previously undiscovered cultural resources. However, if impacts cannot be avoided but could be minimized, the Proposed Action would result in moderate impacts to cultural resources. If mitigation is necessary to resolve adverse effects, the Proposed Action would have major impacts on cultural resources. As a result, the Proposed Action could result in localized, long-term negligible to major impacts on undiscovered cultural resources depending on the characteristics of individual resources and the ability of the project proponent to avoid or minimize impacts.

3.15.5.1.2 Offshore Activities and Facilities

Under the Proposed Action Alternative, impacts to cultural resources could occur from several of the IPFs during construction and installation, including anchoring, new cable emplacement, and presence of structures. Selection of the Proposed Action Alternative would, however, result in beneficial impacts on cultural resources by contributing to slowing or arresting the effects of climate change.

Accidental releases: Accidental release of fuel, fluids, hazardous materials, and trash or debris, if any, could affect marine cultural resources. The Proposed Action would install up to 94 WTG foundations at 102 possible positions and one OCS-DC foundation, which could result in transport and storage of thousands of gallons of fuel required for operation of the WTGs and OSS. The volume of materials released is unlikely to require cleanup operations that would permanently affect cultural resources, however. As a result, the impacts of accidental releases from the Proposed Action alone on cultural resources would be short-term, localized, and negligible to minor.

Anchoring: Construction of the Proposed Action and other offshore wind projects would result in anchoring occurring within the GAA that could impact marine cultural resources.. Four ASLF have been identified within the APE that could be impacted; however, Sunrise Wind intends to avoid impacts to these resources during construction and installation. If Sunrise Wind can successfully avoid impacts to the ancient, submerged landforms during construction and installation under the Proposed Action, then the impacts would be considered negligible to minor. Therefore, anchoring or jacked-up vessels would produce moderate to major, long-term impacts on marine cultural resources if they cannot be avoided during construction activities under the Proposed Action.

Gear utilization and dredging: Gear utilization and dredging could impact cultural resources within the APE. Identification of potential marine cultural resources through HRG survey and analysis should enable the developer to restrict gear utilization and dredging to areas where resources are not extant. As a result, BOEM does not anticipate that gear utilization and dredging activities associated with the Proposed Action would result in impacts to known shipwrecks, submerged aircraft, debris fields, and ASLF. Therefore, impacts from gear utilization and dredging during construction and installation would be negligible to minor, unless an identified or newly discovered resource cannot be avoided, which would result in moderate to major impacts.

Presence of structures: The presence of structures, including foundations and scour protection for WTGs and OSS, could affect marine cultural resources. Depending on the type of foundation, the installation of WTGs and OSSs possess greater potential to disturb marine cultural resources due to the increased depth of impacts during installation. However, the Proposed Action has committed to locating the structures to avoid the 43 ancient, submerged landforms and eight historic-period archaeological resources identified in the SRWF and SRWEC during construction and installation. Due to these commitments, BOEM does not anticipate impacts on known shipwrecks, submerged aircraft, debris fields, and ASLF from development of the Proposed Action. As a result, the presence of structures under the Proposed Action would have minor impacts on marine cultural resources. More substantial impacts could occur if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction, in which case the impacts would be long-term and moderate to major.

The Project's effect on a given above-ground historic property would be a change in the above-ground historic property's visual setting. During the construction phase, the increased flow of ships across the horizon could result in short-term visual effects, drawing attention to the modern vessels as they move toward the proposed Project site. This would have the secondary effect of drawing attention toward the WTGs as they are being erected. However, the presence of seagoing vessels on the horizon is a common feature on the seascape within the APE and potential increases would be short-term in nature. Therefore, although there may be potential effects during the construction of SRWF, it is not anticipated that marine traffic in itself would result in a significant visual effect on above-ground historic properties. As a result, the Proposed Action would be short-term and negligible**.**

The presence of structures, including foundations and scour protection for WTGs and OSS, could affect marine cultural resources. Depending on the type of foundation, the installation of WTGs and OSSs possess greater potential to disturb marine cultural resources due to the increased depth of impacts during installation. However, the Proposed Action has committed to locating the structures to avoid the 43 ancient, submerged landforms and eight historic-period archaeological resources identified in the SRWF and SRWEC during construction and installation. Developers of nearby offshore wind farms are required by BOEM and the relevant SHPOs to conduct investigations to identify potential historic properties that could be impacted during construction and installation of their proposed projects. These measures enable developers to limit or avoid impacts from construction and installation activities during development. Implementation of EPMs and other mitigation treatment plans, similar to those proposed for the Sunrise Wind Project, may serve to resolve or lessen adverse effects to marine cultural resources resulting from development of future offshore wind projects. Nevertheless, the cumulative impacts to marine archaeological resources would range from negligible to major depending on the characteristics of individual resources and whether adverse effects can be avoided, minimized, or require mitigation.

New cable emplacement/maintenance: The installation of array cables and offshore export cables would include site preparation activities (e.g., sand wave clearance, boulder removal) and cable installation via jet plow, mechanical plow, or mechanical trenching, which could affect cultural resources. However, the Proposed Action has committed to avoiding the 43 ASLF and eight potential historic-period resources identified in the SRWF and SRWEC during new cable emplacement. Due to these commitments, BOEM does not anticipate impacts on marine cultural resources from new cable emplacement during development of the Proposed Action. As a result, new cable emplacement and maintenance would have negligible to minor impacts on marine cultural resources. More substantial impacts could occur if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Light (vessels and structures): Construction of the Proposed Action would increase the amount of offshore anthropogenic light from vessels, area lighting during construction and decommissioning of projects (to the degree that construction occurs at night) and use of hazard/warning lighting on WTGs during operations. The susceptibility and sensitivity of cultural resources to lighting impacts from the Proposed Action would vary based on the unique characteristics of individual cultural resources that qualify them for NRHP listing. Nighttime lighting impacts would be restricted to cultural resources for which a dark nighttime sky is a contributing element to their historic integrity, cultural resources stakeholders use at night, and resources that do not generate a substantial amount of their own light pollution. Of the 342 historic properties reviewed in the offshore visual APE, it is expected that at least some resources, such as lighthouses and resources that are ocean-facing, meet these conditions.

Construction of the Proposed Action may require nighttime vessel and construction area lighting. The lighting impacts would be short-term, as they would be limited to the construction phase of the Proposed Action. The intensity of nighttime construction lighting from the Proposed Action would be limited to the active construction area at any given time. Impacts would be further reduced by the distance between the nearest construction area (i.e., the closest line of WTGs) and the nearest cultural resources on the Block Island, Rhode Island and Martha's Vineyard, Massachusetts Coasts. The intensity of lighting impacts would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light. As previously stated, these impacts would be limited to cultural resources for which a dark nighttime sky is a contributing element to their historic integrity and resources used by stakeholders at night, limiting the scale of impacts on cultural resources. Given that of the 307 historic properties reviewed in the offshore visual APE, it is expected that at least some resources, such as lighthouses and resources that are ocean-facing, meet these conditions. As short-term impacts during construction, the lights would be visible, but would not rise to the level of an adverse effect. Nighttime vessel and construction area lighting from the Proposed Action alone would have minor impacts on cultural resources.

Table 3.15-7. Adverse Effects to Marine Cultural Resources

Historic Property	NRHP Designation	NRHP-eligible Criteria	Impact Level
WEA_P-02-D	Eligible	Ancient submerged landform	Negligible to minor
WEA_P-11	Eligible	Ancient submerged landform	Negligible to minor
WEA_P-17	Eligible	Ancient submerged landform	Negligible to minor
WEA_P-22	Eligible	Ancient submerged landform	Negligible to Minor

Future actions to avoid, minimize, or mitigate adverse effects: Sunrise Wind has committed to the following EPMs to avoid, minimize, or mitigate impacts to marine archaeological resources. For ASLF identified within the APE, Sunrise Wind proposes the following measure to avoid or minimize impacts (COP Appendix Z, Sunrise Wind 2023b):

- Avoidance of the recommended 164-foot (50-meter) buffer around ASLF based on HRG survey data and geotechnical data collected for the COP surveys.
- Selection of feasible construction methods that minimize the extent of seabed disturbance associated with SRWEC or IAC construction to avoid adverse physical effects to buried ASLF.
- If avoidance of a target or the recommended 164-foot (50-meter) buffer is not feasible then feasible siting options and construction methods that minimize the extent of seabed disturbance within each ASLF would be evaluated.

In those instances where impacts to ASLF cannot be avoided or minimized, the following mitigation alternatives have been proposed:

- Consultations with BOEM and Native American Tribes to identify specific research questions and goals that can be addressed through geotechnical investigations of the affected ASLF.
- Development of specific protocols for field investigations, laboratory analyses, and interpretations that reflect the priorities of Native American Tribes for whom ASLF have traditional cultural significance.
- Development of specific protocols for the appropriate dissemination of data and interpretations that mutually support the protection of ASLF and associated indigenous knowledge and the scientific research of ancient indigenous interactions with Pleistocene-age landscapes.
- Geotechnical sampling of the affected sections of ASLF within the APE. Sampling methods may include collecting up to four vibracores or using other methods to obtain intact physical samples of preserved paleosols or other deposits for analyses.
- Collaborative laboratory analyses of geotechnical samples with direct participation of Native American Tribe representatives and researchers with the QMA staff and Project representatives.
- Data aggregation and sharing via a non-proprietary, open-source geographic information system (GIS)-format that allows for the incorporation of Sunrise Wind datasets with other relevant data collected from the MA/RI and Massachusetts WEA.

Reporting of mitigation investigations to document the results of analyses and incorporation of the Sunrise Wind data with available datasets from other recent paleoenvironmental and archaeological investigations of the OCS.

Although Sunrise Wind is committed to avoiding impacts to the eight historic resources identified within the APE, in those instances where impacts cannot be avoided the following measures are proposed to mitigate adverse effects considered by BOEM to be NRHP-eligible:

- Consultation with BOEM and other parties to determine significance (NRHP eligibility).
- If NRHP-eligible, consultations to develop a data recovery research design and/or alternative mitigation.
- Data recovery accomplished through targeted diver and/or ROV-supported documentation. A broad range of approaches may be appropriate depending on the specific nature of the resource and the scope of disturbance expected; or
- Alternative mitigation in lieu of data recovery. Examples could include archival research or geophysical survey designed to locate at-risk shipwrecks of high public value, financial contributions to existing shipwreck preservation efforts in the region, or compilation of recent datasets and discoveries to expand and update SHPO inventories of potentially significant submerged archaeological resources.

The project does not include plans to physically alter or demolish any above-ground historic properties but would result in visual impacts. There are no anticipated visual impacts to historic properties resulting from construction or operation of the onshore facilities. However, adverse visual impacts are anticipated from the offshore infrastructure. Sunrise Wind has committed to the following measures to avoid or minimize potential adverse impacts to historic properties within the visual effects APE:

- WTGs would have uniform design, height, and rotor diameter, thereby mitigating visual clutter.
- The WTGs would be painted no lighter than Pure White (RAL 9010) and no darker than Light Grey (RAL 7035) as recommended by BOEM and FAA. Turbines of this color white generally blend well with the sky at the horizon and eliminate the need for daytime warning lights or red paint marking of the blade tips.
- Sunrise Wind would use an ADLS or related means (e.g., dimming or shielding) to limit visual impact, pursuant to approval by FAA and BOEM, commercial and technical feasibility at the time of FDR/FIR approval, and dialogue with stakeholders.
- The onshore transmission cable and onshore interconnection cable would not include any overhead utility poles, thus minimizing potential visual impacts to adjacent properties.
- The OnCS-DC is sited near an existing substation on a parcel zoned for commercial and industrial/utility use.
- Screening would be implemented at the OnCS-DC to the extent feasible, to reduce potential visibility and noise.
- Non-reflective paints and finishes would be used to the extent practicable on Onshore Facilities to minimize reflected glare.
- Lighting at the OCS-DC would be kept to the minimum necessary to comply with navigation safety requirements and safe operating conditions.

- WTGs would be aligned and spaced consistently with other offshore wind facilities in the Rhode Island/Massachusetts WEA, reducing potential for visual clutter.

Sunrise Wind has committed to the following measures to mitigate impacts to above-ground historic resources subject to adverse visual effects (COP Appendix Z, Sunrise Wind 2023b). The mitigation measures are conceptual, pending further engagement with consulting parties. Attachment C of COP Appendix Z (Sunrise Wind 2023b) individually assigns conceptual mitigation to individual resources depending on type.

- Support for oral history projects to document Native American traditions associated with culturally significant marine and terrestrial species at risk due to climate change and/or the significance of economic practices and traditions associated with historic properties.
- Support for scholarships and/or professional training programs for Native American Tribal Members for marine sciences, marine construction, geophysics, geology, history, anthropology, environmental sciences, or indigenous studies.
- Support for planning, feasibility assessments, prioritization, and implementation of coastal resilience measures to minimize sea level and storm hazards, retention or appropriate adaptive re-use of historic shoreline features, and/or habitat restoration that contribute to historic maritime settings or TCPs.
- Repair or restoration work to maintain the physical integrity of affected historic properties, including buildings, structures, and landscape features that contribute to historic maritime settings.
- Preparation of National Register nominations and/or historic resources surveys to increase public awareness and appreciation of coastal historic properties and their association with historic maritime landscapes, evolving land use patterns, and the historical development of the affected communities.
- Support for public interpretation of risks, challenges, and potential solutions for coastal historic properties due to climate change, sea level rise, changing shorelines, and the historical relationship of shorelines and ocean views to the affected properties.

3.15.5.2 Operations and Maintenance

3.15.5.2.1 Onshore Activities and Facilities

BOEM does not anticipate operation and routine maintenance activities would result in impacts to terrestrial archaeological resources. Operation of the onshore components of the Proposed Action would not require any additional ground-disturbing activities that could impact known or previously undiscovered archaeological resources. Routine maintenance of above-ground components would similarly not require any additional ground disturbance that could impact terrestrial archaeological resources. Ground-disturbing activities could be required to maintain or repair buried onshore project components, such as substation equipment and the onshore transmission or interconnection cables. BOEM anticipates, however, that any ground-disturbing activity to access subsurface project components would be conducted within areas previously disturbed during construction and installation of the subsurface components. If undiscovered archaeological resources had been present in those areas, it is likely they would be discovered during construction/installation and subject to the previously described

UDP. As a result, BOEM anticipates that the operation and maintenance of the Proposed Action would have negligible long-term impacts on archaeological cultural resources.

Under the Proposed Action Alternative, negative impacts to above-ground historic resources could result from construction activities associated with port utilization/expansion projects. There would be negligible impacts to above-ground historic resources from construction of onshore facilities at the Holbrook, New York site. Selection of the Proposed Action Alternative would result in beneficial impacts on cultural resources by contributing to slowing or arresting the effects of climate change.

Onshore construction: BOEM does not anticipate the construction, operation and routine maintenance activities associated with the proposed onshore facilities on Long Island, New York would result in impacts to above-ground historic properties. Onshore project components would include construction of approximately 17.5 mi (28.2 km) of onshore transmission cable; an OnCS-DC; and an onshore interconnection cable to connect to the Holbrook Substation. Construction of the OnCS-DC would result in the demolition of two non-historic buildings at the Union Street site in Holbrook. There are no above-ground historic properties in the footprint of any of these facilities and thus there would be no direct impacts to historic above-ground resources. Based on online research of NYSHPO's Cultural Resource Information System conducted in support of the Sunrise Wind Project COP, there is one previously identified resource within the 1-mile radius for assessing effects in the viewshed of the OnCS-DC. The Waverly Cemetery is located 0.7 miles from the proposed OnCS-DC site. Although a formal determination of the Waverly Cemetery's NRHP eligibility has not been made, BOEM considers the Waverly Cemetery NRHP-eligible under Criterion A. An onsite field survey and viewshed analysis conducted in June 2021 did not identify any additional NRHP-eligible historic properties in the APE. The field survey also determined that due to distance and intervening buildings and foliage, the OnCS-DC is only minimally visible from the Waverly Cemetery and would have no adverse effect on those characteristics that qualify the Waverly Cemetery for listing in the NRHP. As a result, BOEM anticipates that the construction, operation and maintenance of the Proposed Action would have negligible long-term impacts on cultural resources.

Port utilization/expansion: The project proponent is evaluating the potential use of several existing port facilities located in New York, Connecticut, and Rhode Island to support offshore construction, assembly and fabrication, crew transfer and logistics (COP Section 3.5.5, Sunrise Wind 2023a). At this time no final determination has been made concerning the specific locations of these activities. The project proponent has stated, however, that if port expansion or modifications occur at any of the port facilities under consideration, those works would either be permitted and undertaken by port owners/operators and/or governmental or private-public partnerships entities in conjunction with state economic development initiatives to attract and support elements of the U.S. offshore wind industry; evaluated as part of BOEM's review of other projects being developed by Sunrise Wind's fellow subsidiaries of North East Offshore LLC (i.e., the SRWF and/or the Revolution Wind Farm); or part of a separate government approval subject to an independent NHPA Section 106 review (COP Section 3.3.10, Sunrise Wind 2023a). Therefore, because there are no port utilization or expansion activities associated with the Proposed Action it would result in negligible impacts on cultural resources.

3.15.5.2.2 Offshore Activities and Facilities

Operation and maintenance activities associated with the Proposed Action would likely not impact marine archaeological resources. Any impacts that might be sustained would probably result from accidental releases and anchoring. Nevertheless, the EMPs instituted to avoid or minimize impacts to marine resources during construction and installation would similarly diminish or eliminate the likelihood of impacts. As a result, BOEM anticipates that the operation and maintenance of offshore facilities would have negligible short-term impacts on marine cultural resources, unless a resource cannot be avoided, in which case the impacts would be considered major and long-term.

O&M activities associated with the Proposed Action would likely impact above-ground historic properties through the introduction of new structures and lighting on those structures in the viewshed of historic properties. The EMPs instituted to avoid or minimize impacts to above-ground historic resources during O&M would diminish impacts but cannot be fully avoided. As a result, BOEM anticipates that the O&M of offshore facilities would have negligible to major long-term impacts on above-ground historic resources.

Accidental releases: The impacts associated with accidental releases during O&M are similar to those that may arise during construction and installation, although the likelihood of a release occurring is diminished due to the decreased scope of activities. As a result, impacts from an accidental release would be considered short-term, localized, and negligible to minor.

Anchoring: Potential impacts from anchoring or jack-up vessels are unlikely considering that marine cultural resources present in the SRWF and SRWEC would have already been identified and could likely be avoided. However, a resource might sustain impacts if anchoring occurs in an area not previously assessed to identify potential submerged cultural resources. Additionally, a non-routine operation and maintenance activity could impact a known marine cultural resource if the nature of the emergency did not allow for proper avoidance measures to be implemented. Nevertheless, impacts from anchoring should be considered unlikely and would be localized and range from negligible to minor.

Light (vessels and structures): The simulated nighttime conditions illustrated in the HRVEA (COP Appendix T, EDR 2023b) assume that the aviation obstruction lights would be on during the nighttime, which could be considered overly conservative since SRWF would utilize an ADLS, if approved by FAA/BOEM to minimize the amount of time the aviation obstruction lights would be activated (i.e., only when aircraft enter the airspace of the SRWF). If successfully implemented, ADLS would limit the activation of the aviation obstruction lights to approximately 1.4 hours per year (Capitol Airspace, 2020 in COP, Appendix T; EDR 2023b), thus substantially limiting the nighttime visibility and visual impact of the SRWF. As a result, BOEM anticipates that the lighting of offshore facilities and structures would have negligible to moderate, long-term impacts on above-ground historic resources.

During the construction phase, vessel lighting associated with the increased flow of ships across the horizon could result in short-term visual effects, drawing attention to the modern vessels as they move toward the Project site. This would have the secondary effect of drawing attention toward the WTGs as they are being erected. However, the presence of seagoing vessels on the horizon is a common feature on the seascape within the APE and potential increases would be short-term in nature. Therefore, although there may be potential effects during the construction of SRWF, it is not anticipated that marine traffic in itself would result in a significant long-term visual effect on above-ground historic properties. BOEM anticipates that the lighting of vessels during construction would have negligible to moderate short-term impacts on above-ground historic resources.

Presence of structures (viewshed): The Project's effect on a given above-ground historic property would be a change (resulting from the introduction of wind turbines and an OSS) in the above-ground historic property's visual setting. The Project would be visible and would result in the greatest potential effects on the visual setting of above-ground historic properties located along the shoreline. The Project's overall impact on the visual settings associated with above-ground historic properties would persist for the period of operation.

For the purposes of this analysis, all inventoried properties located within the APE were considered potentially eligible for listing in the NRHP and were considered for analysis of potential visual impacts. The majority of above-ground historic properties that fall within the Sunrise Wind Project viewshed would have somewhat obstructed views of the SRWF due to screening provided by intervening topography, vegetation, and/or buildings and structures. The proposed turbines are located between 12.8 miles (20.6 km) to 40.5 miles (65.2 km) away from the above-ground historic properties located within the APE. Visual simulations prepared for the SRWF show that in some cases views of the ocean would be disrupted by the presence of the WTGs. The introduction of new vertical elements along the horizon line would create a pattern of visual disturbance of the natural seascape. Distance may be a mitigating factor in some cases. However, even at distances of 20 miles (32.2 km) away, WTGs spread across such a wide swath of the horizon would be apparent to viewers from the shore, and the effect of "stacking" can cause multiple individual WTGs to appear as a larger, more substantial form.

The potential visibility of the SRWF from the individual above-ground historic properties within the APE is summarized in Attachment A and depicted in Figure 3.1-1 of the SRWF HRVEA (COP Appendix T, EDR 2023b). Applying the Criteria of Adverse Effect per Section 106 § 800.5, of the 307 above-ground historic properties located within the APE assessed for potential visual effects, the SRWF would have an adverse effect on a total of 44 above-ground historic properties (approximately 14 percent). Applying the Criteria of Adverse Effect per Section 106 § 800.5, the SRWF is not anticipated to have a potential adverse effect on the remaining 263 inventoried properties within the APE. As a result, the Proposed Action would have long-term, widespread, minor to major impacts on cultural resources. The 263 inventoried properties would be subject to minor impacts because, although the WTGs would be visible, the impact would be insufficient to result in an adverse effect. The visual impacts on the remaining 44 historic properties would be major as the visual impacts are significant enough to require mitigation to resolve the adverse effect.

Climate change: The Proposed Action and other reasonably foreseeable offshore wind projects would incrementally contribute to slowing or arresting global warming and associated climate change and sea level rise. These incremental benefits would contribute to avoiding or minimizing climate change induced impacts on cultural resources. As a result, the Proposed Action and other reasonably foreseeable offshore wind projects would have long-term, widespread, negligible to minor beneficial impacts on cultural resources.

Future Actions to Avoid, Minimize, or Mitigate Adverse Effects on Historic Properties: The Project has been designed to minimize impacts to historic and cultural properties to the extent feasible. Construction of the Project would not require the demolition or physical alteration of any historic buildings or other above-ground historic properties. No adverse visual effects to historic properties from construction or operation of the proposed onshore facilities are anticipated. The Project's effects on a given above-ground historic property would be a change (resulting from the introduction of WTGs/OCS-DC) in the historic property's visual setting. As part of the COP submittal, Sunrise Wind has proposed measures to avoid or minimize potential adverse effects to identified properties within the Visual Effects APE. These measures are described more fully in Section 4.0 of the Sunrise Wind Project COP (Appendix Z; Sunrise Wind 2023b). Sunrise Wind anticipates that unavoidable adverse effects to historic and cultural properties would remain despite implementation of the above-referenced design measures. Proposed measures to mitigate these adverse effects are described in Sections 4.1 and 4.2 of the Sunrise Wind Project COP (Appendix Z, Sunrise Wind 2023b) and in Attachment C of the afore-mentioned document: "Proposed Mitigation Measures for Adverse Visual Effects to Specific Historic Properties". The final minimization and mitigation of adverse effects would be determined through BOEM's NHPA Section 106 consultation process and included as conditions of COP approval.

3.15.5.3 Conceptual Decommissioning

3.15.5.3.1 Onshore Activities and Facilities

Decommissioning of the Proposed Action could result in land disturbance associated with the removal of underground onshore project components such as OnCS-DC foundations and equipment and the onshore transmission and interconnection cables and associated infrastructure. BOEM anticipates, however, that any ground-disturbing activity during removal of subsurface project components would be performed within areas previously disturbed during construction and installation of those components. If undiscovered archaeological resources had been present in those areas, it is likely they would be discovered during construction/installation and subject to the previously described UDP. As a result, BOEM anticipates that the conceptual decommissioning of the Proposed Action would have negligible impacts on cultural resources.

3.15.5.3.2 Offshore Activities and Facilities

Decommissioning of offshore infrastructure would necessitate seabed disturbance that could impact cultural resources. BOEM anticipates, however, that any seabed disturbing activity during removal of project components would be performed within areas previously assessed. Therefore, it is unlikely that unidentified marine archaeological resources would be encountered during decommissioning. Moreover, EPMs instituted to minimize or mitigate impacts to archaeological resources during decommissioning would minimize any potential impacts to cultural resources within the areas where removal of offshore facilities would occur. As a result, BOEM anticipates that the conceptual decommissioning of the Proposed Action would have negligible impacts on marine cultural resources.

Conceptual decommissioning of the Proposed Action would contribute similar lighting impacts from nighttime vessel and construction area lighting as anticipated during construction and installation. Impacts may include light associated with decommissioning vessel traffic. Lighting from the Proposed Action could have negligible to minor impacts on cultural resources depending on the scale and intensity, largely determined by the number of visible lights and their proximity to resources, of the impacts and the unique characteristics of individual historic properties.

3.15.5.4 Cumulative Impacts of the Proposed Action

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

3.15.5.4.1 Onshore Activities and Facilities

Port utilization/expansion: The development of the offshore wind industry, including the Proposed Action, would however, contribute cumulative indirect impacts on cultural resources. While the Proposed Action and individual, reasonably foreseeable offshore wind projects may not include port expansion projects as part of their COP, states, municipal governments, and private entities are redeveloping and expanding port facilities with the goal of attracting offshore wind construction jobs, supply chains, and associated economic activity. While these expansion projects are not a direct result of the Proposed Action or individual, reasonably foreseeable offshore wind projects, the development of the offshore wind industry as a whole is inducing or making these port expansion activities possible. As a result, the Proposed Action and reasonably foreseeable offshore wind projects would result in geographically extensive, long-term, negligible to major indirect impacts on cultural resources from port utilization/expansion projects.

Land disturbance/onshore construction: The Proposed Action could incrementally add to direct cumulative impacts on undiscovered archaeological sites if cultural resources are encountered during future phased identification efforts or as unanticipated discoveries during onshore construction. BOEM required the project proponents for the Vineyard Wind 1 and Sunrise Wind offshore wind farm projects to complete efforts to identify historic properties prior to construction and implement a UDP during project construction and operations as conditions of COP approval and anticipates requiring all of the reasonably foreseeable offshore wind projects to comply with similar conditions. BOEM expects that completion of the NHPA Section 106 review and implementation of unanticipated discovery/post-review discovery plans would reduce the potential number, scale, and extent of cumulative impacts from offshore wind projects on terrestrial archaeological resources. The resulting cumulative impacts to undiscovered terrestrial archaeological resources would range from negligible to major depending on the characteristics of individual resources and whether adverse effects can be avoided, minimized, or require mitigation.

Climate change: The Proposed Action and other reasonably foreseeable offshore wind projects would incrementally contribute to slowing or arresting global warming and associated climate change and sea level rise. These incremental benefits would contribute to avoiding or minimizing climate change induced impacts on cultural resources. As a result, the Proposed Action and other reasonably foreseeable offshore wind projects would have long-term, widespread, negligible to minor beneficial impacts on cultural resources.

3.15.5.4.2 Offshore Activities and Facilities

Accidental releases: Cumulative impacts from the Proposed Action and the reasonably foreseeable future offshore wind projects would be similar to those of the Proposed Action but could affect a larger area. In the context of reasonably foreseeable trends, the contribution of the Proposed Action to the combined impacts of accidental releases from ongoing and planned activities would result in a low risk of a leak of fuel, fluids, or hazardous materials from any of the WTGs and OSS, which would include storage of these substances. The overall impacts on cultural resources from accidental releases from the Proposed Action when combined with ongoing and planned activities would be short-term and minor.

Anchoring: Cumulative impacts from anchoring during future wind farm development would be similar to those of the Proposed Action but could affect a larger area. The Proposed Action would result in negligible to minor impacts to marine resources because of planned avoidance of all ASLF. Future wind farm projects may be unable to avoid impacts to marine resources during anchoring, which would result in major impacts to marine resources. Accordingly, the overall impacts on cultural resources from anchoring from the Proposed Action when combined with ongoing and planned activities would be negligible to minor, but could be major when avoidance is not possible and could be localized or widespread.

New cable emplacement/maintenance: Future offshore wind projects would result in construction of IAC systems and offshore export cable corridors. As with the Proposed Action, future offshore wind projects would likely be able to avoid impacts marine cultural resources due to their relatively small, discrete size. In contrast to the Proposed Action, other projects may be unable to avoid impacts on all ASLF. The combined cable emplacement impacts on cultural resources from the Proposed Action combined with ongoing and planned activities would be localized, long-term, and minor for shipwrecks, downed aircraft, and debris fields; and long-term, widespread, and moderate to major for submerged ASLF. Sunrise Wind has committed to avoiding submerged ASLF during cable emplacement and thus the combined impact on ASLF would mostly result from other projects that may be unable to avoid these areas. Implementation of EMPs and other mitigation treatment plans, similar to those proposed for the Sunrise Wind Project, may serve to resolve or lessen adverse effects to marine cultural resources resulting from development of future offshore wind projects. However, the magnitude of these impacts would remain moderate to major, due to the permanent, irreversible nature of the impacts, unless these ASLF can be avoided.

Light (vessels and structures): Construction of other offshore wind projects in the GAA would contribute similar lighting impacts from nighttime vessel and construction area lighting as under the Proposed Action. Impacts may include light associated with construction vessel traffic, which may slightly increase with construction of the Proposed Action. Lighting from the Proposed Action combined with ongoing and planned activities could have negligible to minor impacts on cultural resources depending on the scale and intensity, largely determined by the number of visible lights and their proximity to resources, of the impacts and the unique characteristics of individual historic properties.

3.15.5.5 Conclusions

Impacts of the Proposed Action

Based on the preceding IPF analysis, BOEM has determined that the Proposed Action would likely result in **major** adverse impacts on cultural resources. Impact determinations for each IPF are provided in the following paragraphs.

Impacts from the Proposed Action would be reduced through implementation of mitigation measures to resolve adverse effects to historic properties developed through the NHPA Section 106 consultation process. Without the pre-construction NHPA requirements to identify historic properties, assess potential effects, and develop treatment plans to resolve effects through avoidance, minimization, or mitigation, the Proposed Action would result in more significant impacts. In addition, the analysis of impacts is based on a maximum-case scenario and BOEM anticipates that impacts would be reduced by implementation of a less impactful construction or infrastructure development scenario within the PDE. BOEM expects that NHPA requirements to identify historic properties and resolve adverse effects would similarly reduce the significance of potential impacts on historic properties from future offshore wind projects as they complete the NHPA Section 106 review process.

The NHPA-required, "good-faith" efforts to identify historic properties and resolve adverse effects resulted in or contributed to Sunrise Wind committing to reduce the magnitude of impacts on cultural resources through the following APMs (COP Appendix Z, Sections 2-5, Sunrise Wind 2023b):

- Using ADLS hazard lighting to limit visual impact, pursuant to approval by FAA and BOEM, commercial and technical feasibility at the time of FDR/FIR approval, and dialogue with stakeholders;
- Using non-reflective pure white and light gray paint no lighter than Pure White (RAL 9010) and no darker than Light Grey (RAL 7035) on offshore structures;
- Screening would be implemented at the OnCS-DC to the extent feasible, to reduce potential visibility and noise. Non-reflective paints and finishes would be used to the extent practicable on Onshore Facilities to minimize reflected glare. Lighting at the OCS-DC would be kept to the minimum necessary to comply with navigation safety requirements and safe operating conditions;
- Support for oral history projects to document Native American traditions associated with culturally significant marine and terrestrial species at risk due to climate change and/or the significance of economic practices and traditions associated with historic properties;
- Support for scholarships and/or professional training programs for Native American Tribal Members for marine sciences, marine construction, geophysics, geology, history, anthropology, environmental sciences, or indigenous studies;
- Support for planning, feasibility assessments, prioritization, and implementation of coastal resilience measures to minimize sea level and storm hazards, retention or appropriate adaptive re-use of historic shoreline features, and/or habitat restoration that contribute to historic maritime settings or TCPs;
- Repair or restoration work to maintain the physical integrity of affected historic properties, including buildings, structures, and landscape features that contribute to historic maritime settings;
- Preparation of National Register nominations and/or historic resources surveys to increase public awareness and appreciation of coastal historic properties and their association with historic maritime landscapes, evolving land use patterns, and the historical development of the affected communities;
- Support for public interpretation of risks, challenges, and potential solutions for coastal historic properties due to climate change, sea level rise, changing shorelines, and the historical relationship of shorelines and ocean views to the affected properties;
- Define avoidance areas surrounding known marine archaeological resources to reduce the chances of accidental disturbance. The minimum recommended size and configuration of these

areas are individually based on characterization of the site and delineation of the site's horizontal and vertical boundaries;

- Avoidance of the recommended 164-foot (50-meter) buffer around ancient submerged landform features;
- If avoidance of a feature or the recommended 164-foot (50-meter) buffer is not feasible as a result of micro-siting challenges or engineering design development, selection of feasible construction methods that minimize the extent of seabed disturbance associated with SRWEC or IAC construction to avoid adverse physical effects to ancient submerged landform features;
- For those ASLF that cannot be avoided, develop treatment plans with NHPA Section 106 consulting parties to resolve adverse effects to historic properties;
- Performing additional phased archaeological identification and evaluation investigations within previously inaccessible portions of the APE prior to any ground-disturbing activities;
- Develop and implement marine and terrestrial UDPs, including stop-work and notification procedures, during all ground and seafloor-disturbing activities associated with construction of the Proposed Action.

Even with these commitments, the Proposed Action would still result in adverse visual effects on above-ground historic properties and adverse physical effects to ancient submerged landform feature historic properties which would require mitigation to resolve those adverse effects. Therefore, the overall impacts on historic properties from the Proposed Action would qualify as **major** as it would result in adverse effects on historic properties, as defined at 36 *CFR* 800.5(a)(1), that would require mitigation to resolve.

Considering all the IPFs together, BOEM anticipates that the impacts on cultural resources from the Proposed Action and the reasonably foreseeable offshore wind projects would be **major** due to the long-term or permanent and irreversible impacts on 47 NRHP-listed/eligible historic above-ground properties as listed in Attachment C of Appendix Z of the Sunrise Wind Project COP (Sunrise Wind 2023a).

Cumulative Impacts from the Proposed Action

Construction impacts from the Proposed Action and reasonably foreseeable offshore wind projects could result in cumulative **major** adverse impacts and **minor beneficial** impacts on cultural resources. Port utilization/expansion associated with or induced by the growth of the offshore wind industry could result in indirect, negligible to major impacts on cultural resources. Onshore land disturbance from the Proposed Action and reasonably foreseeable offshore wind projects could result in negligible to major depending on the characteristics of individual resources and whether adverse effects can be avoided, minimized, or require mitigation. Cumulative impacts from marine accidental releases and lighting impacts from the Proposed Action and reasonably foreseeable offshore wind projects could result in negligible to minor impacts on cultural resources. Anchoring, new cable emplacement, and the construction of new offshore infrastructure (presence of structures) could result in negligible to major cumulative construction phase impacts on cultural resources depending on whether adverse effects to historic properties can be avoided, minimized, or require mitigation. The Proposed Action and present and reasonably foreseeable offshore wind project would also result in negligible to minor beneficial impacts to terrestrial, marine, and above-ground resources by slowing or arresting the effects of climate change.

Impacts from O&M activities from the Proposed Action and reasonably foreseeable offshore wind projects could result in cumulative moderate to major impacts to marine resources if a resource, whether previously identified or discovered during activities, cannot be avoided. Seafloor disturbance from O&M activities, which may impact marine resources, are generally less intrusive and widespread as those occurring during construction and installation. Furthermore, implementation of EPMs for Sunrise Wind and future wind farm projects would likely minimize or eliminate impacts to marine resources during O&M. Consequently, the cumulative impacts to marine resources from O&M would likely be negligible to minor.

Cumulative impacts to marine resources during decommissioning could result in major impacts to the resource if it cannot be avoided during activities required for removal of offshore facilities. Nevertheless, similar to cumulative impacts associated with O&M, potential impacts to marine resources during decommissioning would likely be negligible to minor. Conceptual decommissioning of other offshore wind projects in the GAA would contribute similar lighting impacts from nighttime vessel and construction area lighting as under the Proposed Action. Impacts may include light associated with decommissioning vessel traffic, which may slightly increase with decommissioning of the Proposed Action. Lighting from the Proposed Action combined with ongoing and planned activities could have negligible to minor impacts on cultural resources depending on the scale and intensity, largely determined by the number of visible lights and their proximity to resources, of the impacts and the unique characteristics of individual historic properties.

3.15.6 Alternative C-1 – Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions

Under the Fisheries Habitat Impact Minimization Alternative C-1, the construction, operation, maintenance, and eventual decommissioning of the 11-MW WTGs and an OCS-DC within the proposed Project Area and associated IAC and SRWEC would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, to potentially reduce impacts to complex fisheries habitats that are the most vulnerable to long-term impacts as compared to the Proposed Action, 8 WTG positions in the Priority Areas would be excluded from development (only 94 WTGs are needed to reach maximum capacity of up to 1,034 MW). The 8 WTG positions would be removed from Priority Areas 1, 2, 3, and/or 4 to minimize impacts to fisheries habitat.

3.15.6.1 Construction and Installation

3.15.6.1.1 Onshore Activities and Facilities

The onshore construction and installation activities proposed under Alternative C-1 are the same as those of the Proposed Action. Therefore, impacts to terrestrial and above-ground resources would be the same as those of the Proposed Action.

3.15.6.1.2 Offshore Activities and Facilities

Under the Proposed Action, construction of the proposed Project would avoid identified ASLF. Relocating WTG positions from these areas would not change planned avoidance of ASLF , and as such, Alternative C-1 would result in the same negligible to minor impacts to marine archaeological resources. The offshore construction and installation activities proposed under Alternative C-1 would have the same visual impact as the Proposed Action. As a result, the impact to above-ground resources would be the same as the Proposed Action.

3.15.6.2 Operations and Maintenance

3.15.6.2.1 Onshore Activities and Facilities

The onshore O&M activities proposed under Alternative C-1 are the same as those of the Proposed Action. Therefore, impacts to terrestrial and above-ground resources would the same as those of the Proposed Action.

3.15.6.2.2 Offshore Activities and Facilities

The offshore O&M activities proposed under Alternative C-1 are the same as those of the Proposed Action. Therefore, impacts to marine archaeological resources would the same as those of the Proposed Action.

Excluding development of 8 WTG positions from the Priority Areas even when combined with other proposed activities and measures to reduce WTG visibility would be insufficient to resolve adverse effects to historic properties. Since construction of the Sunrise Wind Project under Alternative C-1 would result in adverse effects on historic properties, as defined at 36 *CFR* 800.5(a)(1), that would require mitigation to resolve, approval of Alternative C-1 would have major impacts on cultural resources.

3.15.6.3 Conceptual Decommissioning

3.15.6.3.1 Onshore Activities and Facilities

The onshore decommissioning activities proposed under the Alternative C-1 are the same as those of the Proposed Action. Therefore, impacts to terrestrial and above-ground resources would be the same as those of the Proposed Action.

3.15.6.3.2 Offshore Activities and Facilities

The offshore O&M activities Proposed Alternative C-1 are the same as those of the Proposed Action. Therefore, impacts to marine archaeological resources and above-ground resources would be the same as those of the Proposed Action.

3.15.6.4 Cumulative Impacts of Alternative C-1

Cumulative impacts to cultural resources under Alternative C-1 would similar to those described under the Proposed Action.

3.15.6.5 Conclusions

Impacts of Alternative C-1

Alternative C-1 would result in the same **major** adverse impacts on marine and terrestrial cultural resources as the Proposed Action.

Cumulative Impacts of Alternative C-1

Alternative C-1 would result in the same **major** adverse impacts on marine and terrestrial cultural resources as the cumulative impacts of the Proposed Action. Additionally, Alternative C-1 and present and reasonably foreseeable offshore wind projects would also result in **minor beneficial** impacts to terrestrial, marine, and above-ground resources by slowing or arresting the effects of climate change.

3.15.7 Alternative C-2 – Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions and Relocation of up to 12 WTG Positions to the Eastern Side of the Lease Area

Under the Fisheries Habitat Impact Minimization Alternative C-2, the construction, operation, maintenance, and eventual decommissioning of the 11-MW WTGs and an OCS-DC within the proposed Project Area and associated IAC and SRWEC would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, to potentially reduce impacts to complex fisheries habitats that are the most vulnerable to long-term impacts as compared to the Proposed Action, up to 8 WTG positions would be excluded from development, and up to an additional 12 WTG positions would be relocated to currently unoccupied positions along the eastern side of the Lease Area. The up to 20 WTG positions (8 removed + 12 relocated) would be removed from Priority Areas 1, 2, 3, and/or 4 to minimize impacts to fisheries habitat.

3.15.7.1 Construction and Installation

3.15.7.1.1 Onshore Activities and Facilities

The onshore construction and installation activities proposed under Alternative C-2 are the same as those of the Proposed Action. Therefore, impacts to previously recorded terrestrial resources and above-ground resources would be the same as those of the Proposed Action.

3.15.7.1.2 Offshore Activities and Facilities

Under the Proposed Action, construction of the proposed Project would avoid identified ASLF. Relocating WTG positions from these areas would not change planned avoidance of ASLF , and as such, Alternative C-2 would result in the same negligible to minor impacts to marine archaeological resources.

The offshore construction and installation activities proposed under Alternative C-2 would have the same visual impact as the Proposed Action. As a result, the impact to above-ground resources would be the same as the Proposed Action.

3.15.7.2 Operations and Maintenance

3.15.7.2.1 Onshore Activities and Facilities

The onshore O&M activities proposed under Alternative C-2 are the same as those of the Proposed Action. Therefore, impacts to terrestrial and above-ground resources would be the same as those of the Proposed Action.

3.15.7.2.2 Offshore Activities and Facilities

The offshore O&M activities proposed under the Alternative C-2 are the same as those of the Proposed Action. Therefore, impacts to marine archaeological resources would be the same or less than the Proposed Action.

While excluding development 8 WTG positions in the Priority Areas could reduce the number of WTGs visible from onshore historic properties, the total reduction even when combined with other proposed activities and measures to reduce WTG visibility would be insufficient to resolve adverse effects to historic properties. Relocating 12 WTG positions from Priority Areas 1 and/or 2 to the eastern portion of the Lease Area would likely reduce the total number of WTGs visible from historic properties on Block Island, mainland Rhode Island, and mainland Massachusetts. However, the total number would be relatively low compared to the total number of WTGs (a roughly 12 percent reduction) and relocating these WTGs to the eastern end of the Lease Area could increase the number of WTGs visible from historic properties on Martha's Vineyard, including a large Native American TCP. Since construction of the SRWF under Alternative C-2 would result in adverse effects on historic properties, as defined at 36 *CFR* 800.5(a)(1), that would require mitigation to resolve, approval of Alternative C-2 would have major impacts on cultural resources.

3.15.7.3 Conceptual Decommissioning

3.15.7.3.1 Onshore Activities and Facilities

The onshore decommissioning activities proposed under Alternative C-2 are the same as those of the Proposed Action. Therefore, impacts to terrestrial and above-ground resources would be the same as those of the Proposed Action.

3.15.7.3.2 Offshore Activities and Facilities

The offshore decommissioning activities Proposed Alternative C-2 are the same as those of the Proposed Action. Therefore, impacts to marine archaeological resources and above-ground resources would be the same or less than the Proposed Action.

3.15.7.4 Cumulative Impacts of Alternative C-2

Cumulative impacts to cultural resources under Alternative C-2 would be the similar to those described under the Proposed Action.

3.15.7.5 Conclusions

Impacts from Alternative C-2

Alternative C-2 would result in the same **major** adverse impacts on marine and terrestrial cultural resources as the Proposed Action.

Cumulative Impacts from Alternative C-2

Alternative C-2 would result in the same **major** adverse impacts on marine and terrestrial cultural resources as the cumulative impacts of the Proposed Action. Additionally, Alternative C-2 and present and reasonably foreseeable offshore wind projects would also result in **minor beneficial** impacts to terrestrial, marine, and above-ground resources by slowing or arresting the effects of climate change.

3.15.8 Alternative C-3 - Reduced Layout from Priority Areas Considering Feasibility Due to Glauconite Sands

Under the Fisheries Habitat Impact Minimization Alternative C-3, the construction, O&M, and eventual decommissioning of the 11-MW WTGs and an OCS within the proposed Project Area and associated inter-array and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, Alternative C-3 was developed to address concerns regarding pile refusal due to glauconite sands in the southeastern portion of the Lease Area while still minimizing impacts to benthic and fisheries resources. Alternative C-3a, C-3b, and C-3c described in Section 3.7.8, *Benthic Resources*, consider different WTG configurations to avoid sensitive habitats and engineering constraints while still meeting the NYSERDA OREC. This alternative only considered removal of WTGs from Priority Area 1 based on consultation with NMFS. Areas with high density of boulder, complex habitat, and data suggesting Atlantic cod aggregation and spawning was considered when determining which WTGs to remove.

3.15.8.1 Construction and Installation

3.15.8.1.1 Onshore Activities and Facilities

The onshore construction and installation activities proposed under Alternative C-3 are the same as those of the Proposed Action. Therefore, impacts to previously recorded terrestrial resources and above-ground resources would be the same as those of the Proposed Action.

3.15.8.1.2 Offshore Activities and Facilities

Under the Proposed Action, construction of the proposed Project would avoid identified ASLF. Relocating WTG positions from these areas would not change planned avoidance of ASLF, and as such, Alternative C-3 would result in the same negligible to minor impacts to marine archaeological resources. The offshore construction and installation activities proposed under Alternative C-3 would have the same visual impacts as the Proposed Action. As a result, the impact to above-ground resources would be the same as the Proposed Action.

3.15.8.2 Operations and Maintenance

3.15.8.2.1 Onshore Activities and Facilities

The onshore O&M activities proposed under Alternative C-3 are the same as those of the Proposed Action. Therefore, impacts to terrestrial and above-ground resources would be the same as those of the Proposed Action.

3.15.8.2.2 Offshore Activities and Facilities

The offshore O&M activities proposed under the Alternative C-3 are the same as those of the Proposed Action. Therefore, impacts to marine archaeological resources would be the same or less than the Proposed Action.

While reducing the total number of WTGs to a maximum of 87 would reduce the number of WTGs visible from onshore historic properties, the total reduction even when combined with other proposed activities and measures to reduce WTG visibility would be insufficient to resolve adverse effects to historic properties. Since construction of the SRWF under Alternative C-3 would result in adverse effects on historic properties, as defined at 36 *CFR* 800.5(a)(1), that would require mitigation to resolve, approval of Alternative C-3 would have major impacts on cultural resources.

3.15.8.3 Conceptual Decommissioning

3.15.8.3.1 Onshore Activities and Facilities

The onshore decommissioning activities proposed under Alternative C-3 are the same as those of the Proposed Action. Therefore, impacts to terrestrial and above-ground resources would be the same as those of the Proposed Action.

3.15.8.3.2 Offshore Activities and Facilities

The offshore decommissioning activities Proposed Alternative C-3 are the same as those of the Proposed Action. Therefore, impacts to marine archaeological resources and above-ground resources would be the same or less than the Proposed Action.

3.15.8.4 Cumulative Impacts of Alternative C-3

Cumulative impacts to cultural resources under Alternative C-3 would be the similar to those described under the Proposed Action.

3.15.8.5 Conclusions

Impacts from Alternative C-3

Alternative C-3 would result in the same **major** adverse impacts on marine and terrestrial cultural resources as the Proposed Action.

Cumulative Impacts from Alternative C-3

Alternative C-3 would result in the same **major** adverse impacts on marine and terrestrial cultural resources as the cumulative impacts of the Proposed Action. Additionally, Alternative C-3 and present and reasonably foreseeable offshore wind projects would also result in **minor beneficial** impacts to terrestrial, marine, and above-ground resources by slowing or arresting the effects of climate change.

3.15.9 Comparison of Alternatives

BOEM has compared the impacts resulting from individual IPFs under Alternatives C-1, C-2, and C-3 to the Proposed Action (Alternative B) and determined that the impacts on terrestrial cultural resources for each alternative would be similar to those of the Proposed Action. The onshore construction and installation activities proposed under Alternatives C-1, C-2, and C-3 are the same as those of the Proposed Action and, as a result, the physical impacts to terrestrial archaeological resources would be the same as those of the Proposed Action. BOEM anticipates the Proposed Action and Alternatives C-1, C-2, and C-3 would have negligible impacts to previously identified archaeological resources and, if undiscovered resources are encountered, could have negligible to major impacts depending on the extent and scale of impacts, the characteristics of individual resources, and whether adverse effects can be avoided, minimized, or require mitigation.

Impacts to marine archaeological resources under Alternative C-1, C-2, and C-3 would be the same as those under the Proposed Action. Under the Proposed Action, construction of the proposed Project plans for avoidance of ASLF, and construction of the project would result in negligible to minor impacts to marine archaeological resources. Viewshed impacts on historic properties under Alternatives C-1, C-2, and C-3 would also be the same as those under the Proposed Action. Excluding placement of WTGs in the northwest corner of the Lease Area could reduce impacts to resources on Block Island and in Rhode Island, but not to an extent that would avoid major impacts.

Table 3.15-8. Comparison of Alternative Impacts on Cultural Resources

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
No Action Alternative: BOEM anticipates that the cultural resource impacts as a result of ongoing activities associated with the Alternative A - No Action of ongoing activities would be **major** adverse. *Cumulative Impacts of No Action Alternative:* BOEM anticipates that the overall cumulative impacts associated with Alternative A, the No Action Alternative, when combined with all other planned activities (including offshore wind) in the GAA would result in overall **major** impacts on individual onshore and offshore cultural resources depending on the scale and extent of impacts and the unique characteristics of individual resources. The construction and operation of reasonably foreseeable offshore wind projects would also have **minor beneficial** impacts on individual onshore and offshore cultural	*Proposed Action:* Based on the preceding IPF analysis, BOEM has determined that the Proposed Action would likely result in **major** adverse impacts on cultural resources. The Proposed Action would still result in adverse visual effects on above-ground historic properties which would require mitigation to resolve those adverse effects. Therefore, the overall impacts on historic properties from the Proposed Action would qualify as **major** as it would result in adverse effects on historic properties, as defined at 36 *CFR* 800.5(a)(1), that would require mitigation to resolve. Considering all the IPFs together, BOEM anticipates that the cumulative impacts on cultural resources from the Proposed Action and the reasonably foreseeable offshore wind projects would be **major** due to the long-term or permanent and irreversible impacts on 47 NRHP-	*Alternative C-1:* Alternative C-1 would result in the same **major** adverse impacts on marine and terrestrial cultural resources as the Proposed Action. *Cumulative Impacts of Alternative C-1:* Alternative C-1 would result in the same **major** adverse impacts and **minor beneficial** cumulative impacts on marine and terrestrial cultural resources as the cumulative impacts of the Proposed Action.	*Alternative C-2:* Alternative C-2 would result in the same **major** adverse impacts on marine and terrestrial cultural resources as the Proposed Action. *Cumulative Impacts of Alternative C-2:* Alternative C-2 would result in the same **major** adverse impacts and **minor beneficial** cumulative impacts on marine and terrestrial cultural resources as the cumulative impacts of the Proposed Action.	*Alternative C-3:* Alternative C-3 would result in the same **major** adverse impacts on marine and terrestrial cultural resources as the Proposed Action. *Cumulative Impacts of Alternative C-3:* Alternative C-3 would result in the same **major** adverse impacts and **minor beneficial** cumulative impacts on marine and terrestrial cultural resources as the cumulative impacts of the Proposed Action.

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
resources as these projects would make incremental contributions to arresting the pace of global warming and climate change and associated impacts on cultural resources.	listed/eligible historic above-ground properties. *Cumulative Impacts of the Proposed Action:* Construction impacts from the Proposed Action and reasonably foreseeable offshore wind projects could result in cumulative **major** adverse impacts and **minor beneficial** impacts on cultural resources. Impacts from operations and maintenance activities from the Proposed Action and reasonably foreseeable offshore wind projects could result in cumulative **major** impacts to marine resources.			

3.15.10 Summary of Impacts of the Preferred Alternative

BOEM has identified Alternative C-3b as the Preferred Alternative as depicted in Figure 2.1-10. Alternative C-3b would include installation of up to 84 WTGs, which is 10 fewer WTGs than the maximum WTGs proposed under the PDE of the Proposed Action. Alternative C-3b would result in the same **major** impacts on marine and terrestrial cultural resources as the Proposed Action.

3.15.11 Proposed Mitigation Measures

The mitigation measures listed in Table 3.15-9 are recommended for inclusion in the Preferred Alternative.

Table 3.15-9. Proposed Mitigation Measures: Cultural Resources

Measure	Description	Effect
Historic Properties Treatment Plans	BOEM, with the assistance of Sunrise Wind, would develop and implement one or multiple 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. Historic Properties Treatment Plans would also provide details and specification for actions consisting of mitigation measures to resolve adverse visual effects and cumulative adverse visual effects on The Scrubby Neck Schoolhouse, Town of West Tisbury, Dukes County, MA; t the Block Island Southeast Lighthouse, NHL, Town of New Shoreham, Washington County, RI; the Bellevue Avenue Historic District, NHL, Newport, RI; the Ocean Drive Historic District, NHL, Newport, RI; The Breakers, NHL, Newport, RI; the Point Judith Lighthouse, Narragansett, RI; the Chappaquiddick Island TCP and the Vineyard Sound & Moshup's Bridge TCP, Dukes County, MA, and the Outer Continental Shelf; Five Historic Properties, Town of Chilmark, Dukes County, MA; Twenty-Four Historic Properties, Town of New Shoreham, Washington County, RI; Ten Historic Properties, Town of Aquinnah, Dukes County, MA.	Mitigation
Funding compensatory mitigation to resolve adverse effects of Scrubby Neck Schoolhouse	Provide funding for the development of an NRHP nomination.	Mitigation
Funding compensatory mitigation to resolve adverse effects on Block Island Southeast Lighthouse NHL	1. Provide funding for the next phase of physical restoration at the NHL. 2. Provide funding for additional aesthetic enhancement at the NHL parking area and entrance, as well as improve the surrounding landscape at these areas.	Mitigation
Funding compensatory mitigation to resolve adverse effects to the Bellevue Avenue Historic District NHL	1. Provide funding for planning studies for energy efficiency, GHG-reduction, HVAC/Climate Controls of public or publicly-accessible contributing resources consistent with the Secretary of Interior's standards and collections conservation needs; 2. Provide funding for aesthetic enhancements to existing landscape features (fencing/plantings/hardscaping) consistent with historic landscape designs; and/or 3. Provide funding for HALS documentation of the NHL.	Mitigation
Funding compensatory mitigation to resolve adverse effects to the Ocean Drive Historic District NHL	1. Provide funding for a Planning, Conditions Assessment, or Feasibility Study for The Bells/The Reefs Property in Brenton State Park. 2. Provide funding for Cultural Landscape Studies. 3. Provide funding for HALS documentation of the NHL.	Mitigation

Measure	Description	Effect
Funding compensatory mitigation to resolve adverse effects to The Breakers Historic District NHL	Provide funding for future phases of The Breakers Landscape Revival Project or related projects associated with the RIHPHC-approved Breakers Landscape Master Plan (see https://newportmansions.thankyou4caring.org/pages/support-the-capital-priorities).	Mitigation
Funding compensatory mitigation to resolve adverse effects to the Point Judith Lighthouse	Provide funding for a Cyclical Maintenance Plan.	Mitigation
Funding compensatory mitigation to resolve adverse effects on the Chappaquiddick Island TCPMA and Outer Continental Shelf	1. Provide funding for scholarships and training for Tribal resources stewardship. 2. Provide funding for a survey and risk assessment of shoreline cultural sites.	Mitigation
Funding compensatory mitigation to resolve adverse effects on Vineyard Sounds and Moshup's Bridge TCP, MA and Outer Continental Shelf	1. Provide funding for scholarships to Mashpee/Aquinnah Tribal members enrolling in accredited colleges or professional training programs for marine sciences, marine construction, geophysics, geology, history, anthropology, archaeology, environmental sciences, or indigenous studies. 2. Provide funding for habitat restoration to preserve, recover, and enhance culturally sensitive species that contribute to the significance of the TCP.	Mitigation
Funding compensatory mitigation to resolve adverse effects on Five Historic Properties, Town of Chilmark, MA	Provide funding for a Historic Stone Wall Survey and Preservation Plan.	Mitigation
Funding compensatory mitigation to resolve adverse effects on Twenty-Four Historic Properties, Town of New Shoreham, RI	Provide funding for Coastal Resiliency Planning and Implementation, including: - Investigations to identify engineering solutions for specific at-risk properties, including historic roadways, breakwaters, stone walls or other cultural features that contribute to the historic setting of individual properties and districts. May include feasibility studies to assess relocation of at-risk historic buildings to BI Trust or Town lands and public interpretation. - Implementation of select resilience projects to mitigate coast hazards to specific historic properties or significant cultural features contributing to the historic maritime setting of districts or buildings.	Mitigation
Funding compensatory mitigation to resolve adverse effects on Ten Historic Properties, Town of Aquinnah, MA	1. Provide funding for completion of the planned curtain wall restoration and/or lantern deck restoration projects at the Gay Head Lighthouse property. 2. Provide funding to support maintenance activities for the long-term preservation of town-owned historic buildings, structures, and landscapes in and around the Gay Head – Aquinnah Shops Area, Gay Head - Aquinnah Town Center	Mitigation

Measure	Description	Effect
	Historic District, and the Edwin DeVries Vanderhoop Homestead.	
Avoid or mitigate impacts on identified archaeological resources	Sunrise Wind must avoid any identified archaeological resource or TCP, including avoidance of 50-meter buffers for identified archaeological resources. If Sunrise Wind 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 purposes of resolving adverse effects per 36 *CFR* 800.6. If Sunrise Wind determines it cannot avoid an archaeological resource or TCP after the ROD has been issued, additional Section 106 consultation would be required.	Avoidance and Mitigation
Archaeological monitoring and unanticipated discovery plans	Implementation of archaeological monitoring and unanticipated discoveries plans for terrestrial and submerged archaeology, which include training and orientation for construction staff, designation of an Archaeologist and Qualified Marine Archaeologist (QMA), and unanticipated discovery procedures and contacts, to reduce potential impacts on any previously undiscovered archaeological resources (if present) encountered during construction.	Minimization

3.15.11.1 Effect of Measures Incorporated into the Preferred Alternative

The mitigation measures listed in Table 3.15-9 are recommended for inclusion in the Preferred Alternative. Mitigation and minimization measures as described in Table 3.15-9 would provide additional information to enhance the support, interpretation, and public education relating to the adversely effected historic properties as detailed in the Memorandum of Agreement. These measures, if adopted, would have no reducing effect to the overall **major** impacts of the Preferred Alternative.

3.16 Demographics, Employment, and Economics

Please see Appendix Q, Section 3.16 for the analysis of the Demographics, Employment and Economics resource.

3.17 Environmental Justice

This section discusses environmental justice (EJ) impacts from the proposed Project, alternatives, and ongoing and planned activities in the GAA. The GAA for EJ, as shown in Figure D-14 in Appendix D, includes the counties where proposed onshore infrastructure and potential port cities are located, as well as the counties closest to the WTA, and/or counties immediately adjacent to counties with ports: Suffolk County, Albany County, Rensselaer County, Kings County and New York County, New York; New London County, Connecticut; Baltimore County and the city of Baltimore, Maryland; Bristol County, Barnstable County, Dukes County, Nantucket County, and Plymouth County, Massachusetts; Gloucester County, New Jersey; Providence County, Washington County, Kent County and Newport County, Rhode Island; and the city of Norfolk, Virginia. These counties (or cities) are the most likely to experience beneficial or adverse EJ impacts from the proposed Project related to onshore and offshore construction and use of port facilities.

EJ impacts are characterized for each IPF as negligible, minor, moderate, or major using the four-level classification scheme outlined in Section 3.17.3. A determination of whether impacts are "disproportionately high and adverse" in accordance with Executive Order 12898 is provided in the conclusion sections for the Proposed Action and action alternatives.

3.17.1 Description of the Affected Environment and Future Baseline Conditions

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires that "each Federal agency shall make achieving EJ part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Subsection 1-101). When determining whether environmental effects are disproportionately high and adverse, agencies are to consider whether there is or would be an impact on the natural or physical environment that significantly and adversely affects a minority population, low-income population, or Indian tribe, including ecological, cultural, human health, economic, or social impacts; and whether the effects appreciably exceed those on the general population or other appropriate comparison group (CEQ 1997). Beneficial impacts are not typically considered EJ impacts; however, this section identifies beneficial effects on EJ populations, where appropriate, for completeness.

Executive Order 12898 directs federal agencies to consider the following with respect to EJ as part of the NEPA process (CEQ 1997):

- The racial and economic composition of affected communities;
- Health-related issues that may amplify Project effects on minority or low-income individuals; and
- Public participation strategies, including community or tribal participation in the NEPA process.

According to USEPA guidance, EJ analyses must address disproportionately high and adverse impacts on minority populations (i.e., who are non-white, or who are white but have Hispanic ethnicity) when minority populations represent over 50 percent of the population of an affected area or when the percentage of minority or low-income populations in the affected area is "meaningfully greater" than the minority percentage in the "reference population"—defined as the population of a larger area in which the affected population resides (i.e., a county, state, or region depending on the geographic extent of the analysis area). Low-income populations are those that fall within the annual statistical poverty thresholds from the United States Department of Commerce, Bureau of the Census, Population Reports, Series P-60 on Income and Poverty (USEPA 2016b).

In addition, with the recent passing of Executive Order 14096 – *Revitalizing Our Nation's Commitment to Environmental Justice for All* there is renewed commitment to being detailed and comprehensive in EJ analyses. As such, BOEM's EJ working group is conducting a best practices study as well as technical workshops to further expand upon these EJ elements.

To evaluate the potential for a disproportionately high and adverse health or environmental impact on an EJ community (defined as minority and/or low-income), it is necessary to identify whether an EJ community is present within the GAA (as shown in Appendix D) for the proposed Project. Recent and relevant data is collected and measured against a community of comparison (or reference population) to determine the presence of EJ communities. To have a comprehensive and transparent approach to EJ community identification, a two-prong approach was implemented whereby EJ communities were identified using both the federal CEQ guidance as well as the state-specific guidance, where available. The Federal CEQ guidance, and state-specific information relative to EJ is presented in the following text and Table 3.17-1 as well as methodology and EJ community identification.

Therefore, by using this conservative approach of utilizing both federal and state guidance, it provides further assurance that the greatest number of EJ communities are identified and noted within the analysis. Using this analysis results in an exhaustive list of census block groups, the details are noted in Appendix B (*Supplemental Information and Additional Figures and Tables*). The figures depicted within this section present the analysis at the census block group level.

<u>Federal CEQ Environmental Justice Guidance</u>

Based upon CEQ's EJ guidance under NEPA, race includes minorities, which are groups that include American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. Minority populations are defined where either (a) the minority population of the impacted area exceeds 50 percent or (b) the minority population of the impacted area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis (CEQ 1997).

CEQ and USEPA guidance do not define *meaningfully greater* in terms of a specific percentage or other quantitative measure. As such, this analysis defines an EJ population as a census block group that either (1) meets USEPA's "50 percent" criterion for race, or (2) is in the 80th or higher percentile for minority or low-income status as compared to the state population in which it is located. USEPA EJ Screening and Mapping Tool data were used to assess the 50 percent criterion for race and the 80th percentile criterion for minority and low-income status (USEPA 2022b).

State Environmental Justice Guidance

In addition to Executive Order 12898, CEQ EJ guidance and other federal guidance, several states within the GAA also have EJ-specific guidance that should be considered. Depending on the state this may range from a discussion of how EJ impacts should be considered within different types of analyses to providing enhanced EJ thresholds and GIS datasets of EJ communities through their own self-identification methodologies. State-specific EJ guidance, policies, and resources for those states within the GAA is presented in Table 3.17-1, followed by additional information on how this information was accounted for in the EJ analysis.

Table 3.17-1. Environmental Justice Offices, Policies and Resources for States in the Geographic Analysis Area

State	State Agency/Department and EJ Policies	Description	State Definitions of an Environmental Justice Community	Source
Connecticut	Connecticut Department of Energy & Environmental Protection (CT DEEP), EJ Program Connecticut Department of Economic and Community Development (DECD) maintains a list of "distressed municipalities."	CT DEEP EJ policy, effective in 1993, incorporates EJ principals into its program development, policy making, and regulatory activities. CT DEEP maintains a digital map of EJ communities on its website. CT law Section 22a-20a of the Connecticut General Statutes, effective in 2020, defines "EJ Community" and provides additional procedures for permit applicants and CT DEEP to follow (analysis, public participation, and more) when evaluating permit applications located in EJ communities.	Per CT law – General Statutes 22a-20a: EJ community is defined as (1) a U.S. census block group where 30% or more of the population has an income below 200% of the federal poverty level; or (2) on the DECD distressed municipality list.	CT DEEP. 1993. CT DEEP. 2022. CT DEEP. 2021.
Maryland	Maryland Department of the Environment (MDE) Commission on EJ and Sustainable Communities (CEJSC), advises the state government regarding EJ issues.	The CEJSC was established in 2001 by Executive Order and codified into Maryland law in 2003 (Section 1-701 of the Environment Article of the Md. Ann. Code). CEJSC is broadly tasked with reviewing and analyzing Maryland laws and policies pertaining to EJ issues, including state agency programs and permits. According to its 2020-2021 annual report, CEJSC is developing criteria to identify vulnerable communities and prioritizing action strategies toward the identified areas of the state that need immediate attention.	There are no required EJ identification methods or tools identified. The MDE maintains a webpage of EJ identification tools referencing USEPA methods: https://mde.maryland.gov/programs/crossmedia/EnvironmentalJustice/Pages/webtools.aspx	Maryland Commission on EJ and Sustainable Communities. 2021.
Massachusetts	Executive Office of Energy and Environmental Affairs (EEA), EJ Policy of the EEA (2021). Massachusetts Department of	The EEA updated its 2002 EJ policy in 2021 and codified its definition of EJ neighborhoods. It maintains a map of EJ populations online. Mass DEP's EJ Strategy and Public Involvement Plan is in development.	One or more of the following are true: 1. The annual median household income is not more than 65% of the statewide income.	EEA. 2021. EEA. 2020.

State	State Agency/Department and EJ Policies	Description	State Definitions of an Environmental Justice Community	Source
	Environmental Protection (MassDEP)	Passed in 2021, Massachusetts' new climate law requires MassDEP to incorporate new EJ requirements into its Massachusetts Environmental Policy Act (MEPA) processes for issuing permits.	2. Minorities comprise 40% or more of the population. 3. 25% or more of households lack English language proficiency. 4. Minorities comprise 25% or more of the population and the annual median household income of the municipality in which the neighborhood is located does not exceed 150% of the statewide annual median household income.	
New Jersey	New Jersey Department of Environmental Protection (NJ DEP) – Office of EJ	NJ DEP's Office of EJ aims to empower residents andcommunities who are often outside of the decision-making process of government, address environmental concerns to improve the quality of life in New Jersey's overburdened communities, and guidestate agencies and the NJ DEP's program areas in incorporating EJ. On September 18, 2020, the Governor signed the New Jersey's EJ Law which defines the criteria by which an Overburdened Community are identified.	New Jersey's EJ Law criteria: 1. At least 35 percent of the households qualify as low-income households (at or below twice the poverty threshold as determined by the United States Census Bureau). 2. At least 40 percent of the residents identify as minority or as members of a state recognized tribal community. 3. At least 40 percent of the households have limited English proficiency (without an adult that speaks English "very well" according to the United States Census Bureau).	NJ DEP Office of EJ. 2022.
New York	New York State Department of Environmental	NYSDEC provides guidance for incorporating EJ concerns into its permitting processes. Policy 29 is from 2003 and aimed at effective public	Policy 29 identifies minority and low-income communities (i.e., census block groups or contiguous area with multiple	NYSDEC. 2003. NYSDEC. 2022. NYSERDA. 2021.

State	State Agency/Department and EJ Policies	Description	State Definitions of an Environmental Justice Community	Source
	Conservation (NYSDEC) is the New York agency focused on EJ, but w York State Energy Research and Development Authority (NYSERDA), the New York Power Authority, and others are involved. NYSDEC Commissioner Policy 29, EJ and Permitting (2003)	participation and providing opportunities for communities and project sponsors to resolve issues of concern to affected Potential EJ Areas (PEJAS). NYSDEC maintains a webpage dedicated to "Maps and geographic information system (GIS) tools for EJ" and designates PEJAs using relevant race and income Census data on an online map. Note: the New York Climate Justice Working Group is currently developing criteria and a definition of "disadvantaged communities" for purposes of implementing the 2019 New York Climate Justice and Community Protection Act. This may impact the identification of EJ communities in the future, but as of February 2022, this work is meant to direct funding towards disadvantaged communities and no official NYSDEC EJ policies have changed.	census block groups) at 51.1 % for minority communities in an urban area and 23.59 % for low-income communities. NYSDEC Maps and GIS Tools for EJ webpage and map thresholds: - At least 52.42% minority community in an urban area. - At least 26.28% minority community in a rural area. - At least 22.82% of the population in an urban or rural area had household incomes below the federal poverty level.	
Rhode Island	Rhode Island Department of Environmental Management (RIDEM) Policy for Considering EJ in the Review of Investigation and Remediation of ContaminatedProperties (2009)	Requires proactive consideration of EJ issues relative to site investigations and property site remediation projects. RIDEM mapped the locations of EJ focus areas, which provide the basis for minimum notice requirements for the investigation and clean-up of contaminated sites.	RIDEM follows USEPA EJ identification guidelines when designated EJ Focus Areas but compares the block groups on a statewide basis instead of a regional one. RIDEM also mapped areas where the percent of the block group that is minority or low-income are high enough to rank in the top 15% of block groups statewide.	RIDEM. 2009. RIDEM. 2022.
Virginia	Virginia Council on EJ (VCEJ), formed in 2019 by Executive Order. Virginia Department of Environmental Quality (VADEQ). VADEQ	In 2019, Virginia Governor Northam issued Executive Order-29 and the VCEJ, which aims to address consistency in how EJ issues are evaluated at the state level.	Virginia does not have an official EJ identification policy at this time (February 2022), but that would change as the VADEQ and VCEJ establish concrete EJ policies that they are currently in the process of creating.	VADEQ. 2020.

State	State Agency/Department and EJ Policies	Description	State Definitions of an Environmental Justice Community	Source
	established an Office of EJ in April 2021 and an Interagency EJ Work Group in August 2021.	The 2020 Virginia General Assembly underscored the Commonwealth's and VADEQ's commitment to EJ by passing the EJ Act. As of February 2022, Virginia agencies (and the VADEQ in particular) are in the process of rolling out new EJ policies.		

Notes:

CEJSC – Commission on EJ and Sustainable Communities; CT DEEP – Connecticut Department of Energy & Environmental Protection; DECD – (Connecticut) Department of Economic and Community Development; DEP – Department of Environmental Protection (New Jersey); MassDEP – Massachusetts Department of Environmental Protection; MDE – Maryland Department of the Environment; MEPA – Massachusetts Environmental Policy Act; NJ DEP – New Jersey Department of Environmental Protection; NYSDEC – New York State Department of Environmental Conservation; RIDEM – Rhode Island Department of Environmental Management; VADEQ – Virginia Department of Environmental Quality; VCEJ – Virginia Council on EJ

3.17.1.1 New York

New York identifies an EJ community as a Potential EJ Area (PEJA) which are U.S. Census block groups that meet one or more of the following criteria (NYSDEC 2022): (1) at least 52.42 percent of the population in an urban area reported themselves to be members of minority groups, (2) at least 26.28 percent of the population in a rural area reported themselves to be members of minority groups, and (3) at least 22.82 percent of the population in an urban or rural area has household incomes below the federal poverty level.

NYSDEC's specific data set PEJA was utilized for this analysis. PEJA has the same general meaning as EJ community. The specific GIS dataset from NYSDEC provides identification of PEJA at the census block group level.

EJ communities in New York's portion of the GAA census block groups that meet criteria of a PEJA are clustered around larger cities and towns near both the potential cable landing sites onshore and potential ports in Suffolk, Albany, Kings, New York and Rensselaer counties (Table 3.17-3, Table 3.17-4, Figure 3.17-1, Figure 3.17-2, Figure 3.17-3, Figure 3.17-4, and Figure 3.17-5).

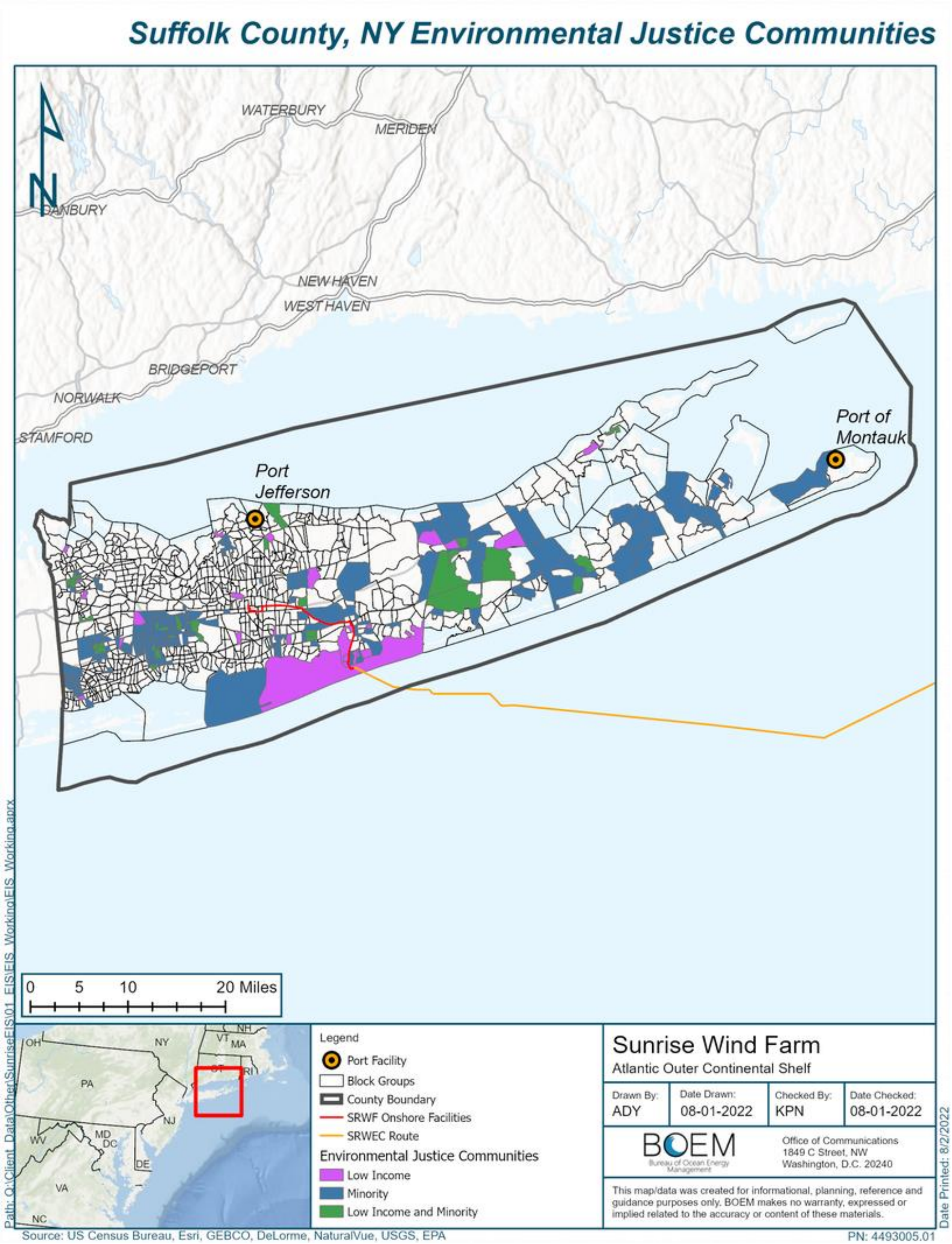


Figure 3.17-1. Environmental Justice Communities Identified in Suffolk County, NY

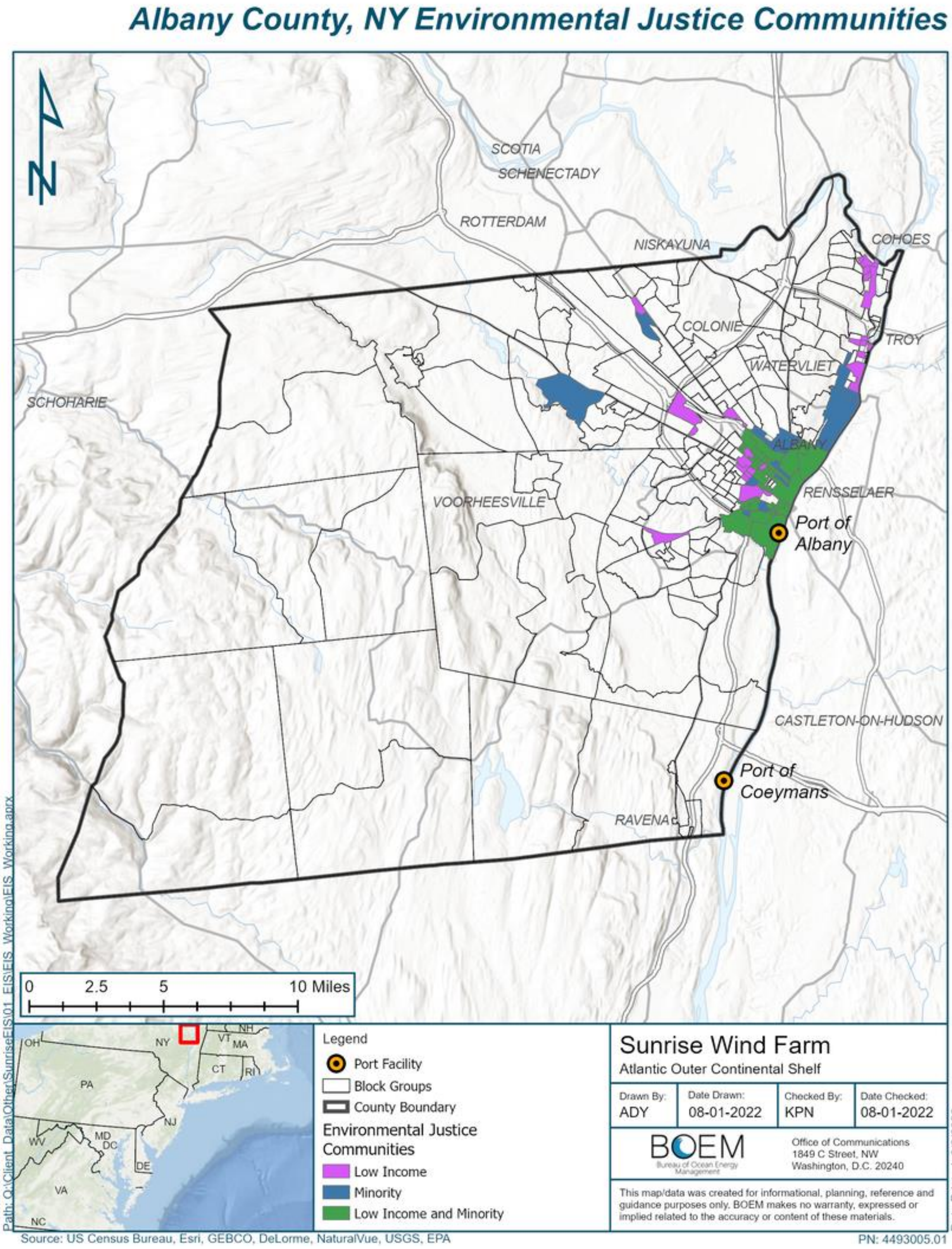


Figure 3.17-2. Environmental Justice Communities Identified in Albany County, NY

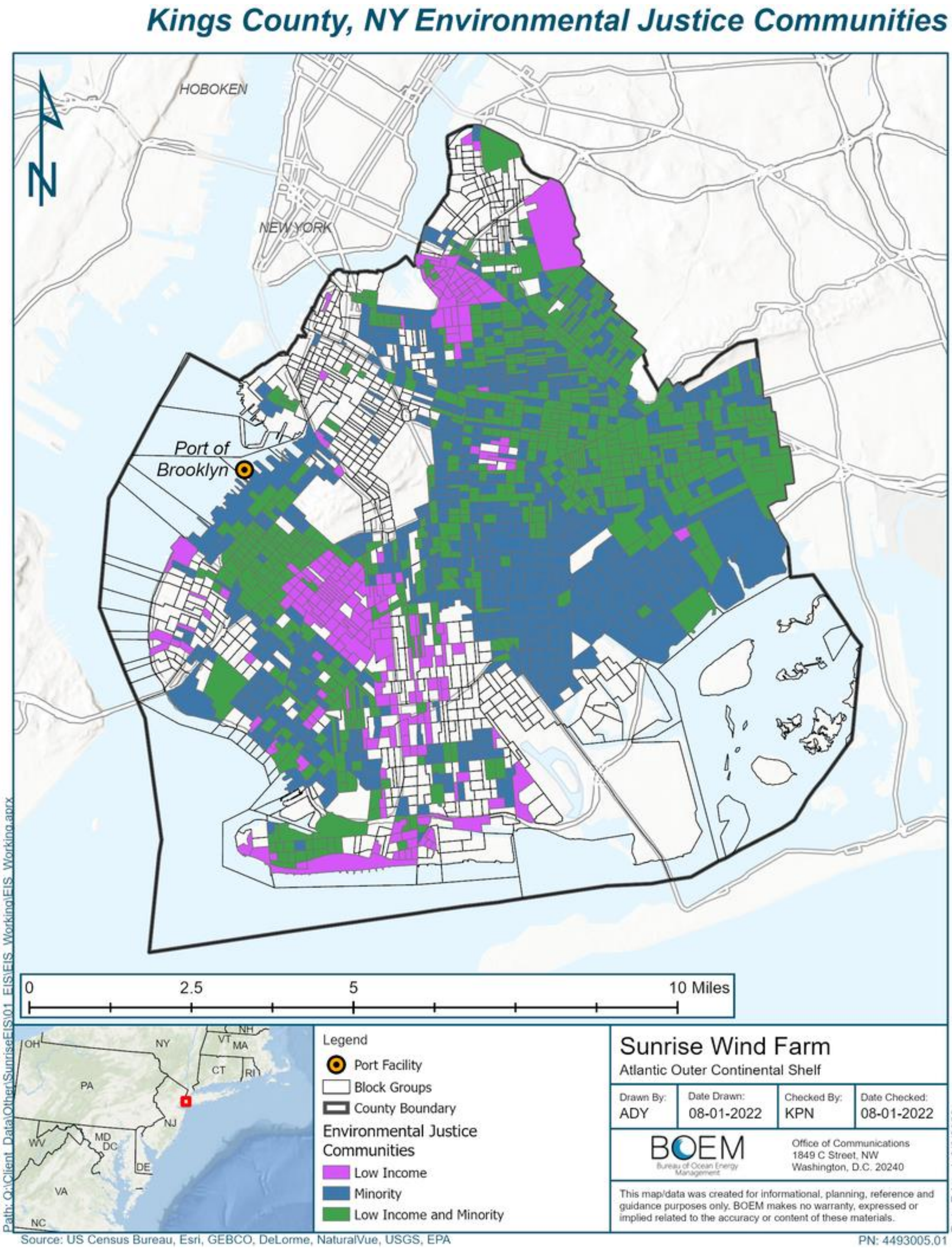


Figure 3.17-3. Environmental Justice Communities Identified in Kings County, NY

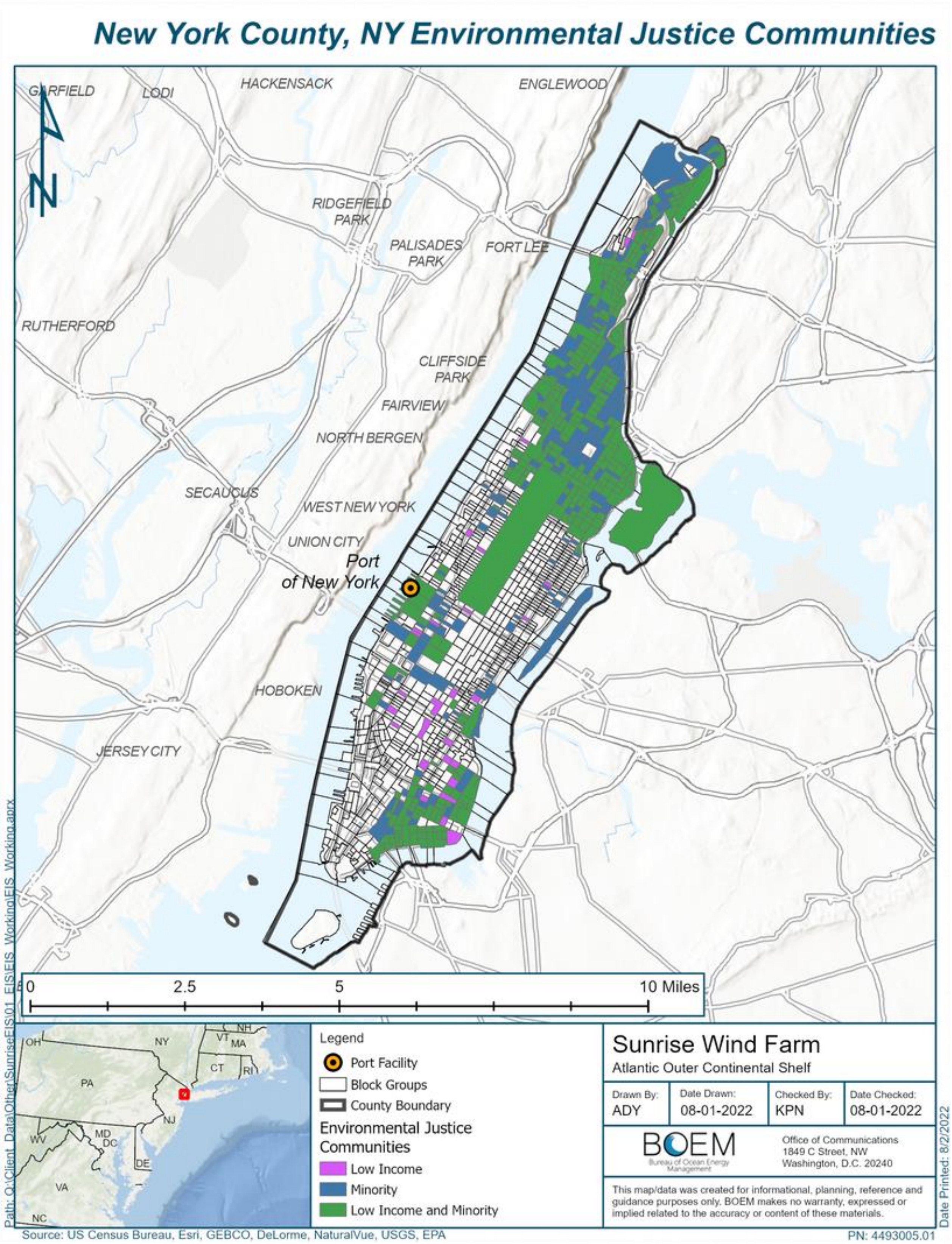


Figure 3.17-4. Environmental Justice Communities Identified in New York County, NY

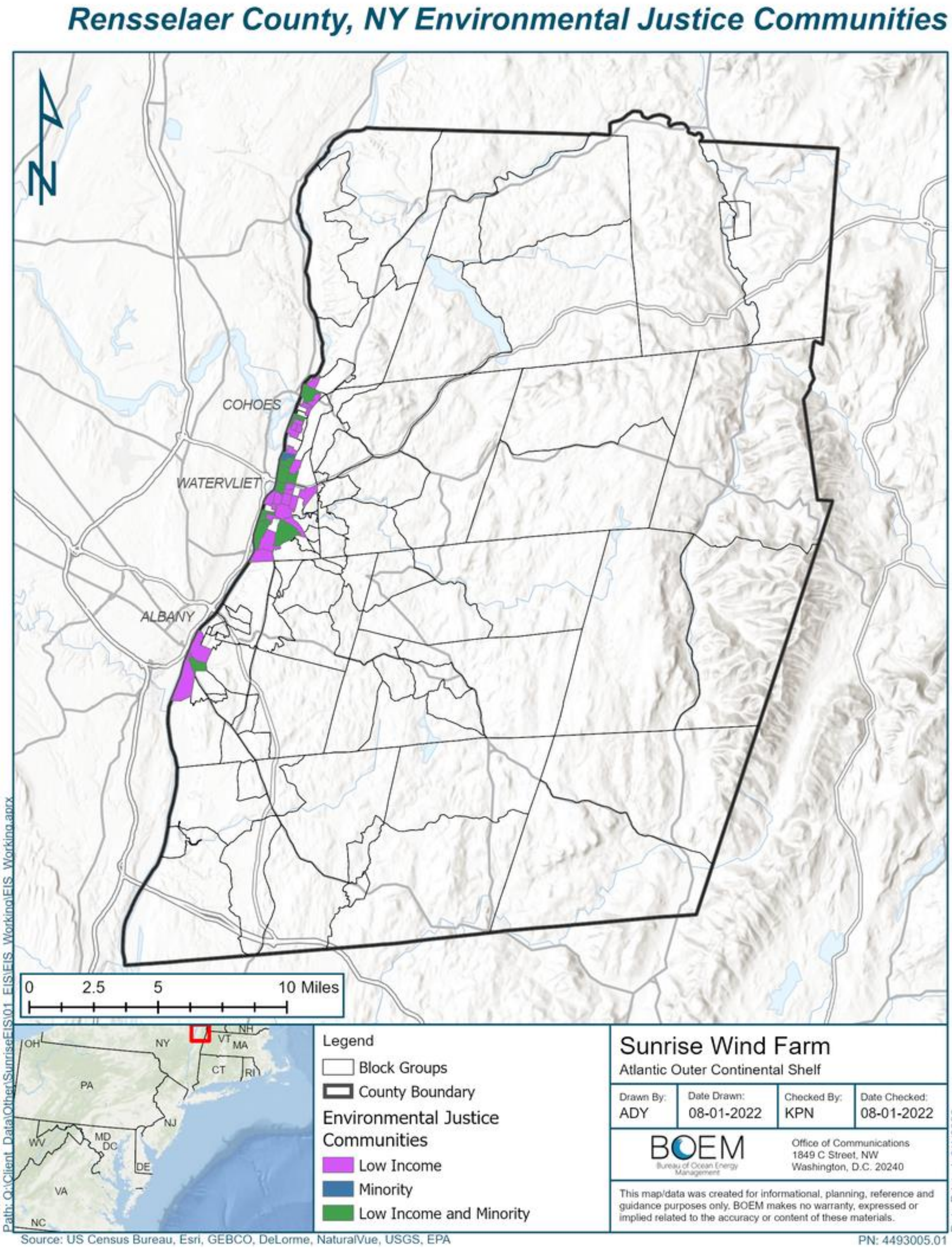


Figure 3.17-5. Environmental Justice Communities Identified in Rensselaer County, NY

3.17.1.2 New Jersey

New Jersey identifies an EJ community as an Overburdened Community (OBC), which are U.S. Census block groups that utilize low-income, composition of minority or state recognized tribal communities, and limited English proficiency as part of its criteria (EJ Law, N.J.S.A. 13:1D-157).

An OBC, as defined by the New Jersey's EJ Law, is any census block group, as determined in accordance with the most recent United States Census, in which:

- at least 35 percent of the households qualify as low-income households (at or below twice the poverty threshold as determined by the United States Census Bureau);
- at least 40 percent of the residents identify as minority or as members of a State recognized tribal community; or
- at least 40 percent of the households have limited English proficiency (without an adult that speaks English "very well" according to the United States Census Bureau).

For this analysis, the specific dataset from the New Jersey Department of Environmental Protection (NJ DEP) for OBCs was obtained, which provides identification of OBCs at the census block group level.

EJ communities in New Jersey's portion of the GAA that meet criteria for OBCs are clustered around larger cities and towns near the potential ports in Gloucester County (Table 3.17-3, Table 3.17-4, and Figure 3.17-6).

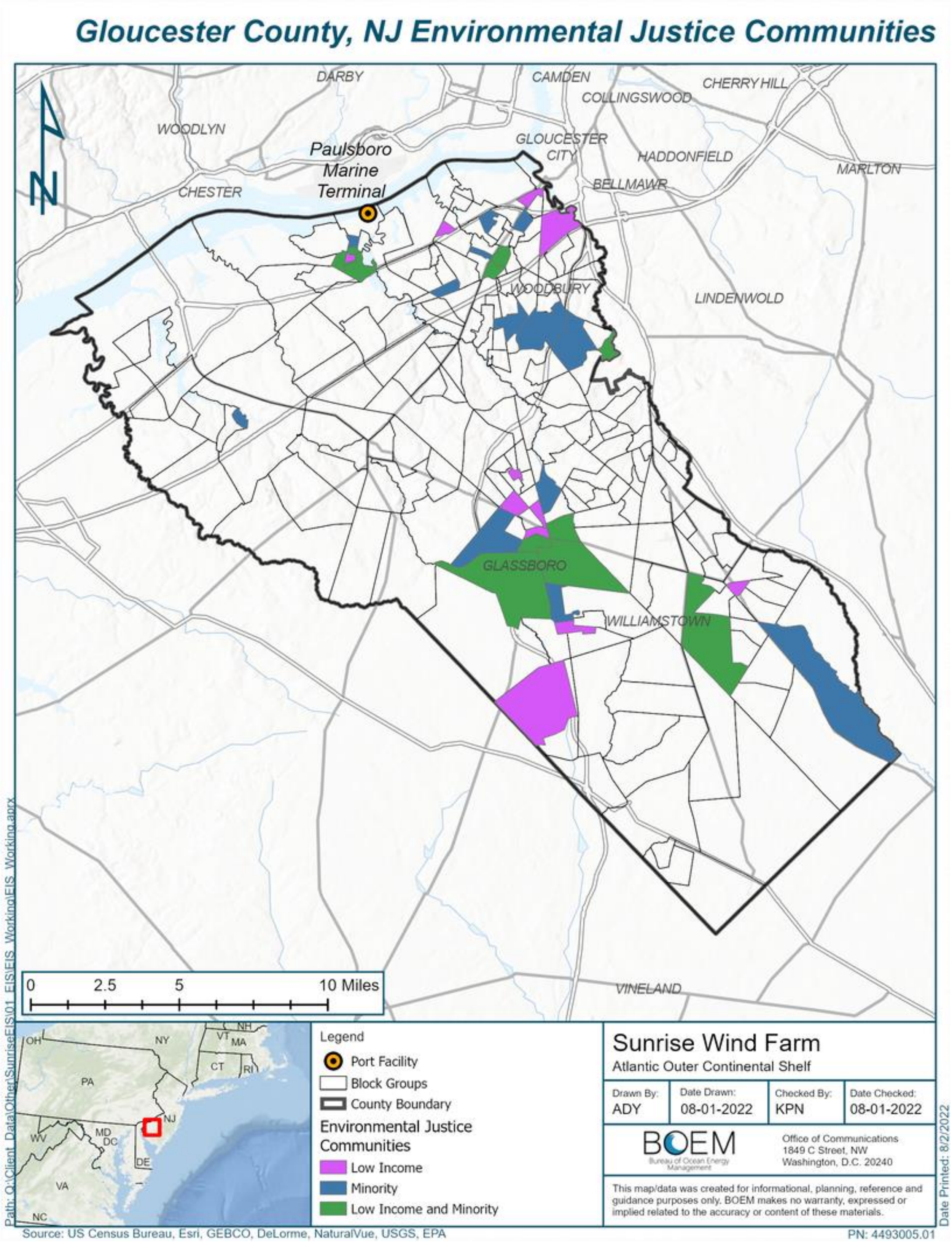


Figure 3.17-6. Environmental Justice Communities Identified in Gloucester County, NJ

3.17.1.3 Connecticut

Connecticut's state law Section 22a-20a, defines an EJ community as a community located in a municipality on the Connecticut DECD list of distressed municipalities or in a census block group that is not in a distressed municipality in which 30 percent or more of the population lives below 200 percent of the federal poverty level. The law provides additional procedures for permit applicants and Connecticut Department of Energy & Environmental Protection (CT DEEP) to follow (analysis, public participation, and more) when evaluating permit applications located in EJ communities.

For this analysis, the EJ community data set at the census block group level was obtained and utilized. However, this dataset did not differentiate between race/ethnicity and income, and for the purposes of this analysis have been grouped into other EJ communities.

EJ communities in Connecticut's portion of the GAA census block groups that meet criteria for an EJ community are clustered around larger cities and towns near the potential ports in New London County (Table 3.17-3, Table 3.17-4, and Figure 3.17-7).

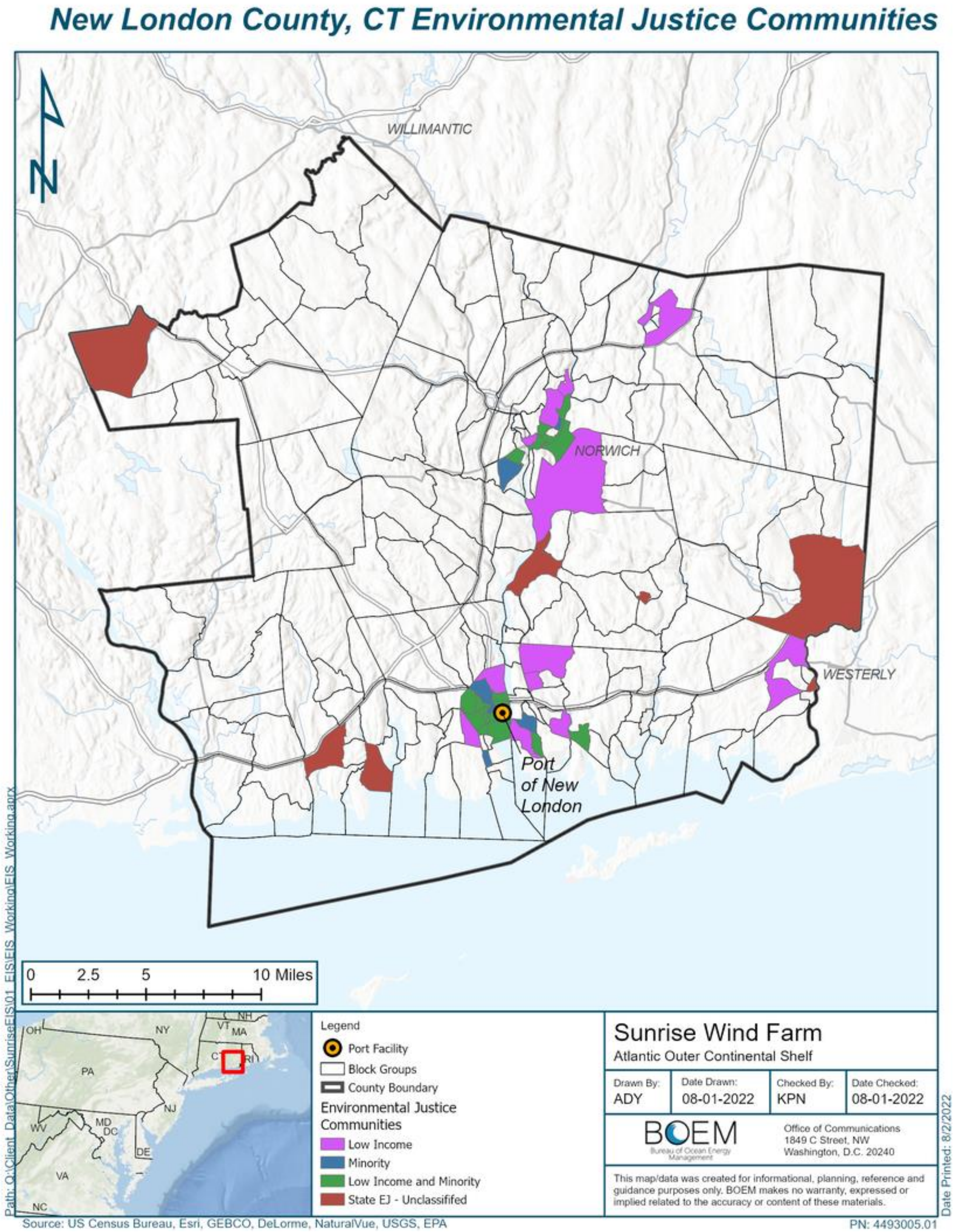


Figure 3.17-7. Environmental Justice Communities Identified in New London County, CT

3.17.1.4 Massachusetts

Massachusetts identifies an EJ community as U.S. Census block groups based upon household income, composition of minority population, and English language proficiency at the census block group level. Massachusetts' Executive Office of Energy and Environmental Affairs (EEA) issued an EJ Policy of the Executive Office of Energy and Environmental Affairs in June 2021 and maintains a map of EJ populations, which was utilized for this analysis (Massachusetts EEA 2020).

As defined by the EEA, EJ population means:

(A) neighborhood that meets one or more of the following criteria:

- (i) the annual median household income is not more than 65 percent of the statewide annual median household income;
- (ii) minorities comprise 40 per cent or more of the population;
- (iii) 25 percent or more of households lack English language proficiency; or
- (iv) minorities comprise 25 percent or more of the population and the annual median household income of the municipality in which the neighborhood is located does not exceed 150 percent of the statewide annual median household income; or

(B) a geographic portion of a neighborhood designated by the Secretary as an EJ population in accordance with law.

EJ communities in the Massachusetts' portion of the GAA census block groups that meet criteria for an EJ population are clustered around larger cities and towns near the potential ports in Bristol, Barnstable, Dukes, Nantucket and Plymouth counties (Table 3.17-3, Table 3.17-4, and Figure 3.17-8 through Figure 3.17-12).

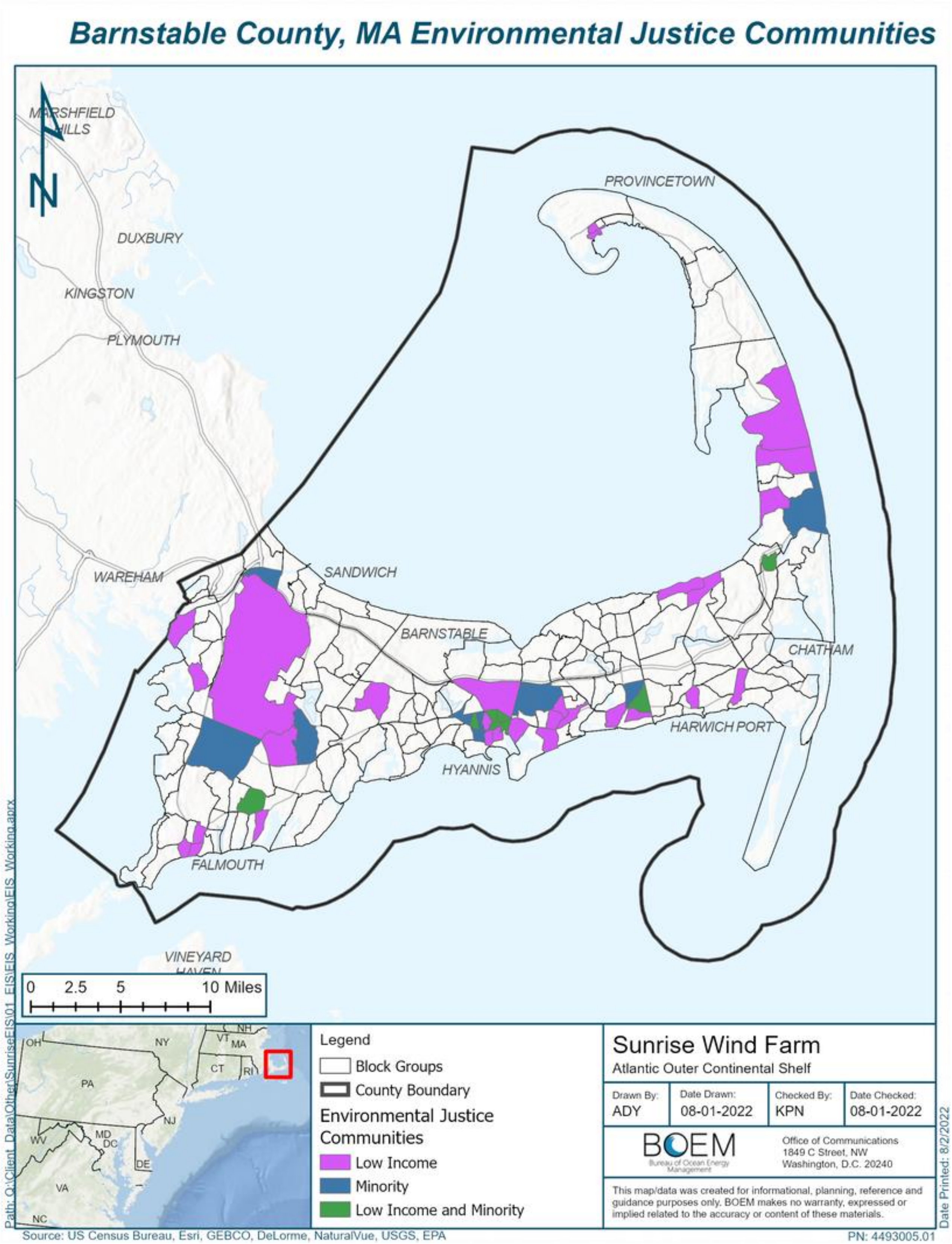


Figure 3.17-8. Environmental Justice Communities Identified in Barnstable County, MA

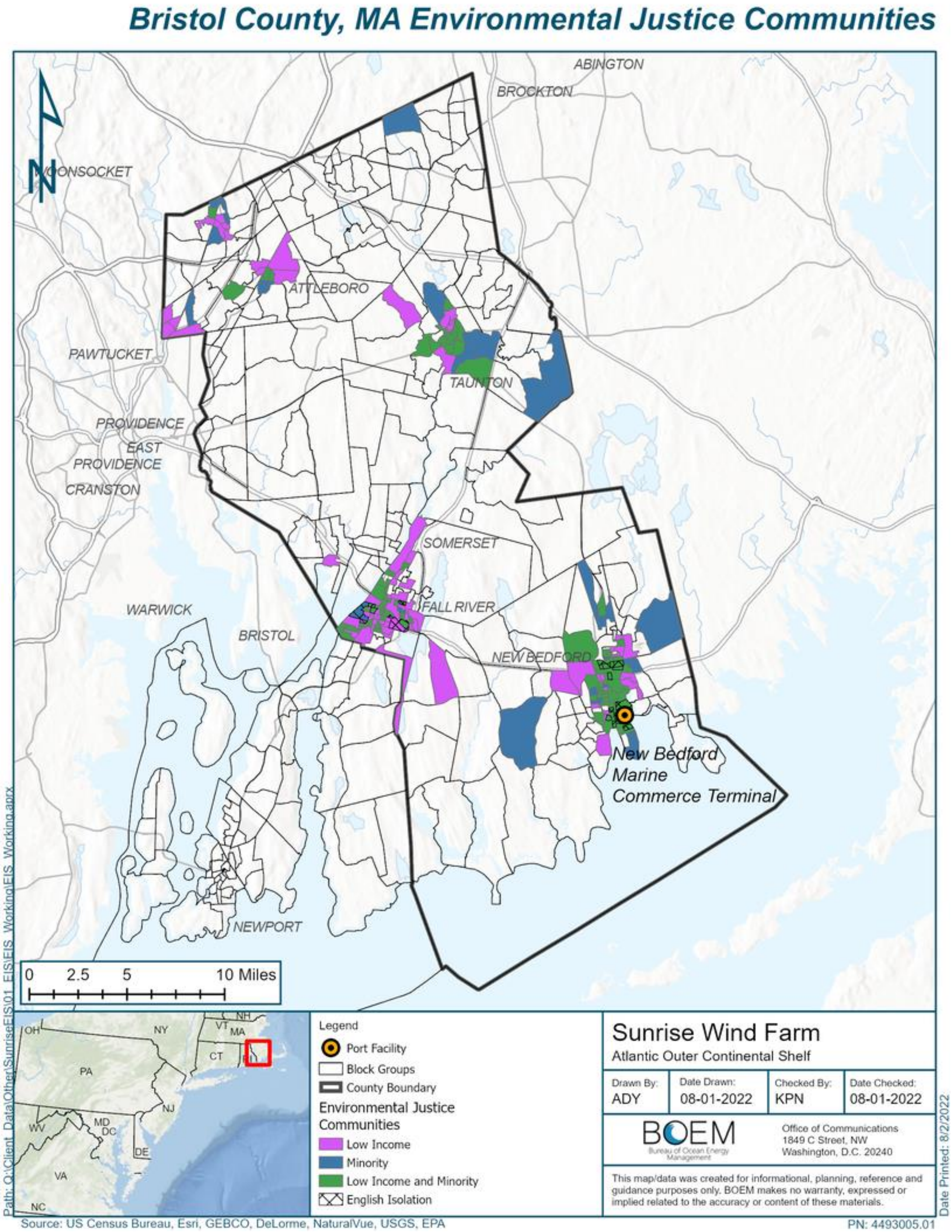


Figure 3.17-9. Environmental Justice Communities Identified in Bristol County, MA

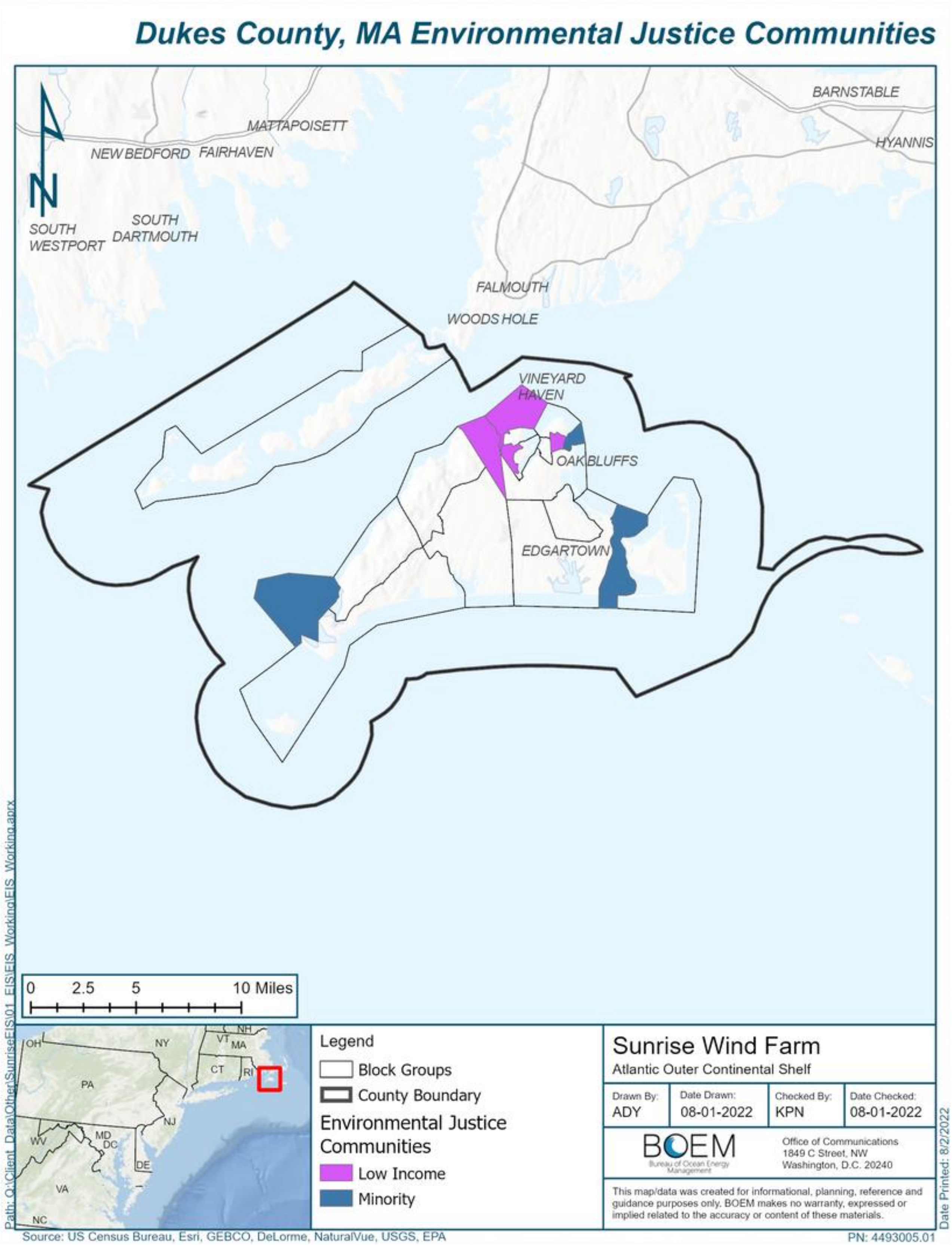


Figure 3.17-10. Environmental Justice Communities Identified in Dukes County, MA

Nantucket County, MA Environmental Justice Communities

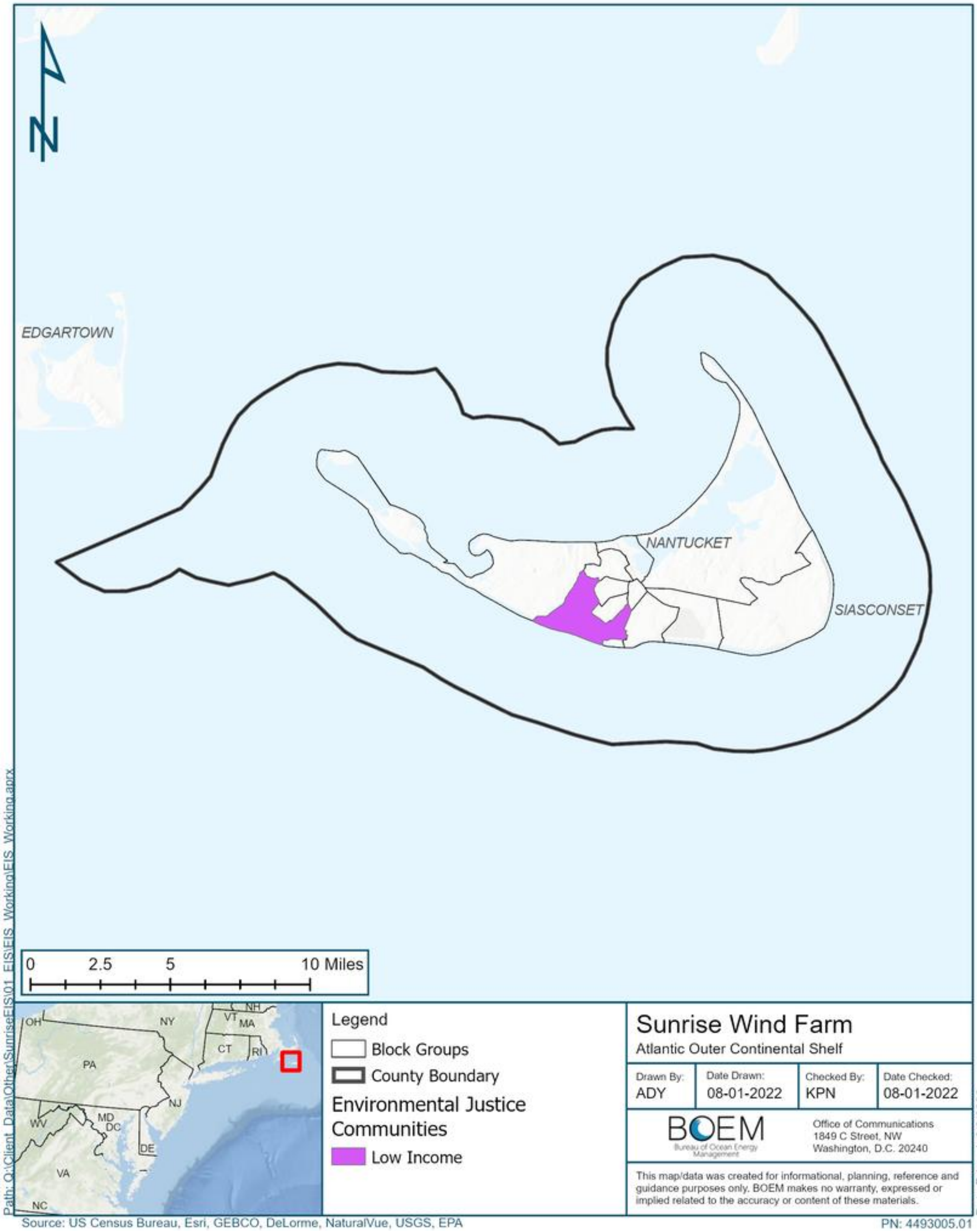


Figure 3.17-11. Environmental Justice Communities Identified in Nantucket County, MA

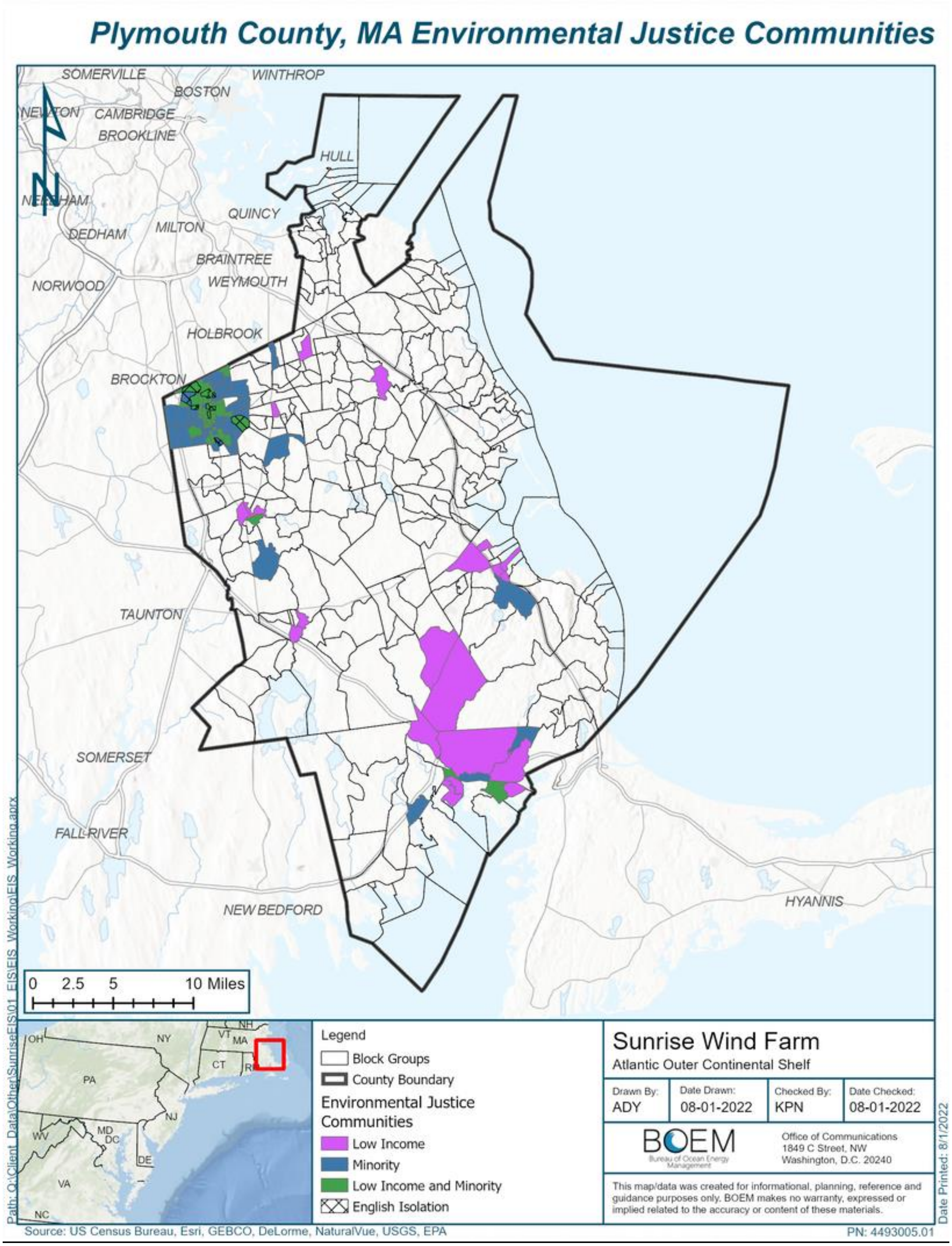


Figure 3.17-12. Environmental Justice Communities Identified in Plymouth County, MA

3.17.1.5 Rhode Island

The Rhode Island Department of Environmental Management (RIDEM) identifies an EJ community based on minority or low-income thresholds and provides mapped areas of EJ communities at the census tract level, which is referred to as EJ Focus Areas (RIDEM 2022).

EJ focus area refers to a census tract that meets one or more of the following criteria:

(i) Annual median household income is not more than 65 percent of the statewide annual median household income;

(ii) Minority population is equal to or greater than 40 percent of the population;

(iii) 25 percent or more of the households lack English language proficiency; or

(iv) Minorities comprise 25 percent or more of the population and the annual median household income of the municipality in the proposed area does not exceed 150 percent of the statewide annual median household income.

EJ communities in the Rhode Island portion of the GAA census block groups that meet criteria for EJ Focus Areas are clustered around larger cities and towns near the potential ports in Kent, Newport, Providence, and Washington counties (Table 3.17-3, Table 3.17-4, and Figure 3.17-13 through Figure 3.17-16).

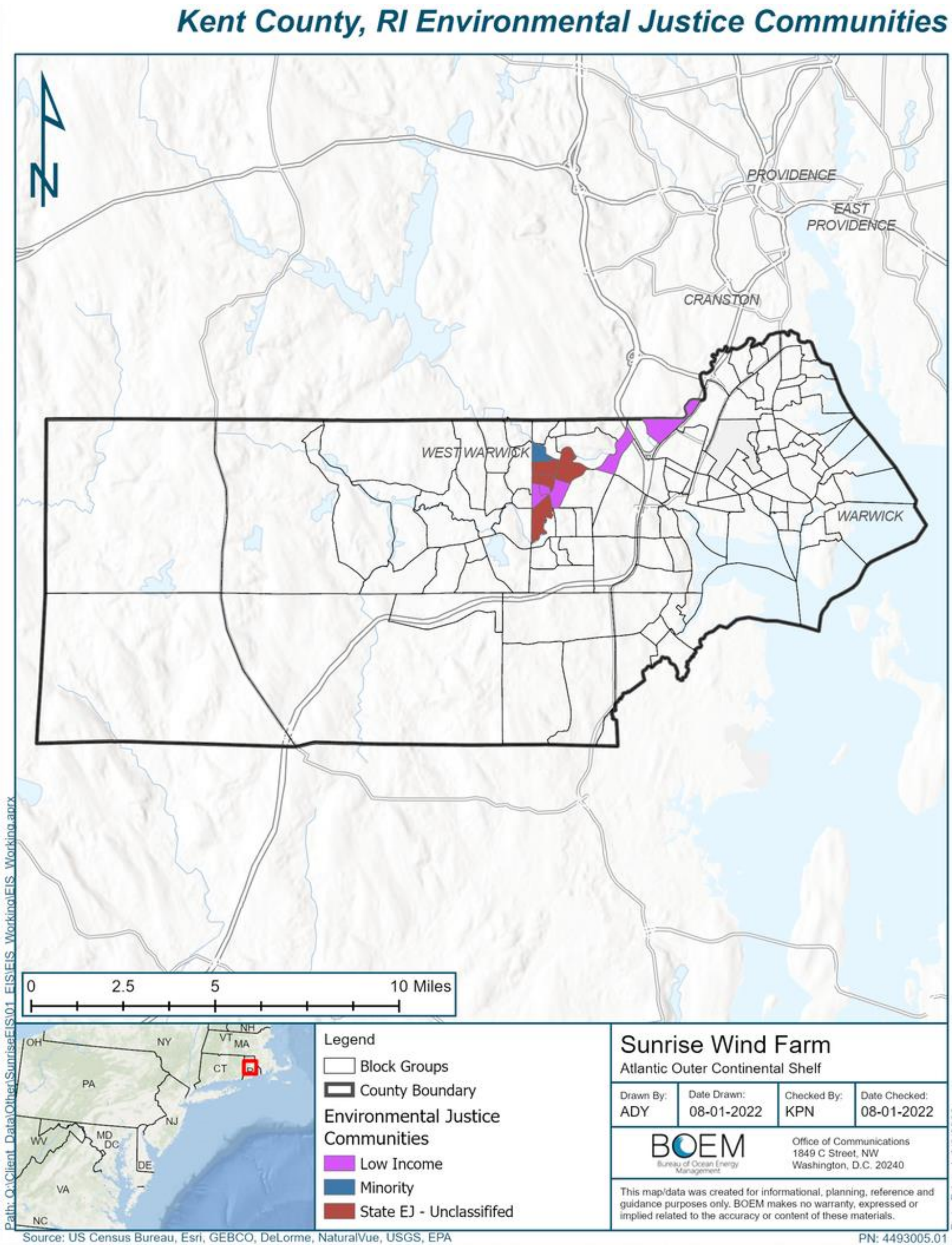


Figure 3.17-13. Environmental Justice Communities Identified in Kent County, RI

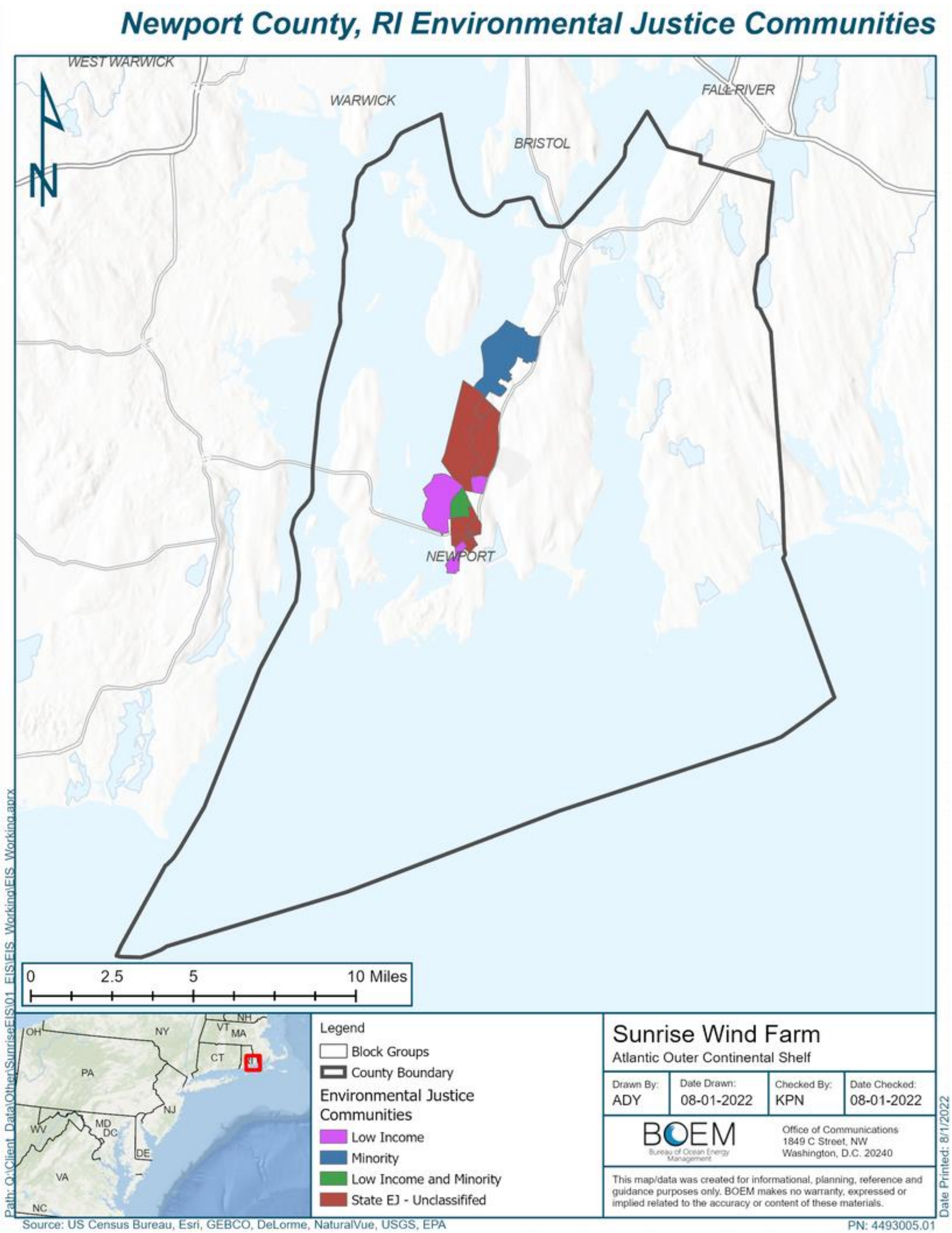


Figure 3.17-14. Environmental Justice Communities Identified in Newport County, RI

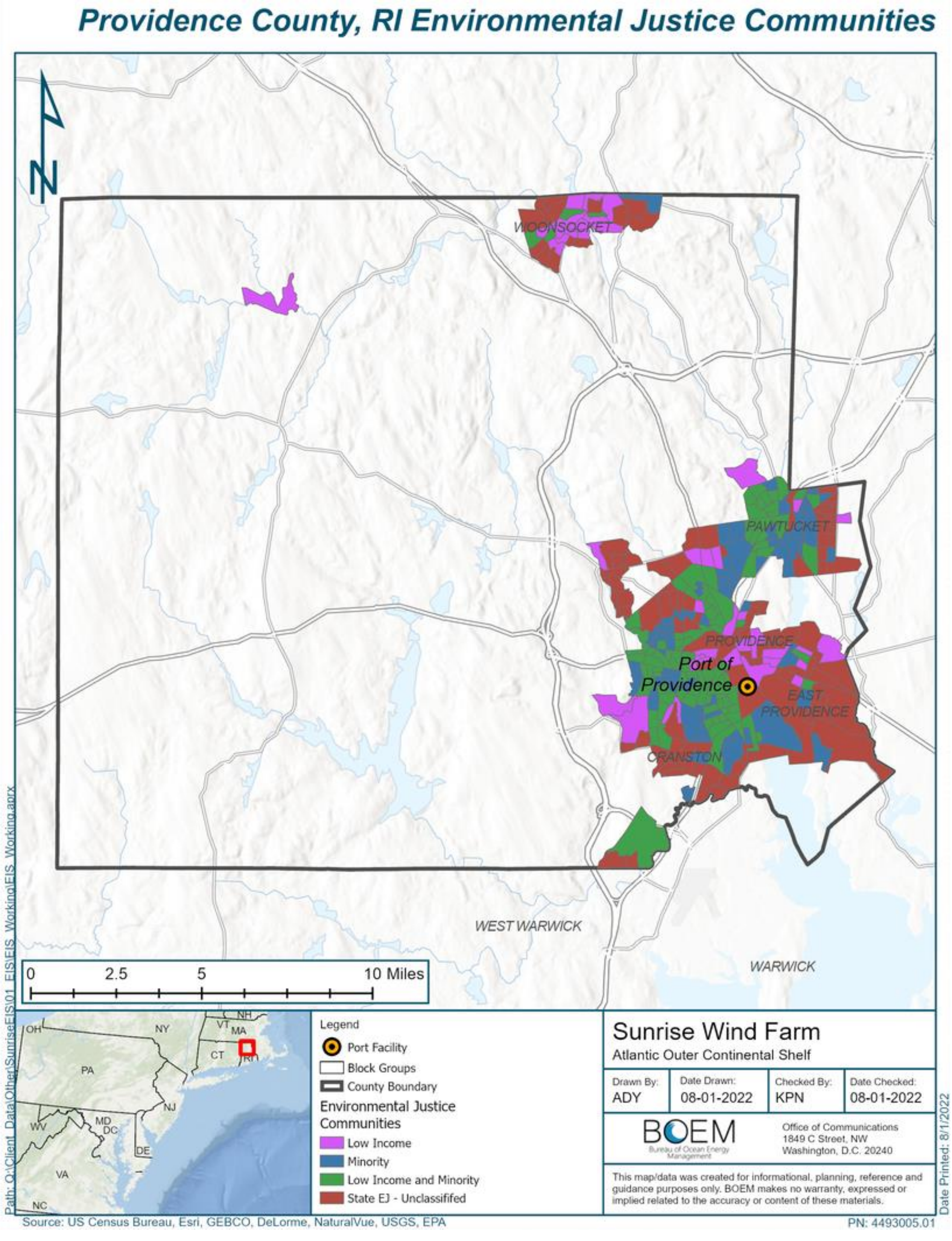


Figure 3.17-15. Environmental Justice Communities Identified in Providence County, RI

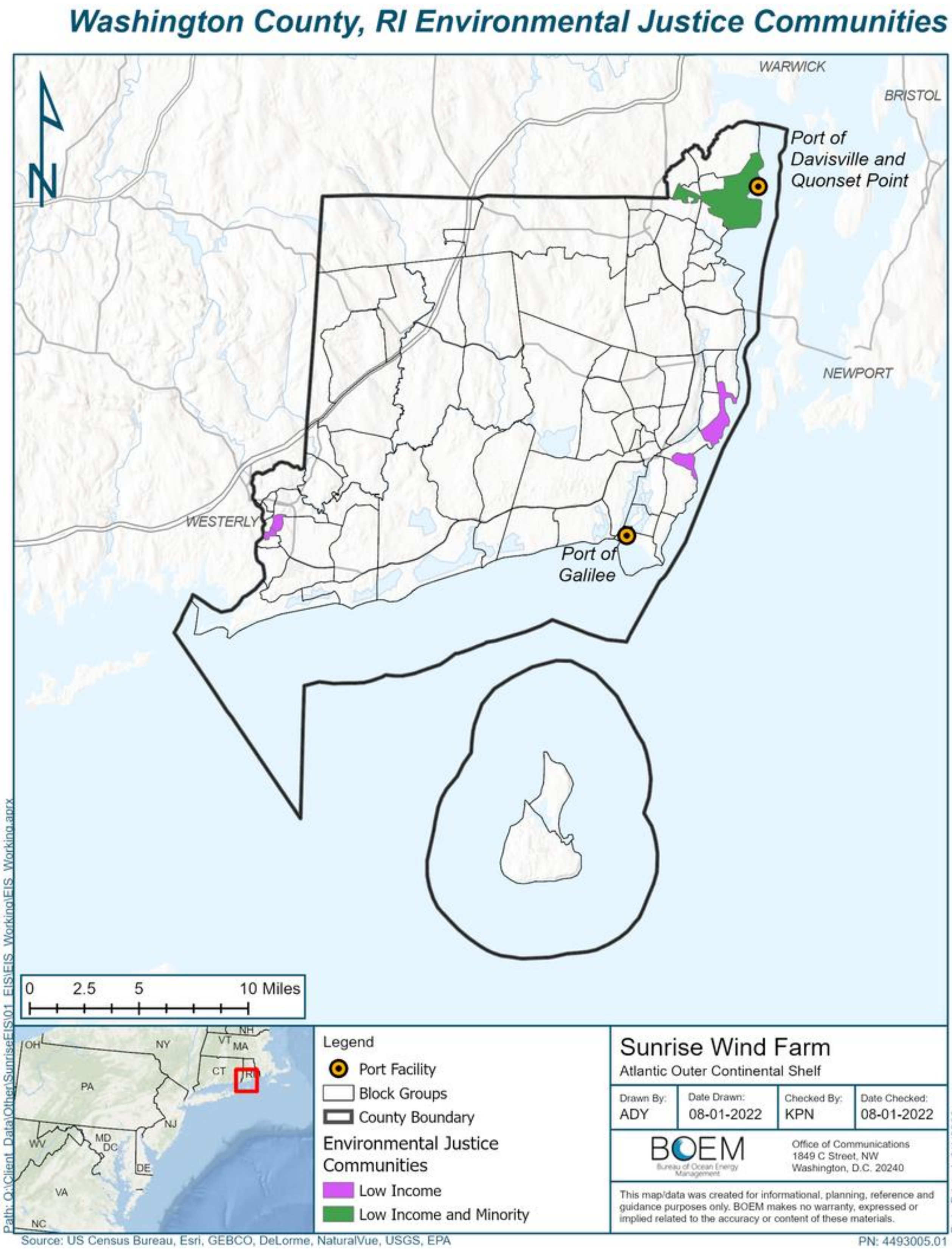


Figure 3.17-16. Environmental Justice Communities Identified in Washington County, RI

3.17.1.6 Other States

For other states within the GAA (Maryland and Virginia) that may have EJ policies, but do not have state-specific thresholds or identified EJ communities; the thresholds used for identifying EJ communities are based on CEQ guidance.

EJ communities in the Maryland portion of the GAA census block groups that meet the criteria for an EJ community are clustered around larger cities and towns near the potential ports in Baltimore County and the city of Baltimore (Table 3.17-3 and Table 3.17-4; Figure 3.17-17, and Figure 3.17-18).

EJ communities in the Virginia portion of the GAA census block groups that meet the criteria for an EJ community are clustered around larger cities and towns near the potential ports in the city of Norfolk (Table 3.17-3, Table 3.17-4, and Figure 3.17-19).

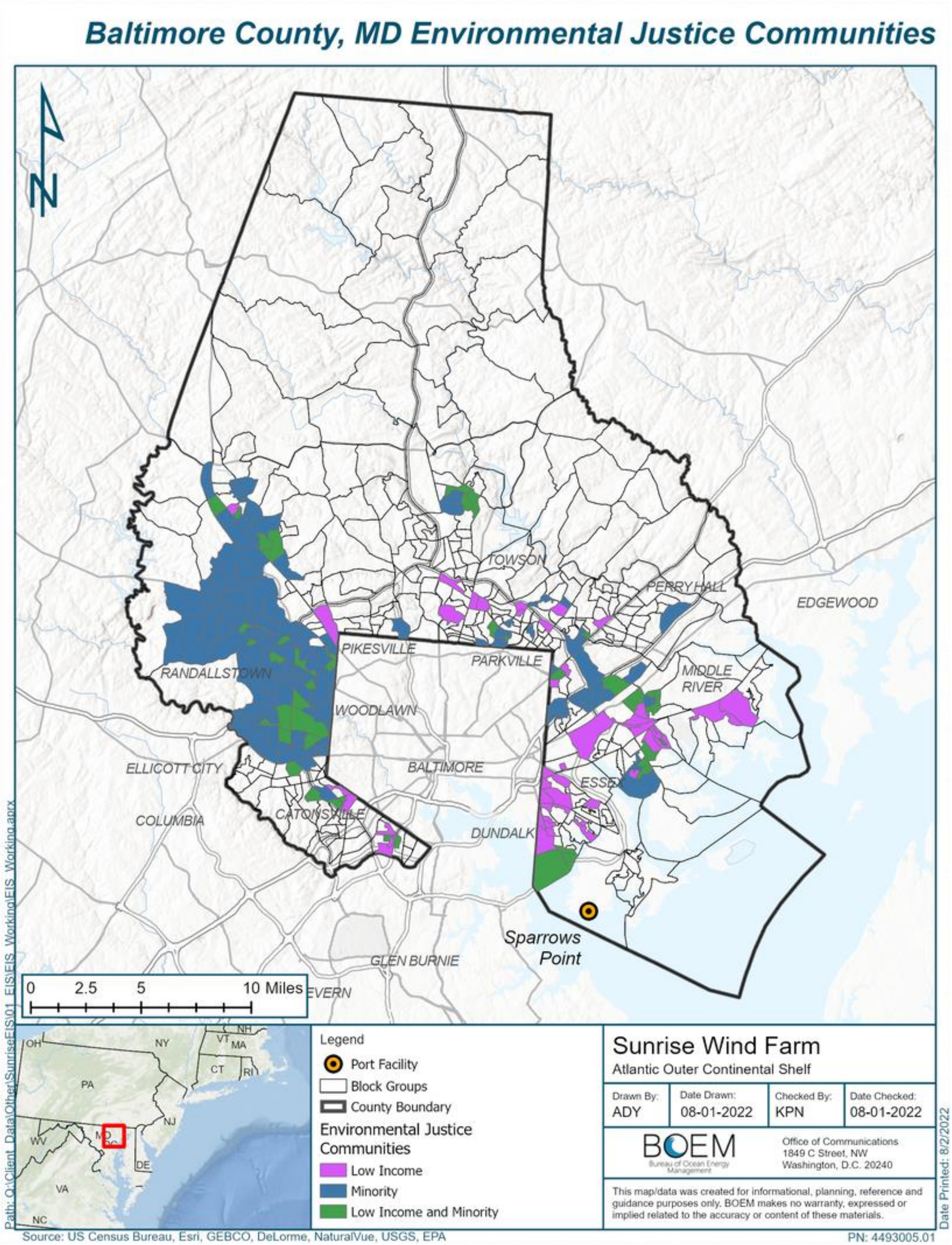


Figure 3.17-17. Environmental Justice Communities Identified in Baltimore County, MD

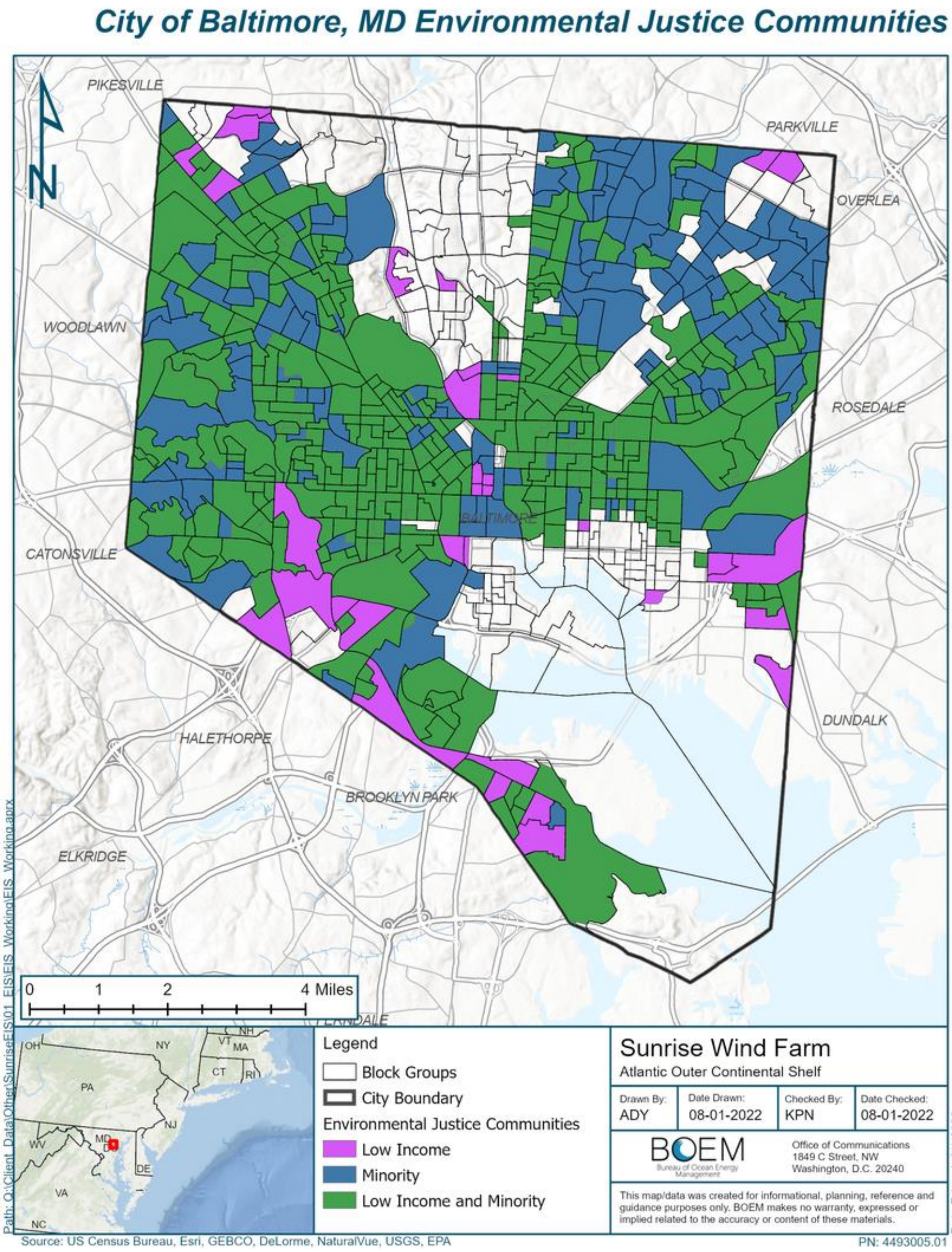


Figure 3.17-18. Environmental Justice Communities Identified in the City of Baltimore, MD

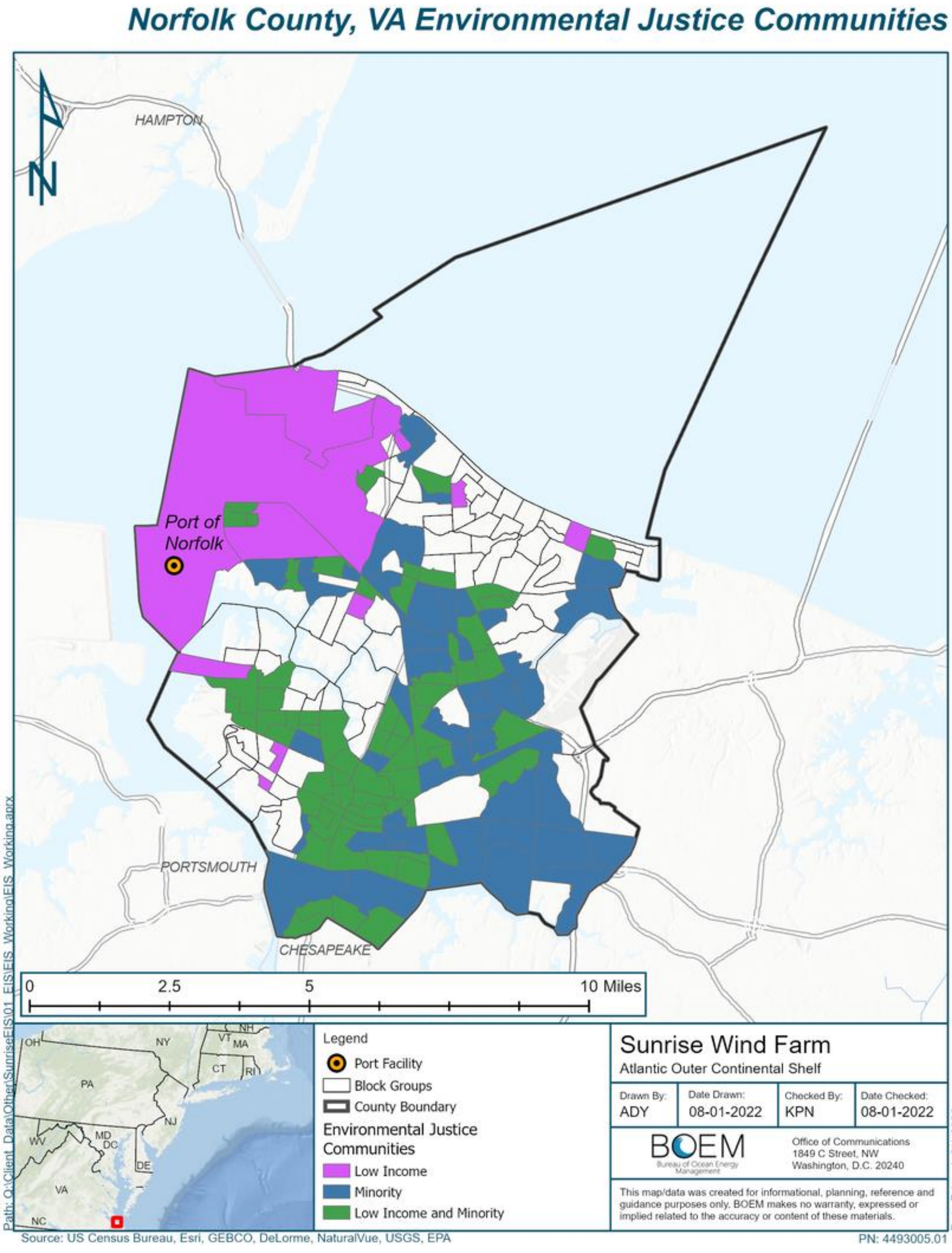


Figure 3.17-19. Environmental Justice Communities Identified in Norfolk County, VA

Table 3.17-2 summarizes trends for non-white populations and the percentage of residents with household incomes below the federally defined poverty line in the counties studied in the GAA.

Table 3.17-2. Environmental Justice Characteristics of Cities/Towns, Counties and States within the Geographic Analysis Area (2020)

Municipality	Population for Whom Poverty is Determined	Percent of Population [b]			
		With Income below Poverty Level [a]	Hispanic or Latino	Minority, Not Hispanic or Latino	Total Minority [c]
New York	7,417,224	13.5%	19.1%	25.8%	44.8%
Suffolk County	489,301	6.7%	19.3%	13.1%	32.4%
Albany County	126,540	11.4%	6.0%	21.9%	27.8%
New York County	759,460	14.9%	25.8%	27.3%	53.1%
Kings County	958,567	19.6%	19.0%	44.6%	63.6%
Rensselaer County	64,906	10.7%	4.9%	11.9%	16.8%
Connecticut	1,385,437	10.0%	16.4%	17.5%	34.0%
New London County	107,827	9.3%	10.6%	13.8%	24.3%
Maryland	2,230,527	8.9%	10.3%	39.6%	49.8%
Baltimore County	313,519	8.7%	5.4%	37.3%	42.7%
City of Baltimore	239,116	20.0%	5.3%	67.2%	72.5%
Massachusetts	2,646,980	10.6%	10.3%	17.2%	27.4%
Bristol County	217,912	11.9%	8.0%	10.7%	18.7%
Barnstable County	94,323	6.8%	3.1%	7.6%	10.7%
Dukes County	6,765	6.5%	3.6%	10.8%	14.4%
Nantucket County	3,713	5.6%	4.2%	10.7%	14.8%
Plymouth County	187,460	8.3%	3.9%	15.4%	19.4%
New Jersey	3,272,224	9.8%	20.4%	24.9%	45.3%
Gloucester County	104,908	7.3%	6.2%	15.3%	21.5%
Rhode Island	414,730	12.3%	15.9%	12.7%	28.6%
Providence County	32,549	22.0%	22.8%	16.4%	39.2%
Washington County	49,102	8.9%	3.2%	5.9%	9.1%
Kent County	69,422	8.9%	5.0%	6.7%	11.7%
Newport County	34,777	9.7%	5.7%	8.5%	14.2%
Virginia	3,184,121	9.9%	9.5%	29.3%	38.8%
Norfolk [d]	88,353	17.4%	8.0%	48.5%	56.6%

Source: USCB 2022.

Notes:

[a] Poverty status used Census Reference Table B17017.

[b] Percentages may not add to totals due to rounding.

[c] Total minority includes Hispanic or Latino, Black or African American, Native American, and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, and persons of some other race (not including White) or two or more races.

[d] Norfolk and the city of Baltimore are a county-equivalent area according to the United States Census Bureau.

To further evaluate the presence of EJ communities on smaller geographic scales to understand potential impacts related to the Project, an examination was conducted at the census block group level. In addition, the assessment provided below utilizes both the application of federal CEQ guidelines, as well as state self-identified EJ communities using their own criteria and datasets. Table 3.17-3 provides the number of census block groups within the GAA that were identified as EJ, along with a percentage of total census block groups in that county and the population of those census block groups where an EJ community is present. For states with specific EJ guidance relative to thresholds for EJ community identification, those thresholds were utilized. For states without specific threshold guidance, the federal thresholds were utilized.

To provide a comprehensive and complete identification of potential EJ communities within the GAA, an extensive data collection and collation effort was conducted using both CEQ guidance and state-specific guidance and datasets, where available. Table 3.17-1 as well as the state-specific discussion outlined above presents the data sets used for states, where available. Essentially, any census block group that was identified as an EJ community using *either* the federal CEQ guidance or the state-specific guidance was included in this analysis. The reason is because there were instances where certain census block groups may be in the state dataset but would not be included if using the federal guidance (or vice versa); therefore, to be as comprehensive as possible, a thorough analysis was conducted for every census block group within the counties of the GAA to establish if they met either the state or federal criteria. The results are summarized in Table 3.17-3, and a detailed and complete table listing all census block groups with an EJ community are presented in Appendix B (*Supplemental Information and Additional Figures and Tables*).

Of the 8,120 census block groups in the GAA, 3,998 (or 49.2 percent) were identified as an EJ community under either federal or state guidance (Table 3.17-3). Baltimore, Maryland was one of the counties/municipalities with the highest percentage of census block groups that are considered EJ communities Kent County, Rhode Island was considered the lowest. The county with the highest population within EJ communities was Kings County and the county with the lowest population was Nantucket County, Massachusetts. In Suffolk County, ports as well as onshore land-based features associated with the Project that would be utilized, had 23.9 percent of the census block groups within the county identified as EJ communities.

Table 3.17-3. Summary of Environmental Justice Census Block Groups Identified in the Geographic Analysis Area Using Both Federal and State Guidance

Municipality/County	Total Number of Block Groups in County	Census Block Groups that are Considered Environmental Justice Communities		
		No. of Block Groups	Percentage of Block Groups	Total Population in Block Groups
New York				
Suffolk County	999	239	23.9%	395,613
Albany County	235	67	28.5%	76,953
Kings County	2,085	1,516	72.7%	1,997,194
New York County	1,170	504	43.1%	837,174
Rensselaer County	125	36	28.8%	37,666
Connecticut				
New London County	188	44	23.4%	69,887
Maryland				
Baltimore County	529	207	39.1%	376,517
City of Baltimore	653	530	81.2%	490,541
Massachusetts				
Bristol County	390	191	49.0%	234,316
Barnstable County	196	21	10.7%	20,764
Dukes County	21	4	19.0%	2,434
Nantucket County	12	1	8.3%	871
Plymouth County	360	85	23.6%	102.547
New Jersey				
Gloucester County	191	35	18.3%	42,077
Rhode Island				
Providence County	499	313	62.7%	380,386
Washington County	94	5	5.3%	6,089
Kent County	122	10	8.2%	12,734
Newport County	62	14	22.6%	16,515
Virginia				
Norfolk	189	119	63.0%	169,033
Totals	**8,120**	**3,998**	**49.2%**	**5,332,950**

Sources: USEPA 2022, NYSDEC 2022, NJ DEP 2020, Massachusetts EEA 2020, RIDEM 2022, Connecticut DEEP 2022

It should be noted that some census block groups may have concentrations of either minority populations, or low-income populations, and also have populations that experience language isolation (i.e., limited English proficiency) or other characteristics defined by the individual states that result in the block being considered an EJ community. The analysis of linguistically isolated populations in areas where there may be project impacts would help inform the potential need for translation of project-related materials. Table 3.17-3 presents the information aggregated by county within the GAA; however, the full analysis by individual census block group is included in Appendix B (*Supplemental Information and Additional Figures and Tables*). To better understand whether the census block groups identified within these counties were identified using federal CEQ guidance or identified with at the state level, Table 3.17-4 provides a further breakdown of these statistics.

It should be noted that some census block groups are included under either the federal identification dataset or the state identification dataset, and in other cases, they may be identified under both criteria. Therefore, the summation of these numbers would not equal the aggregate numbers provided Table 3.17-3 but need to be viewed individually and are provided to offer more context and detail to the analysis. The information within the tables of this section has been aggregated by county as the information by specific census block group is extensive, but included in Appendix B (*Supplemental Information and Additional Figures and Tables*).

Table 3.17-4. Details of Census Block Group Identification of Environmental Justice Communities within the Geographic Analysis Area Using Both Federal and State Guidance

Municipality/County	Federal EJ Guidelines		State EJ Guidelines			
	Total Minority	Total Low-Income	Total Minority	Total Low-Income	Total Limited English	Total Other EJ
New York [a]						
Suffolk County	169	30	195	48	n/a	n/a
Albany County	42	46	40	45	n/a	n/a
Kings County	1,264	612	1,235	706	n/a	n/a
New York County	463	217	447	272	n/a	n/a
Rensselaer County	10	37	8	39	n/a	n/a
Connecticut [b]						
New London County	24	30	n/a	n/a	n/a	10
Maryland [c]						
Baltimore County	162	88	n/a	n/a	n/a	n/a
City of Baltimore	500	386	n/a	n/a	n/a	n/a
Massachusetts [d]						
Bristol County	44	130	122	149	19	n/a
Barnstable County	1	20	19	29	0	n/a
Dukes County	1	3	3	3	0	n/a
Nantucket County	0	1	1	0	0	n/a

Municipality/County	Federal EJ Guidelines		State EJ Guidelines			
	Total Minority	Total Low-Income	Total Minority	Total Low-Income	Total Limited English	Total Other EJ
Plymouth County	70	51	95	50	10	n/a
New Jersey [e]						
Gloucester County	15	17	24	22	0	n/a
Rhode Island [f]						
Providence County	167	144	n/a	n/a	n/a	307
Washington County	1	5	n/a	n/a	n/a	0
Kent County	1	5	n/a	n/a	n/a	8
Newport County	2	5	n/a	n/a	n/a	12
Virginia [g]						
Norfolk	109	72	n/a	n/a	n/a	n/a
Totals	**3,045**	**1,899**	**2,189**	**1,363**	**29**	**327**

Sources: USEPA 2022, NYSDEC 2022, NJ DEP 2020, Massachusetts EEA 2020, RIDEM 2022, Connecticut DEEP 2022.

n/a – This dataset is not available within this state. If the dataset is available, but no census block groups are present that meet those criteria, it is noted with a “0.”

Notes:

[a] New York data is from NYS DEC Office of EJ.

[b] Connecticut data is from CT DEEP.

[c] Maryland utilizes the federal USEPA EJ guidance, as there is no state-specific data available.

[d] Massachusetts data is from Massachusetts EEA.

[e] New Jersey data is from NJ DEP.

[f] Rhode Island data is from RIDEM.

[g] Virginia utilizes the federal USEPA EJ guidance, as there is no state-specific data available.

Figure 3.17-1 through Figure 3.17-19 present the locations of the census block groups collated in Table 3.17-4 that are within the seven states and the respective counties within the GAA. The census block groups that are indicated within the figures meet either the federal or state-specific EJ criteria to be considered an EJ community. Note, states nomenclature may differ when referencing the EJ communities (e.g., Overburdened Communities for New Jersey); however, for the purposes of this document, they are all referred to as EJ communities.

Low-income and minority workers may be employed in commercial fishing and supporting industries that provide employment on commercial fishing vessels, at seafood processing and distribution facilities, and in trades related to vessel and port maintenance, or operation of marinas, boat yards, and marine equipment suppliers and retailers.

In addition, food insecurity is a major concern for many EJ communities. Oftentimes EJ communities are reliant on the availability of locally sourced and affordable food, with some engaging in subsistence fishing to varying degrees. Therefore, impacts on fishing stock available at the local-level would be a factor in assessing impacts to EJ communities.

3.17.1.7 Social Indicator Characteristics

NOAA social indicator mapping (NOAA 2022b) was used to identify EJ populations in the GAA that have a high level of fishing engagement or fishing reliance. The fishing engagement and reliance indices portray the importance or level of dependence of commercial or recreational fishing to coastal communities.

- Commercial fishing engagement is measured by fishing activity (e.g., permits, fish dealers, and vessel landings). A high rank indicates more engagement.
- Commercial fishing reliance measures are based on the population size of a community through fishing activity. A high rank indicates more reliance.
- Recreational fishing engagement measures are based on the presence of recreational fishing through fishing activity estimates. A high rank indicates more engagement.
- Recreational fishing reliance measures the presence of recreational fishing in relation to the population size of a community. A high rank indicates increased reliance.

The categorical rankings for the home ports for vessels that use the Lease Area are provided in Section 3.14, *Commercial Fishing and For-Hire Recreational Fishing*, within Table 3.14-8. There are over 40 ports listed in the table; however, the ports that have the highest average and total revenue include New Bedford, Massachusetts, Point Judith, Rhode Island, Little Compton, Rhode Island, and Newport, Rhode Island. Three of the four of these ports had a high commercial fishing engagement ranking, and three out of four had a medium commercial fishing reliance ranking. Table 3.14-8 provides additional details for the other ports within the GAA.

Within these four port communities that have a high level of commercial fishing engagement or reliance, all four are determined to either be located within EJ populations or adjacent to census block groups considered EJ populations. As provided in Figure 3.17-1 through Figure 3.17-19, there are numerous EJ populations in and around the port facilities that may be utilized during construction and/or operation of SRWF.

NOAA developed social indicator mapping related to gentrification pressure (NOAA 2022b) which is an indicator related to housing disruption, retiree migration and urban sprawl. The gentrification pressure indicators measure factors that, over time, may indicate a threat to the viability of a commercial or recreational working waterfront.

- Housing disruption represents factors that indicate a fluctuating housing market where some displacement may occur due to rising home values and rents including changes in mortgage values. A high rank means more vulnerability for those in need of affordable housing and a population more vulnerable to gentrification.
- Retiree migration characterizes communities with a higher concentration of retirees and the elderly population including households with inhabitants over 65 years old, population receiving social security or retirement income, and the level of participation in the work force. A high rank indicates a population more vulnerable to gentrification as retirees seek the amenities of coastal living.
- Urban sprawl describes areas experiencing gentrification through increasing population density, proximity to urban centers, home values, and the cost of living. A high rank indicates a population more vulnerable to gentrification.

Gentrification mapping indices confirm high to medium/high and medium levels of housing disruption and retiree migration in coastal communities in Suffolk County, New York, where the onshore facilities would be located. High to medium/high gentrification was confirmed in the coastal port areas of Rhode Island and Massachusetts; the ports with the highest utilization of the SRWF Lease Area would be located. Suffolk County, New York, the proposed location of onshore facilities, has many areas that are rated high to medium/high due to both retiree migration and urban sprawl (NOAA 2022b).

EJ analyses must also address impacts on Native American tribes. Federal agencies should evaluate "interrelated cultural, social, occupational, historical, or economic factors that may amplify the natural and physical environmental effects of the proposed agency action," and "recognize that the impacts within Indian tribes may be different from impacts on the general population due to a community's distinct cultural practices" (CEQ 1997). Factors that could lead to a finding of significance for EJ populations include loss of significant cultural or historical resources and the impact's relation to other cumulatively significant impacts (USEPA 2016a). Occupation of the OCS prior to early Holocene sea level rise would have been limited to ancestral indigenous communities and many northeastern tribes retain deep cultural connections to the now submerged lands upon which their ancestors once lived.

BOEM invited the following tribes to participate in government-to-government consultations on the proposed Project: the Mashantucket Pequot Tribal Nation, the Mashpee Wampanoag Tribe, The Delaware Nation, the Shinnecock Nation, the Mohegan Tribe of Indians of Connecticut, the Narragansett Indian Tribe, the Delaware Tribe of Indians and the Wampanoag Tribe of Gay Head (Aquinnah). In addition, five non-Federally recognized tribes could be considered EJ communities.

3.17.2 Scope of the Environmental Justice Analysis

To define the scope of the EJ analysis, BOEM reviewed the impact conclusions for each resource analyzed in this Final EIS Section 3.4 through Section 3.22 to assess whether the Proposed Action and action alternatives would result in major impacts that would be considered high and adverse and whether major impacts had the potential to affect EJ populations given the geographic extent of the impact relative to the locations of EJ populations. Major impacts that had the potential to affect EJ populations were further analyzed to determine if the impact would be disproportionately high and adverse. Although the EJ analysis considers impacts of other ongoing and planned activities, including other future offshore wind projects, determinations as to whether impacts on EJ populations would be disproportionately high and adverse are made for the Proposed Action and action alternatives alone.

The onshore Project infrastructure including cable landfalls, onshore export cable routes, onshore substations, and points of interconnection are within or adjacent to several Census Block Groups with EJ populations identified to be impacted by Project activities. Because onshore construction would affect EJ populations identified in the GAA, impacts associated with construction, O&M, and decommissioning of onshore Project components are carried forward for further analysis of disproportionately high and adverse effects within the EJ analysis. Based on the geographic extent of onshore construction impacts relative to the location of EJ populations, BOEM concludes that EJ populations would experience disproportionately high and adverse effects related to construction, O&M, and decommissioning of onshore infrastructure.

In Table 3.17-5, Sunrise Wind has identified the following locations for ports that could support construction or O&M for the Project.

Table 3.17-5. Potential Ports for Construction or O&M for the Sunrise Wind Project

Port Name	State	Located in or Adjacent to an EJ Community
Port of New London	Connecticut	Yes
New Bedford Marine Commerce Terminal	Massachusetts	Yes
Sparrows Point	Maryland	Yes
Paulsboro Marine Terminal	New Jersey	No
Port of Albany	New York	Yes
Port of Brooklyn	New York	Yes
Port of Coeymans	New York	No
Port Jefferson	New York	No
Port of New York	New York	Yes
Port of Montauk	New York	Yes
Port of Providence	Rhode Island	Yes
Port of Davisville and Quonset Point	Rhode Island	Yes
Port of Galilee	Rhode Island	No
Port of Norfolk	Verginia	Yes

As noted in the table, the Port of Montauk, Port of Albany, Port of Brooklyn, Port of New York, Port of New London, New Bedford Marine Commerce Terminal, Port of Providence, Port of Davisville and Quonset Point, Sparrows Point and the Port of Norfolk are all in or immediately adjacent to Census Block Groups where EJ populations have been identified. Therefore, port utilization is carried forward for analysis of disproportionately high and adverse effects in this EJ analysis under the port utilization and air emission IPFs. In addition, with the current ports located within EJ communities, there is the potential that these populations may have preexisting health disparities which could be impacted by potential project impacts such as air emissions.

Construction, O&M, and decommissioning of offshore structures (WTGs and OSS) could have major impacts on some commercial fishing operations that use the Lease Area, with potential for indirect impacts on employment in related industries that could affect EJ populations. Cable emplacement and maintenance and construction noise would contribute to impacts on commercial fishing. The long-term presence of offshore structures (WTGs and OSS) would have major impacts on scenic and visual resources and viewer experience from some onshore viewpoints that could affect EJ populations. Therefore, impacts of construction, O&M, and decommissioning of offshore Project components is carried forward for analysis of disproportionately high and adverse effects in this EJ analysis under the IPFs for presence of structures, cable emplacement and maintenance, and noise.

Section 3.15, *Cultural Resources*, determined that construction of offshore wind structures and cables could result in major impacts on ASLF if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction. BOEM has committed to working with the Lessee, other NHPA Section 106 consulting parties, federally recognized Native American tribes, and the NYSHPO to develop specific treatment plans to address impacts on ASLF that cannot be avoided. Development and implementation of Project-specific treatment plans, agreed to by all consulting parties, would likely reduce the magnitude of unmitigated impacts on ASLF; however, the magnitude of these impacts would remain moderate to major due to the permanent, irreversible nature of the impacts, unless these ASLF can be avoided. The tribal significance of ASLF identified in the Lease Area and cable corridors has not yet been determined, and consultation with tribes via NHPA Section 106 consultation and government-to-government consultation is ongoing. No other tribal resources such as cultural landscapes, TCPs, burial sites, archaeological sites with tribal significance, treaty-reserved rights to usual and accustomed fishing or hunting grounds, or other potentially affected tribal resources have been identified to date. BOEM would continue to consult with Native American tribes throughout development of the EIS and would consider impacts on tribal resources identified through consultation in the EJ analysis if they are discovered.

Other resource impacts that concluded less-than-major impacts for the Proposed Action and action alternatives or were unlikely to affect EJ populations were excluded from further analysis of EJ impacts. This includes impacts related to bats; benthic resources; birds; coastal habitat and fauna; finfish, invertebrates, and EFH; land use and coastal infrastructure; marine mammals; navigation and vessel traffic; recreation and tourism; sea turtles; water quality; and wetlands. Table ES-2 provides a summary of impact levels determined for each of these resource topics.

3.17.3 Impact Level Definitions for Environmental Justice

This Final EIS uses a four-level classification scheme to analyze potential impact levels on EJ populations from the alternatives, including the Proposed Action. Table 3.17-6 lists the definitions for both the potential adverse impact levels and potential beneficial impact levels for EJ. Table G-16 in Appendix G identifies potential IPFs, issues, and indicators to assess impacts to EJ. Impacts are categorized as beneficial or adverse and may be short-term or long-term in duration. Short-term impacts may occur over a period of a year or less. Long-term impacts may occur throughout the duration of a project.

Table 3.17-6. Definitions of Potential Adverse and Beneficial Impact Levels for Environmental Justice

Impact Level	Definition of Potential Adverse Impact Levels	Definition of Potential Beneficial Impact Levels
Negligible	No measurable impacts would occur.	No measurable impacts would occur.
Minor	Adverse impacts to the affected EJ population could be avoided with environmental protection measures (EPMs) or would be unavoidable but not disproportionately high and adverse.	A small and measurable benefit to affected EJ populations could occur.
Moderate	Adverse impacts to the affected EJ population could be avoided with EPMs or would be unavoidable but not disproportionately high and adverse.	A notable and measurable benefit to affected EJ populations could occur.
Major	The affected EJ population would experience disproportionately high and adverse effects due to: (1) impacts on the natural or physical environment; (2) impacts that appreciably exceed or are expected to appreciably exceed those on the general population or other appropriate comparison group; or (3) impacts that occur or would occur in a minority or low-income population, or Native American tribe affected by cumulative or multiple adverse exposures from environmental hazards.	A large local, or notable regional benefit to affected EJ populations could occur.

3.17.4 Impacts of Alternative A – No Action on Environmental Justice

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

3.17.4.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for EJ described in Section 3.17, *Affected Environment,* 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 that have the potential to affect EJ populations include onshore development and land uses; utilization of ports, marinas, and working waterfronts; port improvements or expansions; and commercial fishing operations. These activities support beneficial employment and generate sources of air emissions, noise, lighting, and vehicle and vessel traffic that can adversely affect the quality of life in affected communities.

Coastal development that leads to gentrification of coastal communities may create space-use conflicts and reduce access to coastal areas and working waterfronts that communities rely on for recreation, employment, and commercial or subsistence fishing. Gentrification can lead to increased tourism and recreational boating and fishing that provide employment opportunities in recreation and tourism. As described in Section 3.17.1, NOAA's social indicator mapping tool for gentrification pressure shows medium-high to high levels of housing disruption and retiree migration in many of the coastal communities within the GAA, including Suffolk County, New York; the location where the onshore project components are located, as well as coastal port areas of Rhode Island and Massachusetts where the ports historically have had the highest utilization of the SRWF Lease Area. Typically, the more inland areas of the states within the GAA have lower gentrification pressure. Housing disruption caused by rising home values and rents can displace affordable housing, with disproportionate effects for low-income populations.

Ongoing offshore wind activities within the GAA that contribute to impacts on EJ include:

- Continued O&M of the Block Island project (5 WTGs) installed in State waters,
- Continued O&M of the CVOW project (2 WTGs) installed in OCS-A 0497, and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of Block Island and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect EJ through the primary IPFs of air quality, land disturbance, lighting, noise, port utilization, presence of structures, and traffic. 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 the section below for planned offshore wind activities, but the impacts would be of lower intensity.

3.17.4.2 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).

Future activities without the Proposed Action include residential, commercial, and industrial development of onshore utility projects, land-based wind energy projects, and other offshore wind projects (excluding the Sunrise Wind Project). Offshore projects other than offshore wind would support the existing marine industries and workforce. Ocean-based industries, including tourism and recreation, commercial fishing, and marine transportation, would continue to be important to the economies of many of the counties within the EJ GAA.

BOEM expects future offshore wind activities to affect EJ populations through the following primary IPFs, noted in Table G-16 in Appendix G.

Planned non-offshore wind activities that may affect EJ populations include port utilization and expansion, construction and maintenance of coastal infrastructure (marinas, docks, and bulkheads), and onshore coastal development that can lead to gentrification of coastal communities and working waterfronts (refer to Appendix E for a description of ongoing and planned activities).

Planned non-offshore wind activities would have impacts similar to those of the ongoing non-offshore wind activities and would range from minor to moderate adverse to minor beneficial. BOEM expects that most impacts of ongoing and planned activities would be minor because while they would be measurable, they would not disrupt the normal or routine functions of the affected population. Impacts of gentrification are expected to be moderate because low-income populations would need to adjust somewhat in response to housing disruptions caused by rising home values and rents. These changes would be long-term, but the intensity would vary across the wide GAA, with higher intensity in coastal communities with waterfront access and lower intensity in more inland areas. BOEM expects that improvements related to employment for ongoing and planned activities would be measurable but small and minor beneficial, Appendix E, provides a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for EJ.

Air quality: Emissions at offshore locations would have regional impacts, with no disproportionate impacts on EJ communities. However, EJ communities near ports could experience disproportionate air quality impacts depending upon the ports that are used, ambient air quality, and the increase in emissions at any given port. Onshore, some industrial waterfront locations would continue to lose industrial uses, with no new industrial development to replace it. The conversion of traditionally industrial uses in these waterfront areas has the potential to reduce air emissions if the municipalities encourage redevelopment to uses such as passive and active recreation or other uses that would result in lower air emissions proximal to EJ communities.

Appendix E identifies 31 future offshore wind projects other than the Proposed Action that could be constructed in the Massachusetts/Rhode Island, New York/New Jersey, Delaware/Maryland, and Virginia/North Carolina Lease Areas, which may utilize the same ports during construction as the Proposed Action. Possible overlapping construction periods, as estimated in Appendix E, could result in up to seven projects under construction at one time. All 10 of the proposed ports that could support construction for the Sunrise Wind Project are either located within or are in close proximity of EJ communities (Table 3.16-2 in Appendix Q outlines the ports supporting different phases of Project activities, and their location). As stated in Section 3.4, *Air Quality*, during the construction phase, total emissions of criterial pollutants and ozone precursors from offshore wind projects other than Sunrise Wind proposed within the air quality GAA, summed over all construction years, are estimated to be 30,217 tons CO; 143,994 tons NO_x; 2,750 tons SO_2, 3,757 tons VOC; 6,477 tons PM_{10}; 4,421 tons $PM_{2.5}$; and 9,138,691 tons of CO_2. This area is larger than the EJ geographic area; therefore, a large portion of the emissions would be generated along the vessel transit routes and the offshore work areas. The Revolution Wind, New England Wind, South Coast Wind, and Beacon Wind 1 Projects are expected to have overlapping construction schedules with the Proposed Action in 2024 and 2025. The magnitude of emissions and resulting impacts would vary spatially and temporally during the construction phase.

Emissions would vary spatially and temporally during construction phases even for overlapping projects. Emissions from vessels, vehicles, and equipment operating in ports could affect EJ communities adjacent or close to those ports. Emissions attributable to the No Action Alternative affecting any neighborhood have not been quantified; however, it is assumed that emissions from the No Action Alternative at ports would contribute a small proportion of total emissions from those facilities. Therefore, air emissions during construction would have small, short-term, variable impacts on EJ communities due to short-term increases in air emissions. The air emissions impacts would be greater if multiple offshore wind projects simultaneously use the same port for construction staging. If construction staging is distributed among several ports, the air emissions would not be concentrated near certain ports and impacts on proximal EJ communities would be lower.

As explained in Section 3.4, *Air Quality*, O&M activities under the No Action Alternative within the air quality GAA would generate air emissions, although less than during construction activities. Estimated O&M phase emissions are 771 tons CO; 3,058 tons NO_x; 45 tons SO_2; 69 tons VOCs; 117 tons PM_{10}; 109 tons $PM_{2.5}$; and 751,649 tons CO_2. Emissions could result from routine or non-routine maintenance activities and repairs involving marine vessels carrying crew and materials, on-vessel equipment, and emergency diesel generators. Overall, operation of future offshore wind projects would produce negligible emissions because wind turbines do not emit pollutants. Operational emissions would overall be intermittent and widely dispersed throughout the GAA and would generally contribute to small and localized air quality impacts. Only the portion of those emissions resulting from ship engines and port-based equipment operating within and near the ports identified above would affect EJ communities. Therefore, during operations of offshore wind projects, the air emissions volumes resulting from port activities are not anticipated to be large enough to have impacts on EJ communities.

The power generation capacity of offshore wind development could potentially lead to lower regional air emissions by displacing fossil fuel plants for power generation, resulting in a potential reduction in regional GHG emissions, as analyzed in further detail in Section 3.4, *Air Quality*. A 2019 study found that nationally, exposure to fine particulate matter from fossil fuel electricity generation in the United States varied by income and by race, with average exposures highest for black individuals, followed by non-Hispanic white individuals. Exposures for other groups (i.e., Asian, Native American, and Hispanic) were somewhat lower. Exposures were higher for lower-income populations than for higher-income populations, but disparities were larger by race than by income (Thind et al. 2019). Exposure to air pollution is linked to health impacts, including respiratory illness, increased health care costs, and mortality. A 2016 study for the Mid-Atlantic region found that offshore wind could produce measurable benefits related to health costs and reduction in loss of life due to displacement of fossil fuel power generation (Buonocore et al. 2016). EJ populations tend to have disproportionately high exposure to air pollutants, likely leading to disproportionately high adverse health consequences. Accordingly, offshore wind generation analyzed under the No Action Alternative would have potential benefits for EJ populations through reduction or avoidance of air emissions and concomitant reduction or avoidance of adverse health impacts. Or avoidance of adverse health impacts at a regional level.

Cable emplacement and maintenance: Cable emplacement and maintenance for future offshore wind projects described in Appendix E would result in seafloor disturbance and short-term increases in turbidity. Cable emplacement and maintenance could displace other marine activities temporarily within cable installation areas. As described in Section 3.14, *Commercial Fisheries and For-Hire Recreational Fishing*, cable installation and maintenance would have localized, short-term impacts on the revenue and operating costs of commercial and for-hire fishing businesses. Commercial fishing operations may temporarily be less productive during cable installation or repair, resulting in reduced income and leading to short-term reductions in business volumes for seafood processing and wholesaling businesses that depend upon the commercial fishing industry. Although commercial and for-hire fishing businesses could temporarily adjust their operating locations to avoid revenue loss, impacts would be greater if multiple cable installation or repair projects are underway offshore of the EJ GAA at one time. Business impacts could affect EJ populations due to the potential loss of income or jobs by low-income workers in the commercial fishing industry. In addition, cable installation and maintenance could temporarily disrupt subsistence fishing, resulting in short-term, localized impacts on low-income residents and tribal members who rely on subsistence fishing as a food source, as well as tribal members for whom fishing and clamming is also a cultural practice.

As noted in Section 3.15, *Cultural Resources*, cable emplacement could damage submerged ancient landforms that may have cultural significance to Native American tribes as part of ancient and ongoing tribal practices, and as portions of a landscape occupied by their ancestors. Disturbance and destruction of even a portion of an identified submerged landform could degrade or even eliminate the value of these resources as potential repositories of archaeological knowledge and cultural significance to tribes. If these landforms are disturbed during offshore cable emplacement, the impact on the cultural resource would be permanent, resulting in a disproportionately high and adverse impact on the affected Native American tribes.

Land disturbance: Offshore wind development would require onshore cable installation, substation construction or expansion, and possibly expansion of shore-based port facilities. Depending on siting, land disturbance could result in short-term, localized, variable disturbances of neighborhoods and businesses near cable routes and construction sites due to typical construction impacts such as increased noise, dust, traffic, and road disturbances. Potential short-term, variable impacts on EJ communities could result from land disturbance, depending upon the location of onshore construction for each offshore wind project.

Lighting: The view of nighttime aviation warning lighting required for offshore wind structures could have impacts on economic activity in locations where lighting is visible by affecting the decisions of tourists or visitors in selecting coastal locations to visit. Service industries that support tourism are a source of employment and income for low-income workers. Impacts on tourism are anticipated to be localized, not industry-wide (Section 3.21, *Recreation and Tourism*), therefore would have little impact on EJ populations. Lighting on WTGs could affect cultural and historic resources, including views of night sky and the ocean that are important to Native American tribes. Section 3.15, *Cultural Resources,* and Section 3.22, *Scenic and Visual Resources,* evaluate visual impacts on historic and cultural resources.

As additional offshore wind projects become operational, the nighttime lighting would be visible from a greater number of coastal locations. The aviation hazard lighting from offshore wind farm WTGs could potentially be visible from beaches and coastal areas in the GAA, depending on vegetation, topography, weather, and atmospheric conditions. Aviation hazard lighting is evaluated as part of the discussion of scenic and visual resources in Section 3.22, *Scenic and Visual Resources*, and briefly discussed in Section 3.21, *Recreation and Tourism*. The impacts on recreation and tourism-related economic activity, if any, would be long-term and continuous and could, in turn, have impacts on EJ populations, specifically low-income employees of tourism-related businesses.

Lighting impacts would be reduced if the emerging technology of ADLS is used. ADLS lighting would be activated only when an aircraft approaches (Section 3.22, *Scenic and Visual Resources*). Depending on exact location and layout of offshore wind projects, ADLS would likely limit the frequency of WTG aviation warning lighting use. This technology, if used, would significantly reduce the impacts of lighting.

Noise: As described in greater detail in Sections 3.14 and 3.16, *Commercial Fishing and For-Hire Recreational Fishing* and *Demographics, Employment and Economics*, respectively, noise from site assessment G&G survey activities, pile driving, trenching, and vessels is likely to result in short-term revenue reductions for commercial fishing and marine recreational businesses that operate in the areas offshore from the GAA, which could impact EJ populations who may be employed in these industries. Construction noise, especially site assessment G&G surveys and pile driving, would affect fish and marine mammal populations, with impacts on commercial and for-hire fishing and marine sightseeing businesses. There would be noise generated from helicopter activity both during construction and O&M phases of the Project. The severity of impacts would depend on the proximity and temporal overlap of offshore wind survey and construction activities, and the location of noise-generating activities in relation to preferred locations for commercial/for-hire fishing and marine tours.

The localized impacts of offshore noise on fishing could affect subsistence fishing by low-income residents. In addition, noise would affect some for-hire fishing businesses or marine sightseeing businesses, as these visitor-oriented services are likely to avoid areas where noise is generated due to the disruption for the customers.

Impacts of offshore noise on marine businesses would be short-term and localized, occurring during surveying and construction, with no noticeable impacts during operations and only periodic, short-term impacts during maintenance. Noise impacts during surveying and construction would be more widespread when multiple offshore wind projects are under construction at the same time. The projects within offshore areas of the east coast from the GAA for EJ could have 3,027 offshore WTGs and 69 offshore substations/converter stations installed by 2030 (Appendix E). The impacts of offshore noise on marine businesses and subsistence fishing would have short-term, localized impacts on low-income workers in marine-dependent businesses as well as residents who practice subsistence fishing and clamming, resulting in impacts on EJ populations. Therefore, commercial fisheries and for-hire recreational fishing activities, along with other recreation and tourism activities (e.g., marine sightseeing businesses) that are most active in the summer months would likely be more impacted than those active during the winter months.

Onshore construction noise would temporarily inconvenience visitors, workers, and residents near sites where onshore cables, substations, or port improvements are installed to support offshore wind development. Impacts would depend upon the location of onshore construction in relation to businesses or EJ communities and could be short-term and intermittent, similar to those of other onshore utility construction activity.

Noise generated by offshore wind staging operations at ports would potentially have impacts on EJ communities if the port is near such communities. Within the GAA for EJ populations, the port cities in various states noted in Table 3.16-2 in Appendix Q (refer to COP Figure 3.3.10-1; Sunrise Wind 2023), are within or near EJ communities. The noise impacts from increased port utilization would be short-term and variable, limited to the construction period, and would increase if a port is used for multiple offshore wind projects during the same time period. Noise impacts would be reduced if intervening buildings, roads, or topography lessen the intensity of noise in nearby residential neighborhoods, or if noise-reduction measures are used for motorized vehicles and equipment.

Port utilization: Offshore wind project installation would require port facilities for berthing, staging, and loadout with offshore development supporting planned expansions and modifications at ports in the GAA. Offshore wind projects that utilize ports in or near EJ communities (e.g., the port cities in various states noted in Table 3.16-2 in Appendix Q) (refer to COP Figure 3.3.10-1; Sunrise Wind 2023), may contribute to adverse impacts on these communities from increased air emissions and noise generated by port utilization or expansion (refer to discussions in the air emissions and noise sections). Port use and expansion would have beneficial impacts on employment at ports. Port utilization for offshore wind would have short-term, beneficial impacts for EJ populations during construction and decommissioning, resulting from employment opportunities, support for other local businesses by port-related businesses, and employee expenditures. Beneficial impacts would result from port utilization during offshore wind operations, but these impacts would be of lower magnitude.

Presence of structures: As described in Sections 3.14, *Commercial Fisheries and For-Hire Recreational Fishing*, Section 3.15, *Cultural Resources*, Section 3.19, *Navigation and Vessel Traffic*, and Section 3.21, *Recreation and Tourism*, the offshore structures required for offshore wind projects, including WTGs, OSSs, and offshore cables protected with hardcover, would affect employment and economic activity generated by marine-based businesses.

Commercial fishing businesses would want to adjust routes and fishing grounds to avoid offshore work areas during construction and to avoid WTGs and OSSs during operations. Concrete cable covers and scour protection could result in gear loss and would make some fishing techniques unavailable in locations where the cable coverage exists. For-hire recreational fishing businesses would want to avoid construction areas and offshore structures. A decrease in revenue, employment, and income within commercial fishing and marine recreational industries is likely to affect low-income workers, resulting in impacts on EJ populations. The impacts during construction would be short-term and would increase in magnitude when multiple offshore construction areas exist at the same time. The projects within the offshore areas of the east coast of the United States are outlined in Appendix E. Impacts during operations would be long-term and continuous but may lessen in magnitude as business operators adjust to the presence of offshore structures and as any short-term marine safety zones needed for construction are no longer needed.

In addition to the potential impacts on marine activity and supporting businesses, WTGs are anticipated to provide new opportunities for subsistence and recreational fishing through fish aggregation and reef effects, and to provide attraction for recreational sightseeing businesses, potentially benefiting subsistence fishing and low-income employees of marine-dependent businesses.

Views of offshore WTGs could have impacts on individual locations and businesses serving the recreation and tourism industry, based on visitor decisions to select or avoid certain locations. Because the service industries that support tourism are a source of employment and income for low-income workers, impacts on tourism would result in impacts on EJ populations. As stated in Section 3.22, *Scenic and Visual Resources*, portions of WTGs associated with offshore wind farm development and the No Action Alternative could potentially be visible from shorelines, depending on vegetation, topography, weather, and atmospheric conditions. While WTGs could be visible from some shoreline locations in the GAA, WTGs would not dominate offshore views, even when weather and atmospheric conditions allow views. The impact of visible WTGs on recreation and tourism is likely to be limited to individual decisions by some visitors and is unlikely to affect most shore-based tourism businesses or the GAA's tourism industry (Section 3.21, *Recreation and Tourism*). Therefore, views of offshore WTGs are not anticipated to result in impacts on EJ populations, specifically low-income employees of tourism-related businesses.

The development of future offshore wind projects would introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources along the coastlines of New York, Connecticut, Massachusetts, and Rhode Island. Impacts on above-ground cultural resources from the presence of structures would be limited to those cultural resources from which future offshore wind projects would be visible, which would typically be limited to historic buildings, structures, objects, districts, and TCPs relatively close to shorelines and on elevated landforms near the coast. BOEM consulted with Native American tribes for whom these views are culturally important, as part of the review under the NHPA Section 106. Section 3.15, *Cultural Resources* provides evaluations of visual impacts on historic and cultural resources.

Traffic: Offshore wind construction and decommissioning and, to a lesser extent, offshore wind operation would generate increased vessel traffic. The anticipated offshore wind projects within the areas of the east coast of the United States are outlined in Appendix E. Vessel traffic for each project is not known; however, it is assumed that several of these projects would utilize ports and areas similar to Sunrise Wind.

The volume of vessel traffic during construction would complicate marine navigation in the offshore construction areas and create the potential for vessel congestion and reduced capacity within and near the ports that support offshore construction, with potential competition for berths and docks. The short-term impacts on commercial fishing or recreational boating would affect all local boaters and would not have disproportionate impacts on residents or businesses within areas identified as EJ communities; however, the impact may be of greater magnitude for individuals who fish for subsistence or members of EJ communities who depend on jobs in commercial/for-hire fishing or marine recreation for their livelihood. Simultaneous development of multiple offshore wind projects could increase port-related vessel congestion. However, the impacts could be reduced by appropriate port planning and preparation.

Accordingly, vessel traffic generated by offshore wind project construction would have short-term, variable impacts on EJ communities due to the impacts on jobs, income, and subsistence fishing resulting from impacts on marine businesses, port congestion, and availability of berths. The magnitude of impact would depend upon the navigation patterns and the extent of facility preparation and planning at the port. In addition to the short-term impacts related to navigation and port availability, the increased need for marine transportation to support offshore wind development could have beneficial impacts on EJ populations through the provision of jobs and support of businesses.

It is expected that offshore wind development may increase onshore traffic to some extent due to accessing of ports during construction and O&M phases for employees, supplies, equipment, and mobilization. Many of these ports are located in cities and other population centers and a certain amount of port-related traffic is routine. It is recommended that individual projects would have a traffic management plan to understand and mitigate periods where traffic may negatively impact the surrounding communities. However, due to the geographic spread of the analysis area, along with the multiple different ports supporting the various offshore activities, specific and localized impacts cannot be predicted.

3.17.4.3 Conclusions

Impacts of the No Action Alternative

Under the No Action Alternative, EJ population within the GAA would continue to be influenced by regional environmental, demographic, and economic trends. However, while the proposed Project would not be built under the No Action Alternative, BOEM expects ongoing activities would persist in the Lease Area and have short-term to long-term impacts on EJ populations through the following trends, including: ongoing population growth and new development; resulting traffic increases and industrial development, possibly increasing emissions near EJ communities; gentrification of coastal communities; ongoing commercial fishing, seafood processing, and tourism industries that provide job opportunities for low-income residents; and construction-related air pollutant emissions and noise when these occur near EJ communities. BOEM anticipates that the EJ impacts as a result of ongoing activities associated with the Alternative A – No Action of these ongoing activities would be **minor** to **moderate** adverse to **minor beneficial**.

Cumulative Impacts of the No Action Alternative

Reasonably foreseeable trends affecting EJ populations, other than offshore wind, include changes in the commercial fishing and seafood processing industries due to climate change and environmental stress; growing recreational and tourism industries for coastal economies; new development that would result in increased motor vehicle emissions; historically industrial waterfront locations redeveloping; and continued pressure to balance development pressure and coastal activity with protection of air and water quality. BOEM anticipates that the cumulative impacts of these trends and planned activities on EJ populations would be minor. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in minor adverse cumulative impacts on EJ populations, 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; and the loss of industry in historically industrial port areas.

Considering all the IPFs, BOEM anticipates that the overall cumulative impacts associated with future offshore wind activities in the GAA combined with ongoing activities and reasonably foreseeable activities other than offshore wind would result in overall **minor** to **moderate** adverse. This reflects short-term impacts on minority and low-income communities from cable emplacement, lighting, construction phase noise and vessel traffic, and the long-term presence of offshore structures, which could affect marine-dependent businesses, thereby potentially resulting in job losses for low-income workers. Construction-related port activities could have impacts on EJ communities near ports through air emissions, traffic, and/or noise. This rating reflects the potentially adverse impacts on tribes resulting from long-term impacts on culturally important ocean views and permanent impacts on submerged ancient landforms or other resources of importance to the values and practices of certain Native American Tribes (Section 3.15, *Cultural Resources*).

BOEM anticipates that the impacts associated with future offshore wind activities in the GAA would result in **minor beneficial** effects on minority and low-income populations through economic activity and job creation. Additional beneficial effects may result from reductions in air emissions if offshore wind displaces energy generation using fossil fuels, and minor beneficial employment benefits associated with future offshore wind construction and O&M, increased port utilization, and improved opportunities for for-hire recreational fishing. Beneficial effects are mentioned here for completeness but are not part of an EJ review under federal guidelines (CEQ 1997); therefore, are not assigned a level of significance.

3.17.5 Relevant Design Parameters and Potential Variances in Impacts

This Final EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in Appendix C would result in impacts similar to or less than those described in the sections below. The following proposed relevant design parameters and potential variances (Appendix C) that would influence the magnitude of the impacts to EJ populations:

- The number, size, and location of WTGs;
- During construction phase, the amount of helicopter support required;
- Related to onshore export cable route and construction (Holbrook Construction Areas and Volumes), the length of onshore cable route, cable trenches, corridor width, and corridor area;
- Related to onshore substation (Holbrook), the permanent site area and short-term construction workspace;
- Related to overhead Transmission Line (Holbrook), the maximum length of onshore interconnection cable route, landfall type, the HDD noise levels, and number of personnel.

3.17.6 Impacts of Alternative B – Proposed Action on EJ

Impacts on EJ communities would occur when the Proposed Action's adverse effects on other resources, such as air quality, water quality, employment and economics, cultural resources, recreation and tourism, commercial fishing, or navigation, are felt disproportionately within EJ communities, due either to the location of these communities in relation to the Proposed Action or to their higher vulnerability to impacts.

The impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and other future offshore wind activities are listed by IPF in Appendix G. The most impactful IPFs would likely include cable emplacement, vessel traffic during construction, and the presence of offshore structures because of the potential impacts of these IPFs on submerged landforms (and associated cultural resource impacts), marine businesses (fishing and recreational), views of WTGs, and subsistence fishing. Beneficial economic effects would result from port utilization and reduction in air emissions because of displacement of fossil fuel electricity generation. Beneficial economic effects would result from port utilization and reduction in air emissions, resulting from displacement of fossil fuel electricity generation. Impacts are characterized by onshore and offshore activities during each period of the project (Construction and Installation, O&M, and Conceptual Decommissioning).

3.17.6.1 Construction and Installation

3.17.6.1.1 Onshore Activities and Facilities

Air quality: Construction and installation activities onshore could have an adverse and disproportionate impact on EJ communities present in the vicinity of the proposed facilities. During construction of the OnCS-DC, onshore transmission cable and onshore interconnection cable, there would be a variety of road and non-road engines in use that would produce emissions. Construction-related emissions associated with these engines during construction of the Onshore Facilities would be short-term and would cease when construction is completed. Impacts would be similar to other construction projects, and air emissions are noted in Section 3.4, *Air Quality* (located in Appendix Q). In addition to air emissions, a localized increase in fugitive dust may result during onshore construction activities. To minimize potential emissions of fugitive dust during construction, the Project would develop a dust control plan including a robust dust control program that would be required as part of contract specifications.

The OnCS-DC, onshore transmission cable and onshore interconnection cable are located within, adjacent to, or within the vicinity of several Census Block Groups that are considered EJ communities (as shown Figure 3.17-1), and therefore have an adverse disproportionate impact on these communities; however, these activities would be short-term nature and are considered to be a minor disproportionate, adverse impact.

Cable emplacement and maintenance: Construction of onshore facilities includes installation of the onshore cable, primarily within public road and utility ROWs, and substation construction within a designated industrial area. The onshore transmission cable and onshore interconnection cable are located within, immediately adjacent to, or in the vicinity of several EJ communities (Figure 3.17-1). Impacts during cable installation would be similar to other construction type projects. Impacts could include air emissions from vehicle and equipment usage and an increase in particulate matter related to dust (see Section 3.4, *Air Quality*), along with potential noise and traffic impacts during the construction period. Noise and traffic impacts would be mitigated to the extent possible through APMs and the development of a Maintenance and Protection of Traffic (MPT) plan as part of the Project's EM&CP. In addition, outreach efforts and stakeholder engagement activities have contacted adjacent residences with respect to notifications for fieldwork and surveys. Overall, the construction of onshore facilities would be short-term in nature and are considered to be a minor disproportionate, adverse impact.

Land disturbance: The OnCS-DC, onshore transmission cable and onshore interconnection cable are located within, immediately adjacent to, or in the vicinity of several EJ communities, this includes the census block group where landfall would occur at Smith Point County Park (Figure 3.17-1). Construction of the onshore export cable route would temporarily disturb neighboring land uses through construction noise, vibration, and dust and other air emissions, and cause delays in travel along the affected roads (as discussed individually throughout this section), but would have only short-term, variable, minor impacts on EJ communities. Installation of the cables would occur within a temporary construction corridor, along existing roadway and utility rights-of-way (e.g., William Floyd Parkway and Transmission Line ROW, LIRR, Sunrise Highway). The route siting evaluating potential routes and constraints evaluated various factors, local stakeholder engagement, adjacent land uses, and proximity to environmental and cultural resources. The established route does traverse census block groups that are EJ communities.

From a cultural resource perspective, ground-disturbing activities conducted during construction of onshore facilities have the potential to impact terrestrial archaeological resources. To avoid impacts to intact archaeological resources, the onshore facilities are primarily sited within previously disturbed and developed areas (e.g., roadways, ROWs, developed industrial/commercial areas) to the extent feasible, to minimize impacts to potential archaeological resources. In addition, facilities were sited using guidance from previous cultural resources surveys and input from Native American tribes to avoid or minimize impacts to historic properties. Desktop and infield archaeological investigations conducted in undisturbed portions of the project did not identify any previously known or undiscovered archaeological resources within the Proposed Action APE (COP Section 4.6.2, Sunrise Wind 2023). As a result of these activities, BOEM anticipates that the Proposed Action would have negligible impacts on previously recorded terrestrial archaeological resources.

The Proposed Action's onshore land disturbance activities are not anticipated to overlap in location with other offshore wind projects. If land disturbance overlaps with other offshore wind projects, in context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined onshore land disturbance impacts on EJ populations from ongoing and planned activities would likely be short-term, variable, and negligible to minor.

Lighting: Lighting in this context primarily refers to aviation safety lighting for the offshore WTGs, and there is not anticipated to be additional lighting for onshore activities and facilities outside of perhaps some lights during the construction period, as needed. The impact of any onshore lighting related to the Proposed Action on EJ populations would be short-term and negligible and not considered to be a disproportionate, adverse impact.

Noise: Noise onshore may be present from the construction and installation of the OnCS-DC, onshore transmission cable and onshore interconnection cable, including construction-related vehicle noise (i.e., dump trucks, backhoes, concrete saws, air compressors and portable generators), noise from areas requiring HDD, site preparation, and general vehicular traffic (note, port noise is discussed in the next section under Offshore Activities and Facilities). The OnCS-DC, onshore transmission cable and onshore interconnection cable are located within, immediately adjacent to, or in the vicinity of several EJ communities. The noise generated during construction and installation of onshore facilities would be short-term and would have a minor disproportionate impact on EJ communities.

Port utilization: Port utilization in this context primarily refers to vessel support related to the construction, O&M and decommissioning of offshore facilities. Therefore, there would be no impact related to onshore activities and facilities.

Presence of structures: Presence of structures in this context primarily refers to the WTGs and other support facilities offshore; therefore, there would be no impact related to onshore activities and facilities. With respect to viewshed of WTGs from onshore historic resources, Table 3.15-5 in Section 3.15, *Cultural Resources*, outlines the number and type of above-ground historic resources within the PAPE for viewshed resources. This includes 342 resources, of which 11 are NHLs, 66 are NRHP-listed districts or individual properties, 61 are NRHP-eligible properties, and three are TCPs. Previously identified resources not evaluated for the NRHP are considered NRHP-eligible by BOEM for the purposes of this project and include 38 Rhode Island Historic Preservation and Heritage Commission Resources, 140 resources inventoried by the Massachusetts Historical Commission, and 23 Rhode Island Historical Cemeteries. The geographic breakdown for these 342 resources includes 7 resources in New York, 3 in Connecticut, 168 in Massachusetts, and 164 in Rhode Island.

Traffic: Traffic in this context primarily refers to land-based vehicular traffic related to the construction of onshore facilities, including the OnCS-DC, onshore transmission cable and onshore interconnection cable. This may require some detours and/or additional congestion during the period of construction of the onshore facilities along the roadways where the cable would be installed but be similar to a routine construction project. The OnCS-DC, onshore transmission cable and onshore interconnection cable are located within, adjacent to, or within the vicinity of several Census Block Groups that are considered EJ communities, and therefore have an impact on these communities; however, these traffic-related activities would be short-term in nature and through the development of an MPT plan as part of the Project's EM&CP, it would minimize potential traffic impacts and associated impacts are considered to be a minor disproportionate, adverse impact. This Onshore Maintenance and Protection of Traffic Plan (GEN-15) is specifically noted in Appendix H, Table H-1 – Applicant Proposed Measures.

3.17.6.1.2 Offshore Activities and Facilities

Air quality: Emissions during construction and installation of facilities at offshore locations would have regional impacts, with no disproportionate impacts on EJ communities. However, EJ communities near ports could experience disproportionate air quality impacts, depending upon the ports that are used. The Proposed Action's contributions to increased air emissions at the 14 ports being considered for this action (with four ports only identified for O&M activities and one port supporting both construction and O&M), which are predominately, or adjacent to, EJ communities, are not specifically evaluated. The 10 ports are being considered for use during the construction and installation of the Proposed Action are across seven states and geographically dispersed. Increased short-term and variable emissions from Proposed Action construction and operations would have negligible to minor disproportionate, adverse impacts on the communities near the ports.

The total estimated emissions during the construction phase of the project are presented in Table 3.4-5 of Section 3.4 (see Appendix Q) and calculate the tons per year (tpy) of emissions onshore and within 3 nm of the seven states within the GAA. Overall air emissions impacts would be minor to moderate during the Proposed Action construction, operations, and decommissioning, with the greatest quantity of emissions produced in the Lease Area and by vessels transiting from ports to the Lease Area (see Section 3.4, *Air Quality,* for additional details).

As noted previously, other offshore wind projects using ports within the GAA for EJ populations would overlap with the Project's construction phase, and associated short-term air quality impacts, which would be likely to vary from minor to moderate significance levels. The impacts at specific ports close to EJ communities cannot be evaluated because port usage has not been identified; however, most air emissions would occur at offshore locations rather than at the ports.

As noted under Alternative A, offshore wind within the various east coast Lease Areas would result in greater potential displacement of fossil fuel power generation. Net reductions in air pollutant emissions resulting from the Proposed Action alone would result in long-term benefits to communities (regardless of EJ status) by displacing emissions from fossil-fuel-generated power plants. As explained in Section 3.4, *Air Quality*, by displacing fossil fuel power generation, once operational, the Proposed Action would result in annual avoided emissions estimated to range between 1,380 and 2,548 tons of NO_X, 377 to 696 tons of $PM_{2.5}$, 1,227 to 2,266 tons of SO_2, and 2.1 to 3.8 million tons of CO_2 (Section 3.4, Table 3.4-7). Minority and low-income populations are disproportionately affected by emissions from fossil fuel power plants nationwide and by higher levels of air pollutants. Therefore, the Proposed Action alone could benefit EJ communities by displacing fossil fuel power generating capacity within or near the GAA.

Cable emplacement and maintenance: Offshore cable emplacement for the Proposed Action would temporarily affect commercial fishing and for-hire recreational fishing businesses, marine recreation, and subsistence fishing during cable installation. As noted in Sections 3.14, *Commercial Fisheries and For-Hire Recreational Fishing* and Section 3.21, *Recreation and Tourism*, installation of the Proposed Action's cables would have short-term, localized, minor impacts on marine businesses (commercial fishing or recreation businesses) and subsistence fishing. Cable installation could affect fish and mammals of interest for fishing and sightseeing through dredging and turbulence, although species would recover upon completion of installation activities. Installation and construction of offshore cable components for the Proposed Action could therefore have a short-term, minor impact on low-income workers in marine businesses.

The Proposed Action would require that export cables cross up to 104.6 mi (168.4 km) from the landfall location to the Lease Area (COP Section 1.1; Sunrise Wind 2023). In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined offshore cable emplacement impacts on EJ populations from ongoing and planned activities would likely be short-term and minor, resulting from the impact on subsistence fishing and employment and income from marine businesses, which may employ low-income individuals.

As noted in Section 3.15, *Cultural Resources*, cable emplacement could damage submerged ancient landforms that may have cultural significance to Native American tribes as part of ancient and ongoing tribal practices, and as portions of a landscape occupied by their ancestors. As noted in Section 3.15.1, *Cultural Resources*, a survey identified 43 preserved ASLF within the APE; 13 are located within the SRWEC corridor and 30 are located within the SRWF (COP, Appendix R; RCG&A 2023). Disturbance and destruction of even a portion of an identified submerged landform could degrade or even eliminate the value of these resources as potential repositories of archaeological knowledge and cultural significance to tribes. If these landforms are disturbed during offshore cable emplacement, the impact on the cultural resource would be permanent, resulting in a disproportionately high and adverse impact on the affected Native American tribes.

Land disturbance: In this context, land disturbance refers to onshore components of the Proposed Action; therefore, there would be no impacts to EJ communities related to construction and installation of offshore facilities.

Lighting: Lighting in this context refers primarily to the aviation hazard lighting on the WTGs but could also include minor to moderate effects from nighttime lighting associated with vessels and other construction and installation related equipment. The impacts would be primarily to the recreational and commercial fishing, pleasure, and tour boating community, which may employ low-income individuals within the marine business industry. The impact to EJ communities from visual impacts associated with lighting from offshore facility construction and installation would be negligible, and the impacts from potential marine-related businesses being impacted would be minor.

Noise: Noise from the offshore facilities component of the Proposed Action construction (primarily pile driving) could temporarily affect fish and marine mammal populations, hindering fishing and sightseeing near construction activity within the Lease Area, which could discourage some businesses from operating in these areas during pile driving (see Section 3.14 *Commercial Fisheries and For-Hire Recreational Fishing*). This would result in a localized, short-term, negligible impact on low-income jobs supported by these businesses, as well as on subsistence fishing, but would return to normal conditions following the completion of construction activities.

Noise generated by the Proposed Action’s staging operations at ports would potentially affect EJ communities if the port is near such communities. The Proposed Action is considering 10 ports for support during construction activities related to offshore facilities, most of which are in or adjacent to predominantly EJ communities. These ports have other industrial and commercial sites, as well as major roads, which generate ongoing noise. Therefore, although the additional noise from the Proposed Action alone has not been determined, it is unlikely to produce noise beyond what is already observed in the EJ communities near the ports. The noise impacts from increased port utilization would increase if a port were used for more than one offshore wind project. Depending upon the specific ports selected to support construction, noise from the Proposed Action, in combination with ongoing and planned activities, would have a variable, short-term, negligible to minor impact on EJ communities.

Port utilization: The Proposed Action would require port facilities for berthing, staging, and loadout to support the construction and installation of offshore facilities. Air emissions and noise generated by the Proposed Action's activities would potentially affect EJ communities at ports in or near these communities (as discussed elsewhere within this section), although these effects are anticipated to be both short-term in nature, and negligible to minor impacts.

The Proposed Action would potentially have a beneficial impact on EJ from port utilization due to greater economic activity and increased employment at the ports in the GAA, primarily during construction and decommissioning and to a lesser extent during operations. The Proposed Action would have minor beneficial impacts on EJ through increased job availability.

Presence of structures: Presence of structures in this context primarily refers to the WTGs and other support facilities offshore. Therefore, during the construction and installation phase there would not necessarily be structures permanently in place. The impacts surrounding the presence of structures is discussed in more detail under O&M.

Traffic: In this context, traffic is referring to vessel traffic generated during construction of the offshore facilities as part of the Proposed Action. Construction vessel trips would originate or terminate at one of the 10 ports being considered to support the Project during the construction and installation phase. Most of these ports are in predominantly EJ communities (see Figure 3.17-1 through Figure 3.17-19). Vessel traffic during construction is likely to have a short-term, minor impact on members of EJ communities who rely on subsistence fishing or employment and income from commercial fishing, for-hire recreational fishing and marine recreation, due to increased vessel traffic near ports and potential displacement from berths and docks.

3.17.6.2 Operations and Maintenance

3.17.6.2.1 Onshore Activities and Facilities

Air quality: O&M activities onshore would be minimal upon installation of the OnCS-DC, onshore transmission cable and onshore interconnection cable. The OnCS-DC, onshore transmission cable and onshore interconnection cable are located within, immediately adjacent to, or in the vicinity of several Census Block Groups that are considered EJ communities (Figure 3.17-1 through Figure 3.17-19). Although onshore O&M activities would occur throughout the life of the project, activities would be limited to monitoring, vegetation maintenance, repairs and related tasks, some on a recurring basis, others on an as-needed basis. Therefore, the Proposed Action's O&M of the onshore activities and facilities would have a negligible impact to EJ communities.

Onshore cable maintenance: Onshore facilities O&M for the onshore transmission cable and onshore interconnection cable are located within, immediately adjacent to, or in the vicinity of several EJ communities. However, O&M activities would be limited to monitoring and as-needed repairs during the useful life of the project. Therefore, the Proposed Action's operation and maintenance of the onshore cables would have a negligible impact to EJ communities.

Land disturbance: During the O&M phase of the project, the onshore transmission cable infrastructure, including cable landfall sites and onshore cables, would be underground and primarily within roads and utility rights-of-way, while the substation would operate within an industrial area. As a result, operations and occasional maintenance or repair operations from the Proposed Action would have negligible impacts and despite various portions of the roads and rights-of-way being within, immediately adjacent to, or in the vicinity of EJ communities, O&M would not result in disproportionate impacts on EJ communities.

Underground transmission cables and substations for other offshore wind development are anticipated to use cable routes and substation locations that comply with local land use regulations, and these improvements are not likely to be close enough to the Proposed Action to affect the same neighboring land uses. Accordingly, in context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined impacts of land use changes on EJ populations from ongoing and planned activities would likely be negligible.

Lighting: Lighting in this context primarily refers to aviation safety lighting for the offshore WTGs. It is not anticipated that there would be lighting for onshore activities and facilities during the O&M phase of the project, beyond perhaps some lights during a specific repair or maintenance activity, as needed during non-daylight activities. The impact of any onshore lighting related to O&M and the Proposed Action on EJ populations would be negligible.

Noise: Noise onshore may be present from O&M activities related to the OnCS-DC, onshore transmission cable and onshore interconnection cable. This would include operation of the OnCS-DC, which would be a new noise source and limited noise from routine maintenance that may require short-term use of equipment to facilitate inspections and repairs.

Based upon modeling of in-air noise (see COP Appendix I2; Exponent Engineering P.C. 2022), the OnCS-DC located at the Union Avenue site indicated that operational noise at the nearest noise sensitive receptor (NSR) would range from 28 to 67 dB, and the project sound level at the closest residence would be 42 dB, which is an increase of 0 dB over existing conditions. The Project would install appropriate, proposed mitigative measures and also comply with all specified regulatory criteria from the USEPA, NYS DEC, and the Town of Brookhaven. As noted in Table 1.5-1 of the COP (Sunrise Wind 2023), there has been extensive community outreach and stakeholder engagement conducted to date, including communication with the Town of Brookhaven and Suffolk County, New York where the onshore facilities are primarily located. In addition, communication has been made to residences abutting the corridor regarding fieldwork and surveys, and several open houses have been held about the project.

Therefore, although the OnCS-DC, onshore transmission cable and onshore interconnection cable are located within, immediately adjacent to, or in the vicinity of several EJ communities, noise generated from O&M activities would be minimal, ongoing and long-term for operation of the OnCS-DC and minimal and short-term when they do occur for routine maintenance. It is anticipated that Project-related noise would have a negligible to minor disproportionate impact on EJ communities.

Port utilization: Port utilization in this context primarily refers to vessel support related to the construction, O&M and decommissioning of offshore facilities. Therefore, there would be no impact related to onshore activities and facilities.

Presence of structures: Presence of structures in this context primarily refers to the WTGs and other support facilities offshore; therefore, there would be no impact related to onshore activities and facilities.

Traffic: Traffic in this context primarily refers to land-based vehicular traffic during the O&M phase for onshore facilities. Once the onshore facilities are constructed, there would be minimal long-term traffic impacts. There could be routine or as-needed maintenance along the cable routes or at the OnCS-DC; however, this would be negligible in the context of the surrounding area. The OnCS-DC, onshore transmission cable and onshore interconnection cable are located within, adjacent to, or within the vicinity of several Census Block Groups that are considered EJ communities, and therefore could have an impact on these communities; however, O&M traffic-related activities would be considered a negligible disproportionate, adverse impact. In addition, an Onshore Maintenance and Protection of Traffic Plan (GEN-15) would be implemented to further mitigate and reduce impacts.

3.17.6.2.2 Offshore Activities and Facilities

Air quality: Air emissions during the offshore O&M phase could occur during periodic marine vessel or helicopter use to transport material and personnel to the SRWF, OCS-DC, SRWEC, or IAC for regular inspections and routine maintenance practices and from on-vessel equipment used for repairs or maintenance; however, a smaller number of vessels would be needed during the O&M phase as compared to the construction phase. O&M activities would be conducted through utilization of a variety of vessels and operate out of up to five identified ports across New York and Rhode Island, including the Port of Brooklyn, Port Jefferson, and Port of Montauk, New York and/or the Port of Davisville and Quonset Point and Port of Galilee, Rhode Island (also noted in Table 3.16-2 in Appendix Q). EJ communities near ports could experience disproportionate air quality impacts, depending upon the ports that are used for O&M. The Proposed Action's contributions to increased air emissions at the five ports being considered for O&M support for this action are predominately, or adjacent to, EJ communities. Specific air emissions related to the Proposed Action's O&M activities per port are not specifically evaluated. However, as stated in Section 3.4*, Air Quality*, overall air emissions impacts would be minor during the Proposed Action O&M, with the greatest quantity produced in the Lease Area and by vessels transiting from ports to the Lease Area.

As noted previously, other offshore wind projects using ports within the GAA for EJ populations would overlap with the Project's O&M phase and associated air quality impacts, which would be likely to vary from minor to moderate significance levels. The impacts at specific ports close to EJ communities cannot be evaluated because port usage has not been identified; however, most air emissions would occur at offshore locations rather than at the ports.

Cable emplacement and maintenance: O&M activities related to the offshore cable emplacement for the Proposed Action would temporarily affect commercial fishing and for-hire recreational fishing businesses, marine recreation, and subsistence fishing during infrequent maintenance; however, would be less than during construction and installation. Impacts on EJ populations from O&M activities would likely be short-term and minor, resulting from the impact on subsistence fishing and employment and income from marine businesses, which may employ low-income individuals.

Land disturbance: In this context, land disturbance refers to onshore components of the Proposed Action; therefore, there would be no impacts to EJ communities related to O&M of offshore facilities.

Lighting: Aviation hazard lighting from 94 WTGs associated with the Proposed Action could potentially be visible from coastal locations. Sunrise Wind has committed to voluntarily implement ADLS or related means (e.g., dimming or shielding) to limit visual impact. ADLS would activate the Proposed Action's WTG lighting only when aircraft approach the SRWF WTGs, as compared to standard continuous FAA hazard lighting.

As described in Section 3.22, *Scenic and Visual Resources*, nighttime aviation safety lighting on all of the Proposed Action's WTGs could be visible from coastal and elevated locations (depending on vegetation, topography, weather, and atmospheric conditions). Impacts could include recreational and commercial fishing, pleasure, and tour boating community would experience major adverse effects in foreground views. Onshore viewers would experience minor to moderate effects from nighttime lighting associated with O&M activities.

As a result, the lighting of offshore structures would result in a long-term, continuous, negligible impact on EJ communities as a result of the negligible impact on views important to the recreation/tourism economic sector that provides employment for low-income workers.

Noise: Noise generated by the Proposed Action's ports that would support O&M activities would potentially affect EJ communities if the port is near such communities. The Proposed Action is considering five ports for support during construction activities related to offshore facilities, most of which are in or adjacent to predominantly EJ communities. These ports have other industrial and commercial sites, as well as major roads, which generate ongoing noise. Therefore, noise from the Proposed Action alone would have variable, negligible impacts on EJ communities near the ports. The noise impacts from increased port utilization would increase if a port were used for more than one offshore wind project. Depending upon the specific ports selected to support O&M activities, noise from the Proposed Action would have a negligible impact on EJ communities.

Port utilization: The Proposed Action would require port facilities to support O&M activities related to offshore facilities. Five ports are being considered for supporting offshore O&M activities (Table 3.16-2 in Appendix Q). Air emissions and noise generated by the Proposed Action's activities would potentially affect EJ communities at ports in or near these communities (as discussed elsewhere within this section), although these effects are anticipated to be negligible to minor impacts.

The Proposed Action would have a beneficial impact on EJ from port utilization due to greater economic activity and increased employment at the ports in the GAA, although to a lesser extent during the O&M phase than during construction. The Proposed Action would have minor beneficial impacts on EJ through increased job availability.

Presence of structures: The establishment of offshore structures under the Proposed Action includes up to 94 WTGs, an OCS-DC, as well as associated foundations and cables, which would result in both adverse and beneficial impacts on marine businesses (i.e., commercial fishing and for-hire recreational fishing businesses, offshore recreational businesses, and related businesses) and subsistence fishing. Beneficial impacts would be generated by the reef effect of offshore structures, providing additional opportunity for subsistence fishing, tour boats, and for-hire recreational fishing businesses. Impacts would result from navigational complexity within the Lease Area, disturbance of customary routes and fishing locations, and the presence of scour protection and cable hardcover, leading to possible equipment loss and limiting certain commercial fishing methods.

Overall, the presence of structures in the offshore environment from the Proposed Action would have minor to moderate impacts on marine businesses (Sections 3.14, *Commercial Fisheries and For-Hire Recreational Fishing,* and Section 3.21, *Recreation and Tourism*), resulting in long-term, continuous, minor impacts on EJ populations due to the impact on low-income workers in marine industries and low-income residents who rely on subsistence fishing.

In addition, as described in Section 3.22, *Scenic and Visual Resources*, all of the Proposed Action's WTGs could be visible from coastal locations, depending upon vegetation, topography, and atmospheric conditions. The impact of visible WTGs on recreation and tourism is anticipated to be minor, and the impact is unlikely to meaningfully affect the recreation and tourism industry as a whole. Views of WTGs associated with the Proposed Action are therefore anticipated to have a negligible impact on EJ populations based upon the minimal anticipated impact on low-income employees of the recreation and tourism economic sector.

Traffic: In this context, traffic is referring to vessel traffic generated during the O&M phase of the Proposed Action for offshore facilities. O&M vessel trips would originate or terminate at one of the five ports being considered to support the Project during the construction and installation phase. Most of these ports are in predominantly EJ communities. Vessel traffic would be limited during the O&M phase and would have a long-term, negligible impact on EJ communities.

Non-routine activities associated with the Proposed Action could include response to spills from maintenance or repair vessels or activities requiring repair of WTGs, equipment, or cables that would generally require intense, short-term activity associated with oil spill response or to address emergency conditions. The presence of unexpectedly frequent vessel activity in ports, in offshore locations or near individual WTGs, could temporarily prevent or deter subsistence, commercial fishing or for-hire recreational fishing, or tourist activities near the site of a given non-routine event. The impacts of non-routine activities resulting from the Proposed Action on EJ populations would be minor.

3.17.6.3 Conceptual Decommissioning

3.17.6.3.1 Onshore Activities and Facilities

Air emissions: The decommissioning phase for onshore activities and facilities would be similar to, or of lesser intensity, than during the construction and installation phase and would occur for a shorter period of time; however, the location of the onshore facilities is within, adjacent to, or in the vicinity of EJ communities. The potential impacts to EJ populations related to air emissions would be similar to or less than under the construction and installation phase, and also short-term, and therefore are expected to have a minor, disproportionate impact on EJ populations.

Cable emplacement and maintenance: Onshore cable decommissioning would be similar in nature to the construction and installation related impacts. The onshore transmission cable and onshore interconnection cable are located within, immediately adjacent to, or in the vicinity of several EJ communities. Impacts during cable decommissioning would be similar to other construction type projects, and could include air emissions, noise, and traffic impacts, as well as visual impacts. However, the decommissioning would be short-term and even shorter-term than construction and are considered to be a minor disproportionate, adverse impact.

Land disturbance: The decommissioning phase for onshore activities and facilities would be similar to, or of lesser intensity, than during the construction and installation phase and would occur for a shorter period of time; however, the location of the onshore facilities is within, adjacent to, or in the vicinity of EJ communities. The potential impacts to EJ communities related to land disturbance would be similar to, or less than under the construction and installation phase, and also short-term, and therefore are expected to have a minor, disproportionate impact on EJ populations.

Lighting: Lighting in this context primarily refers to aviation safety lighting for the offshore WTGs, and there is not anticipated to be additional lighting for onshore activities and facilities outside of perhaps some lights during the decommissioning period, as needed. The impact of any onshore lighting related to the Proposed Action on EJ populations would be short-term and negligible.

Noise: Noise onshore may be present from the decommissioning activities of the OnCS-DC, onshore transmission cable and onshore interconnection cable, which may include similar activities as during construction and installation. This would include construction-related vehicle noise (i.e., dump trucks, backhoes, concrete saws, air compressors and portable generators), site rehabilitation, and general vehicular traffic. The OnCS-DC, onshore transmission cable and onshore interconnection cable are located within, immediately adjacent to, or in the vicinity of several EJ communities. The noise generated during decommissioning of onshore facilities would be short-term and would have a minor disproportionate impact on EJ communities.

Port utilization: Port utilization in this context primarily refers to vessel support related to the construction, O&M and decommissioning of offshore facilities. Therefore, there would be no impact related to onshore activities and facilities.

Presence of structures: Presence of structures in this context primarily refers to the WTGs and other support facilities offshore; therefore, there would be no impact related to onshore activities and facilities.

Traffic: Traffic in this context primarily refers to land-based vehicular traffic related to the decommissioning of onshore facilities, including the OnCS-DC, onshore transmission cable and onshore interconnection cable, which is assumed to be similar to construction and installation. This may require some detours and/or additional congestion during the period of decommissioning of the onshore facilities along the roadways where the cable would be installed but be similar to a routine construction project. he OnCS-DC, onshore transmission cable and onshore interconnection cable are located within, adjacent to, or within the vicinity of several Census Block Groups that are considered EJ communities, and therefore have an impact on these communities; however, these traffic-related activities would be short-term nature and through the development of an MPT plan as part of the Project’s EM&CP, similar to the construction phase, potential traffic impacts would be minimized and associated impacts and considered to be a minor disproportionate, adverse impact.

3.17.6.3.2 Offshore Activities and Facilities

Air emissions: The decommissioning phase for the offshore facilities would be similar to the construction and installation phase but occur for a shorter period of time. Activities would include removing the structure and foundations of the SRWF, OCS-DC, and SRWEC. There would be a short-term increase in marine vessel and helicopter traffic. It is expected that similar equipment would be used as during construction, but emissions are expected to be less because of improved emission control technology and more stringent emission standards 25-35 years in the future. Decommissioning is expected to be completed within two years and any emissions would cease after decommissioning is complete. The potential impacts to EJ populations would be similar to or less than under the construction and installation phase, and also short-term, and therefore are expected to have a minor, disproportionate impact on EJ populations.

Cable emplacement and maintenance: The decommissioning of offshore cable for the Proposed Action would temporarily affect commercial fishing and for-hire recreational fishing businesses, marine recreation, and subsistence fishing during cable installation, in a similar manner as during construction and installation but to a lesser degree. Decommissioning activities would have a short-term, localized, minor impact on marine businesses (commercial fishing or recreation businesses) and subsistence fishing. Decommissioning activities could affect fish and mammals of interest for fishing and sightseeing through dredging and turbulence, although species would recover upon completion and removal of the cable. Decommissioning of offshore components for the Proposed Action could therefore have a short-term, minor impact on low-income workers in marine businesses.

Therefore, impacts to EJ populations would likely be short-term and minor, resulting from the impact on subsistence fishing and employment and income from marine businesses, which may employ low-income individuals.

Land disturbance: In this context, land disturbance refers to onshore components of the Proposed Action; therefore, there would be no impacts to EJ communities related to decommissioning of offshore facilities.

Lighting: Lighting in this context refers primarily to the aviation hazard lighting on the WTGs but could also include minor to moderate effects from nighttime lighting associated with vessels and other decommissioning related equipment. The impacts would be primarily to the recreational and commercial fishing, pleasure, and tour boating community, which may employ low-income individuals within the marine business industry. The impact to EJ communities from visual impacts associated with lighting from offshore facility decommissioning would be negligible, and the impacts from potential marine-related businesses being impacted would be minor.

Noise: Noise from decommissioning offshore facilities associated with the Proposed Action could temporarily affect fish and marine mammal populations, hindering fishing and sightseeing near decommissioning activity within the Lease Area, which could discourage some businesses from operating in these areas (see Section 3.14, *Commercial Fisheries and For-Hire Recreational Fishing*). It is assumed noise generated during decommissioning would be similar to that experienced during construction. This would result in a localized, short-term, negligible impact on low-income jobs supported by these businesses, as well as on subsistence fishing, but would return to normal conditions following the completion of decommissioning activities.

Noise generated by the Proposed Action's operations at ports supporting decommissioning would potentially affect EJ communities if the port is near such communities. It is assumed the Proposed Action would utilize a combination of the same 10 ports for decommissioning as were utilized during construction activities, most of which are in or adjacent to predominantly EJ communities. These ports have other industrial and commercial sites, as well as major roads, which generate ongoing noise. Therefore, noise from the Proposed Action alone would have short-term, variable, negligible impacts on EJ communities near the ports. The noise impacts from increased port utilization would increase if a port were used for more than one offshore wind project. Depending upon the specific ports selected to support decommissioning, noise from the Proposed Action, in combination with ongoing and planned activities, would have a variable, short-term, negligible to minor impact on EJ communities.

Port utilization: The Proposed Action would require port facilities for decommissioning activities related to offshore facilities. Air emissions and noise generated by the Proposed Action's activities would potentially affect EJ communities at ports in or near these communities (as discussed elsewhere within this section), although these effects are anticipated to be even shorter-term than during construction and installation and considered negligible to minor impacts.

Presence of structures: Presence of structures in this context primarily refers to the WTGs and other support facilities offshore. Therefore, during the decommissioning phase the structures would be in the process of being removed. Therefore, the offshore Lease Area environment would generally return to pre-existing conditions and impacts, whether adverse or beneficial, related to the Project would no longer be present.

Traffic: In this context, traffic is referring to vessel traffic generated during decommissioning of offshore facilities related to the Proposed Action. It is assumed that vessels supporting the decommissioning would originate or terminate at one of the same 10 ports being considered to support the Project during the construction and installation phase. Most of these ports are in predominantly EJ communities. Vessel traffic impacts during decommissioning would be similar to the impacts during construction and installation.

3.17.6.4 Cumulative Impacts of the Proposed Action

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

As noted in Appendix E, other offshore wind projects using ports within the GAA would overlap with the Project's construction and O&M phases. Short-term air quality impacts during the construction phase would be likely to vary from minor to moderate levels and to a lesser degree there would be long-term negligible impacts from O&M. The impacts at specific ports close to EJ populations cannot be evaluated because port usage has not been identified; however, most air emissions would occur at offshore locations rather than at the ports. Generation of offshore wind energy within offshore wind lease areas for future offshore wind projects would result in greater potential displacement of fossil fuel power generation than the Proposed Action alone. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the combined air quality impacts on EJ populations from ongoing and planned activities including future offshore wind would likely be negligible to minor, due to short-term emissions near ports during construction and decommissioning, or at the O&M facility during operations. The proposed Project could also have beneficial effects for EJ populations, due to long-term reduction in air emissions from fossil fuel power generation.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the combined offshore cable emplacement impacts on EJ populations from ongoing and planned activities including future offshore wind would likely be short-term and minor, resulting from the impact on subsistence fishing and reduced employment and income of workers employed in industries supporting commercial fishing. Because impacts of Proposed Action cable emplacement on EJ populations would be short-term and minor, BOEM has determined that impacts of this IPF on EJ populations would not be "high and adverse" for the purpose of the EJ analysis.

Ongoing activities and future non-offshore wind activities would occasionally generate additional pile-driving noise near ports and marinas, some of which may be near EJ populations. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area and longer time period. The increased impacts would affect commercial fishing and for-hire recreational fishing and supporting marine businesses, resulting in impacts on employment and income, which may include EJ populations. In context of reasonably foreseeable trends, the incremental impacts contributed by the Proposed Action to the combined pile-driving impacts on EJ populations from ongoing and planned activities including future offshore wind would be negligible to minor, based on the assessment of potential impacts of pile driving on boating, fisheries, and supporting marine businesses. Because impacts of Proposed Action noise on EJ populations would be negligible to minor, BOEM has determined that impacts of this IPF on EJ populations would not be "high and adverse" for the purpose of the EJ analysis.

The Proposed Action in combination with other offshore wind energy projects would result in a greater number of offshore structures affecting larger offshore areas. This could have an adverse impact on commercial fisheries, but potentially a slight benefit to recreational fishing due to the artificial reef effect. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts on EJ populations that may support commercial fishing, for-hire recreational fishing and/or other marine businesses from ongoing and planned activities, which are anticipated to range from minor to moderate adverse to minor beneficial.

3.17.6.5 Conclusions

Impacts of the Proposed Action

In summary, BOEM anticipates that the impacts of individual IPFs from the Proposed Action alone would be negligible to moderate on EJ populations within the GAA. During both construction and operations, the impacts on low-income employees of marine industries and supporting businesses (commercial fishing, support industries, marine recreation, and tourism) from all IPFs would range from negligible to minor. The minor impacts would result from disruption of marine activities during offshore cable installation and the impacts on commercial and for-hire fishing resulting from the long-term presence of offshore structures. The Proposed Action would result in minor to moderate impacts on EJ communities due to air emissions and noise at onshore construction sites and ports, but this would be short-term during construction and less during the O&M phase of the project because of less overall vessel activity. Potentially beneficial impacts on EJ populations would result from port utilization and increased vessel traffic, and the resulting employment and economic activity. Beneficial impacts could also result if the Proposed Action displaces fossil fuel energy generation in locations that improve air quality and health outcomes for EJ populations. Net reductions in air pollutant emissions resulting from the Proposed Action alone would result in long-term benefits to communities (regardless of EJ status) by displacing emissions from fossil-fuel generated power plants. As explained in Section 3.4, *Air Quality*, by displacing fossil fuel power generation, once operational, the Proposed Action would result in annual avoided emissions ranging between 1,380 and 2,548 tons of NO_X, 377 to 696 tons of $PM_{2.5}$, 1,227 to 2,266 tons of SO_2, and 2.1 to 3.8 million tons of CO_2. Minority and low-income populations are disproportionately affected by emissions from fossil fuel power plants nationwide and by higher levels of air pollutants. Therefore, the Proposed Action alone could benefit EJ communities by displacing fossil fuel power generating capacity within or near the GAA.

Considering the combined impacts of all IPFs, BOEM anticipates that the Proposed Action would have overall **moderate** impacts on all EJ populations, and therefore BOEM determined that impacts of the Proposed Action on low-income and minority populations would not be disproportionately high and adverse and could be avoided or reduced with APMs or would be unavoidable but not disproportionately high and adverse.

In addition, **minor beneficial** effects to EJ populations may result from reductions in air emissions if offshore wind displaces energy generation using fossil fuels, as well as beneficial effects from economic activity and job creation.

Cumulative Impacts of the Proposed Action

The Proposed Action in combination with other offshore wind energy projects would result in a greater number of offshore structures affecting larger offshore areas, and additional onshore construction and port utilization within the GAA. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the cumulative impacts on EJ populations from ongoing and planned activities, which are anticipated to be **moderate** overall. In addition, **minor beneficial** cumulative impacts to EJ populations may result from reductions in air emissions if offshore wind displaces energy generation using fossil fuels, as well as beneficial effects from economic activity and job creation.

3.17.7 Alternative C-1 - Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions

3.17.7.1 Construction and Installation

3.17.7.1.1 Onshore Activities and Facilities

Impacts of Alternative C-1

Under Alternative C-1, the potential impacts from the construction and installation of onshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action.

Cumulative Impacts of Alternative C-1

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts on EJ populations from ongoing and planned activities, which are anticipated to be **moderate** overall.

3.17.7.1.2 Offshore Activities and Facilities

Under Alternative C-1, the construction of the 11-MW WTGs, OCS-DC, and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. Removal of 8 WTG positions from Priority Areas 1, 2, 3 and/or 4 would not change the overall number of WTGs associated with the Project. Therefore, the potential impacts from the construction and installation of offshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action.

3.17.7.2 Operations and Maintenance

3.17.7.2.1 Onshore Activities and Facilities

Under Alternative C-1, the potential impacts from the O&M of onshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action.

3.17.7.2.2 Offshore Activities and Facilities

Under Alternative C-1, the O&M of the 11-MW WTGs, OCS-DC, and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. Removal of 8 WTG positions from Priority Areas would not change the overall number of WTGs associated with the Project that would need to be operated and maintained. Therefore, the potential impacts from the O&M of offshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action.

3.17.7.3 Conceptual Decommissioning

3.17.7.3.1 Onshore Activities and Facilities

Under Alternative C-1, the potential impacts from the conceptual decommissioning of onshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action.

3.17.7.3.2 Offshore Activities and Facilities

Under Alternative C-1, the conceptual decommissioning of the 11-MW WTGs, OCS-DC, and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. Removal of 8 WTG positions from Priority Areas would not change the overall number of WTGs associated with the Project that would need to be decommissioned. Therefore, the potential impacts from the conceptual decommissioning of offshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action.

3.17.7.4 Cumulative Impacts of Alternative C-1

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-1 to the cumulative impacts on EJ populations would be essentially the same as those described under the Proposed Action, which were noticeable to moderate, depending on the IPF.

3.17.7.5 Conclusions

Impacts of Alternative C-1

Alternative C-1 would include the removal of 8 WTG positions from Priority Areas 1, 2, 3, and/or 4 of the SRWF Lease Area for the purposes of habitat impact minimization; however, the overall number of WTGs (up to 94) would remain the same and the onshore facilities and components would remain as described under the Proposed Action. The impacts resulting from individual IPFs associated with Alterative C-1 would be the same for both offshore activities and facilities and onshore activities and facilities. Therefore, the overall impact magnitudes to EJ populations would be impacted to the same degree when compared to the Proposed Action. These are anticipated to be **moderate** adverse impacts and **minor beneficial** impacts on EJ populations.

Cumulative Impacts of Alternative C-1

Overall, Alternative C-1 combined with ongoing and planned activities would result in the same impacts as described in the Proposed Action, which include **moderate** adverse cumulative impacts and **minor beneficial** impacts on EJ populations in the GAA.

3.17.8 Alternative C-2 – Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions and Relocation of up to 12 WTG Positions to the Eastern Side of the Lease Area

3.17.8.1 Construction and Installation

3.17.8.1.1 Onshore Activities and Facilities

Under Alternative C-2, the potential impacts from the construction and installation of onshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action and Alternative C-1.

3.17.8.1.2 Offshore Activities and Facilities

Under Alternative C-2, the construction of the 11-MW WTGs, OCS-DC, and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. Removal of up to 8 WTG positions from Priority Areas 1, 2, 3 and/or 4 and relocation of up to an additional 12 WTG positions to the eastern side of the Lease Area would not change the overall number of WTGs associated with the Project. Therefore, the potential impacts from the construction and installation of offshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action and Alternative C-1.

3.17.8.2 Operations and Maintenance

3.17.8.2.1 Onshore Activities and Facilities

Under Alternative C-2, the potential impacts from the O&M of onshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action and Alternative C-1.

3.17.8.2.2 Offshore Activities and Facilities

Under Alternative C-2, the O&M of the 11-MW WTGs, OCS-DC, and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. Removal of up to 8 WTG positions from Priority Areas and relocation of up to an additional 12 WTG positions to the eastern side of the Lease Area would not change the overall number of WTGs associated with the Project that would need to be operated and maintained. Therefore, the potential impacts from the O&M of offshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action and Alternative C-1.

3.17.8.3 Conceptual Decommissioning

3.17.8.3.1 Onshore Activities and Facilities

Under Alternative C-2, the potential impacts from the conceptual decommissioning of onshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action and Alternative C-1.

3.17.8.3.2 Offshore Activities and Facilities

Under Alternative C-2, the conceptual decommissioning of the 11-MW WTGs, OCS-DC, and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. Removal of up to 8 WTG positions from Priority Areas and relocation of up to an additional 12 WTG positions to the eastern side of the Lease Area would not change the overall number of WTGs associated with the Project that would need to be decommissioned. Therefore, the potential impacts from the conceptual decommissioning of offshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action and Alternative C-1.

3.17.8.4 Cumulative Impacts of Alternative C-2

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-2 to the cumulative impacts on EJ populations would be similar to or slightly less than those described under the Proposed Action, which were noticeable to moderate, depending on the IPF. The relocation of up to 12 WTG positions to the eastern portion of the SRWF Lease Area for the purposes of habitat impact minimization would lessen the impacts under certain IPFs but would not substantially change the incremental contribution to cumulative impacts.

3.17.8.5 Conclusions

Impacts of Alternative C-2

Alternative C-2 would include the exclusion of up to 8 WTGs from Priority Areas and the relocation of up to an additional 12 WTG positions to the eastern portion of the SRWF Lease Area for the purposes of habitat impact minimization; however, the same overall number of WTGs (94) as the Proposed Action would be installed and operated. In addition, there would be no change to the onshore facilities and components. The impacts resulting from individual IPFs associated with Alterative C-2 would be essentially the same the Proposed Action for both offshore activities and facilities and onshore activities and facilities. Therefore, the overall impact magnitudes to EJ populations would be impacted to the same degree when compared to the Proposed Action and Alternative C-1. These are anticipated to range be **moderate** adverse impacts and **minor beneficial** impacts on EJ populations.

Cumulative Impacts of Alternative C-2

Overall, Alternative C-2 combined with ongoing and planned activities would result in the same impacts as described in the Proposed Action and Alternative C-1, which include **moderate** adverse cumulative impacts and **minor beneficial** impacts on EJ populations in the GAA.

3.17.9 Alternative C-3 - Reduced Layout from Priority Areas Considering Feasibility Due to Glauconite Sands

Under the Fisheries Habitat Impact Minimization Alternative C-3, the construction, O&M, and eventual decommissioning of the 11-MW WTGs and an OCS within the proposed Project Area and associated inter-array and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, Alternative C-3 was developed to address concerns regarding pile refusal due to glauconite sands in the southeastern portion of the Lease Area while still minimizing impacts to benthic and fisheries resources. Alternative C-3a, C-3b, and C-3c described in Section 3.7.8, *Benthic Resources*, consider different WTG configurations to avoid sensitive habitats and engineering constraints while still meeting the NYSERDA OREC. This alternative only considered removal of WTGs from Priority Area 1 based on consultation with NMFS. Areas with high density of boulder, complex habitat, and data suggesting Atlantic cod aggregation and spawning was considered when determining which WTGs to remove.

3.17.9.1 Construction and Installation

3.17.9.1.1 Onshore Activities and Facilities

Under Alternative C-3, the potential impacts from the construction and installation of onshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action and Alternatives C-1 and C-2. The reduction in the number of WTGs would not change onshore activities or impacts.

3.17.9.1.2 Offshore Activities and Facilities

Under Alternative C-3, the potential impacts from the construction and installation of offshore activities and facilities on EJ communities are anticipated to be nearly identical to those described under Alternative C-1 and C-2. Alternative C-3 reduces the number of WTGs that would be installed by between 7 and 14 in total. This reduction in the number of WTGs that would be constructed would slightly decrease the adverse impacts associated with other resource areas, such as commercial fisheries and for-hire recreational fishing, recreation and tourism impacts and demographics, employment and economics; however, the incremental reduction in potential adverse impacts would not substantially change conclusions with respect to EJ.

3.17.9.2 Operations and Maintenance

3.17.9.2.1 Onshore Activities and Facilities

Under Alternative C-3, the potential impacts from the O&M of onshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action and Alternatives C-1 and C-2.

3.17.9.2.2 Offshore Activities and Facilities

Under Alternative C-3, the potential impacts from the O&M of offshore activities and facilities on EJ communities are anticipated to be nearly identical to those described under Alternative C-1 and C-2. Alternative C-3 reduces the number of WTGs that would be installed by between 7 and 14 in total. This reduction in the number of WTGs that would be constructed would slightly decrease the adverse impacts associated with other resource areas, such as commercial fisheries and for-hire recreational fishing, recreation and tourism impacts and demographics, employment and economics; however, the incremental reduction in potential adverse impacts would not substantially change conclusions with respect to EJ.

3.17.9.3 Conceptual Decommissioning

3.17.9.3.1 Onshore Activities and Facilities

Under Alternative C-3, the potential impacts from the conceptual decommissioning of onshore activities and facilities on EJ communities are anticipated to be the same as described under the Proposed Action and Alternatives C-1 and C-2.

3.17.9.3.2 Offshore Activities and Facilities

Under Alternative C-3, the potential impacts from the conceptual decommissioning of offshore activities and facilities on EJ communities are anticipated to be nearly identical to those described under Alternative C-1 and C-2. Alternative C-3 reduces the number of WTGs that would be installed by between 7 and 14 in total. This reduction in the number of WTGs that would be constructed would slightly decrease the adverse impacts associated with other resource areas, such as commercial fisheries and for-hire recreational fishing, recreation and tourism impacts and demographics, employment and economics; however, the incremental reduction in potential adverse impacts would not substantially change conclusions with respect to EJ.

3.17.9.4 Cumulative Impacts of Alternative C-3

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-3 to the cumulative impacts on EJ populations would be similar to or slightly less than those described under the Proposed Action (and Alternatives C-1 and C-2), which were noticeable to moderate, depending on the IPF. The reduction of between 7 and 14 WTGs to avoid glauconite sands would lessen the impacts under certain IPFs but would not substantially change the incremental contribution to cumulative impacts.

3.17.9.5 Conclusions

Impacts of Alternative C-3

Alternative C-3 would include the reduction of between 7 and 14 WTGs from primarily the southern and eastern portion of the SRWF Lease Area for the purposes of avoiding glauconite sands. In addition, there would be no change to the onshore facilities and components. The impacts resulting from individual IPFs associated with Alterative C-3 would be essentially the same as those described under Alternatives C-1, C-2 as well as Alternative B (the Proposed Action) for both offshore activities and facilities and onshore activities and facilities. Therefore, the overall impact magnitudes to EJ populations would be impacted to the same degree when compared to the Proposed Action and Alternatives C-1 and C-2. These are anticipated to be **moderate** adverse impacts and **minor beneficial** impacts on EJ populations.

Cumulative Impacts of Alternative C-3

Overall, Alternative C-3 combined with ongoing and planned activities would result in the same cumulative impacts as described in the Proposed Action and Alternatives C-1 and C-2, which include **moderate** adverse impacts and **minor beneficial** impacts on EJ populations in the GAA.

The overall reduction in the number of WTGs that would be installed and operated would result in a slight incremental reduction in impacts to certain resources and IPFs but would not change the overall conclusions.

3.17.10 Comparison of Alternatives

Adverse impacts would result from construction activity (onshore and offshore), air emissions, traffic, and noise, while beneficial impacts would result primarily from construction activity and job creation. In combination with reasonably foreseeable trends for the analysis area, impacts to EJ populations from all evaluated action alternatives and other offshore activity would range from negligible to moderate adverse and negligible to minor beneficial. Table 3.17-7 provides an overall summary of alternative impacts.

Table 3.17-7. Comparison of Alternative Impacts Environmental Justice

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
No Action Alternative: BOEM anticipates that the EJ impacts as a result of ongoing activities associated with the Alternative A - No Action of these ongoing activities would be **minor** to **moderate** adverse to **minor beneficial.** *Cumulative Impacts of the No Action Alternative:* Considering all the IPFs, BOEM anticipates that the overall adverse cumulative impacts associated with future offshore wind activities in the GAA combined with ongoing activities and reasonably foreseeable activities other than offshore wind would result in overall **minor** to **moderate**. BOEM also anticipates that the impacts	*Proposed Action:* BOEM anticipates that the impacts of individual IPFs from the Proposed Action alone would be negligible to moderate on EJ populations within the GAA. Considering the combined impacts of all IPFs, BOEM anticipates that the Proposed Action would have overall **moderate** adverse impacts on all EJ populations. In addition, **minor beneficial** effects to EJ populations may result from reductions in air emissions if offshore wind displaces energy generation using fossil fuels, as well as beneficial effects from economic activity and job creation.	*Alternative C-1:* The impacts resulting from individual IPFs associated with Alterative C-1 would be the same for both offshore activities and facilities and onshore activities and facilities. Therefore, the overall impact magnitudes to EJ populations would be impacted to the same degree when compared to the Proposed Action. These are anticipated to be **moderate** adverse impacts and **minor beneficial** impacts on EJ populations. *Cumulative Impacts of Alternative C-1:* Overall, Alternative C-1 combined with ongoing and planned activities would result in the same cumulative impacts as described in the Proposed Action,	*Alternative C-2:* The impacts resulting from individual IPFs associated with Alterative C-2 would be essentially the same the Proposed Action for both offshore activities and facilities and onshore activities and facilities. Therefore, the overall impact magnitudes to EJ populations would be impacted to the same degree when compared to the Proposed Action and Alternative C-1. These are anticipated to be **moderate** adverse impacts and **minor beneficial** impacts on EJ populations. *Cumulative Impacts of Alternative C-2:* Overall, Alternative C-2 combined with ongoing and planned activities would result in the same	*Alternative C-3:* The impacts resulting from individual IPFs associated with Alterative C-3 would be essentially the same as described under the Proposed Action and Alternatives C-1 and C-2 for both offshore activities and facilities and onshore activities and facilities. Therefore, the overall impact magnitudes to EJ populations would be impacted to the same degree when compared to the Proposed Action and Alternatives C-1 and C-2. These are anticipated to be **moderate** adverse impacts and **minor beneficial** impacts on EJ populations. *Cumulative Impacts of Alternative C-3:* Overall, Alternative C-3 combined with ongoing and planned

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
associated with future offshore wind activities in the GAA would result in **minor beneficial** effects on minority and low-income populations through economic activity and job creation.	*Cumulative Impacts of the Proposed Action:* The Proposed Action in combination with other offshore wind energy projects would result in a greater number of offshore structures affecting larger offshore areas, and additional onshore construction and port utilization within the GAA. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts on EJ populations from ongoing and planned activities, which are cumulatively anticipated to be **moderate** overall. Additionally, **minor beneficial** impacts may result from reductions in air emissions, as well as beneficial effects from economic activity and job creation.	which include **moderate** adverse impacts and **minor beneficial** impacts on EJ populations in the GAA.	cumulative impacts as described in the Proposed Action and Alternative C-1, which include **moderate** adverse impacts and **minor beneficial** impacts on EJ populations in the GAA.	activities would result in cumulative similar impacts as described in the Proposed Action and Alternatives C-1 and C-2, which include **moderate** adverse impacts and **minor beneficial** impacts on EJ populations in the GAA.

3.17.11 Summary of Impacts of the Preferred Alternative

BOEM has identified Alternative C-3b as the Preferred Alternative as depicted in Figure 2.1-10. Alternative C-3b would include installation of up to 84 WTGs, which is 10 fewer WTGs than the maximum WTGs proposed under the PDE of the Proposed Action. As a result, BOEM anticipates that there would be **moderate** impacts on EJ populations within the GAA under Alternative C-3b, which would be similar to those described under Alternative B. There would also be beneficial effects to EJ populations resulting from reductions in air emissions if offshore wind displaces energy generation using fossil fuels, as well as beneficial effects from economic activity and job creation. These beneficial effects would be similar to those described under Alternative B, but potentially a small degree less due to less overall WTGs being installed.

3.17.12 Proposed Mitigation Measures

No additional measures to mitigate impacts on environmental justice have been proposed for analysis.

3.17.12.1 Effect of Measures Incorporated into the Preferred Alternative

Since no mitigation measures have been proposed, impacts levels for the Preferred Alternative would remain as described above in Section 3.17.11.

3.18 Land Use and Coastal Infrastructure

Please see Appendix Q, Section 3.18 for the analysis of the Land Use and Coastal Infrastructure resource.

3.19 Navigation and Vessel Traffic

Please see Appendix Q, Section 3.19 for the analysis of the Navigation and Vessel Traffic resource.

3.20 Other Uses (Marine Minerals, Military Use, Aviation, and Scientific Research and Surveys)

3.20.1 Description of the Affected Environment and Future Baseline Conditions

This section discusses potential impacts on other uses (marine minerals, military use, aviation, and scientific research and surveys) from the proposed Project, alternatives, and future offshore wind activities in the GAA (Appendix D, Figure D-17). The GAA for other uses as described in Appendix D differs based on the other use being analyzed. For marine mineral extraction, the GAA encompassed areas within 0.31 mi (0.50 km) of the SRWF and footprints of other cables and wind lease areas in the Rhode Island/Massachusetts WEA. An area roughly bounded by Montauk, New York; Providence, Rhode Island; Provincetown, Massachusetts; and within a 10-mi buffer from wind lease areas in the Rhode Island/Massachusetts WEA was the GAA for national security and military uses, aviation and air traffic, and radar systems. In addition, the aviation and air traffic GAA encompassed airspace and airports used by regional air traffic, and radar systems included air space used by regional air traffic. The cables and pipelines GAA encompassed an area within 1 mile of the Project and other undersea facilities and wind lease areas in the Rhode Island/Massachusetts WEA. The northeast Atlantic OCS large marine ecosystem was the GAA for scientific research and surveys.

3.20.1.1 Marine Mineral Extraction

BOEM's Marine Mineral Program manages non-energy minerals (primarily sand and gravel) in federal waters of the OCS and leases access to these resources to target shoreline erosion, beach renourishment, and restoration projects. The closest active lease in BOEM's Marine Minerals Program is located approximately 165 miles (266 km) from the Project near Harvey Cedars, Surf City, Long Beach Township, Ship Bottom, and Beach Haven, New Jersey (Lease Number OCS-A-0505).

In addition, reconnaissance and/or design-level OCS studies along the east coast from Rhode Island to Florida have identified potential future sand resources. Sand resources identified near the Project include locations offshore Rhode Island (between Block Island and Charlestown), Long Island (Rockaway Beach, Long Beach, and Fire Island, New York), and Sandy Hook, New Jersey. The nearest sand resource is located 35 miles (56 km) to the northwest of the SRWF.

The USEPA Region 1 designates and manages ocean disposal sites for materials offshore in the region of the Project. The 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 eq seq.). Nine active projects are located in the analysis area along the Massachusetts, Rhode Island, Connecticut, and New York coasts, with the closest dredge disposal site, the Rhode Island Sound Disposal Site (RISDS) located northeast of Block Island, approximately 12.3 miles (19.8 km) from the Project (USACE 2018). No inactive or closed disposal sites are located in the GAA.

Increased shoreline erosion and coastal damage from storms has led to increased demand for sand resources in recent years. Although this increased demand is expected to continue, BOEM does not anticipate overlap between marine mineral leases and the Proposed Action.

The EIS assesses the potential environmental, social, economic, historic, and cultural impacts that could result from the construction, operation, maintenance, and eventual decommissioning of the Sunrise Wind Project proposed by Sunrise Wind LLC in its COP (Sunrise Wind 2023). The EIS will inform BOEM in deciding whether to approve, approve with modifications, or disapprove the COP. The Final EIS is not a final decision document, but rather considers the potential impacts that could result from the Proposed Action. In the proposed Project, Sunrise Wind is not proposing actions related to mining to gather the materials needed for wind turbines. The potential environmental impacts related to mining rare earth metals is considered in other processes and in proposals related to that occurring. This is not a part of the Proposed Action by the Applicant, and therefore, is not described in this EIS.

3.20.1.2 National Security and Military Uses

Military uses (U.S. Navy and other services, including Homeland Security [USCG]) span the SRWF, SRWEC-OCS, and SRWEC-NYS. Such uses exist largely because of the proximity to Naval Station Newport, Newport Naval Undersea Warfare Center (Rhode Island), Naval Submarine Base New London, and USCG Academy (city of New London) (BOEM 2018; RI CRMC 2010). The U.S. Atlantic Fleet conducts training and testing exercises in the Narraganset Bay Operating Area, and the Newport Naval Undersea Warfare Center routinely performs testing in the area (BOEM 2012). Air National Guard training ranges are also located in this area.

Military and national security interests are expected to continue to use offshore areas in the analysis area at similar levels in the foreseeable future. Search and rescue (SAR) occur on an as-needed basis and thus could be considered non-routine, USCG and other entities conduct regular SAR training and perform active SAR missions frequently enough in or near the GAA that SAR is evaluated here as a routine activity. The installation of foundations within the GAA could attract interest for recreational fishing or sightseeing, resulting in vessels that may travel farther offshore than typically occurs. Recreational fishing vessel traffic would be additive to vessel traffic that already transits the leased areas, and could increase demand for USCG SAR operations near the WTGs, with the structures themselves complicating SAR operations.

3.20.1.3 Aviation and Air Traffic

There are multiple public and private-use airports located within the general proximity of the Project, including sites in New York, Massachusetts, Rhode Island, and Connecticut (see Figure 4.8.3-1 of COP, Sunrise Wind 2023). Brookhaven Calabro (HWV) airport is the nearest airport to the Landfall and Long Island MacArthur (ISB) is the nearest airport to the OnCS-DC.

Air traffic is expected to continue at current levels in and around the Project in the foreseeable future.

3.20.1.4 Cable and Pipelines

There are existing submarine cables that run through regional waters, and which are laid on, or buried within, the seafloor and are used to transmit communications or power. Most of these existing cables pass through Green Hill, RI and along the south shore of Long Island, New York (Figure 4.7.5-1 in COP, Sunrise Wind 2023). In addition, there are NOAA nautical chart cable and pipeline areas that denote where such infrastructure may be located. The existence of these areas does not necessarily mean that actual cables or pipeline are present (BOEM 2018).

3.20.1.5 Radar Systems

Model results and studies from the U.S. and Europe incorporating typical offshore wind farm configurations have demonstrated that wind turbines cause interference to oceanographic high-frequency (HF) radar systems. HF radar systems primarily measure ocean surface currents (speed and direction, determined from sea state) and waves. They are used for marine spill response, U.S. Coast Guard search and rescue, weather forecasting, and other marine applications. Mitigation measures to address wind turbine interference to HF radar systems include software (BOEM 2021) paired with in-situ current and wave sensors within and around the periphery of the WEA. NOAA-funded HF radar stations operated by NOAA Integrated Ocean Observing System (IOOS) academic partners exist within the region (Figure 4.7.5-1 in COP, Sunrise Wind 2023) and include:

- HF radar on Block Island (IOOS 2018; two radars operated by University of Rhode Island and Rutgers University)
- HF radar on Martha's Vineyard (IOOS 2018; one radar operated by Rutgers University and three radars operated by Woods Hole Oceanographic Institution)
- HF radar on Nantucket Island (IOOS 2018; one radar operated by Rutgers University and one radar operated by Woods Hole Oceanographic Institution)
- HF radar on Long Island (IOOS 2018; one radar operate by University of Rhode Island and two radars operated by Rutgers University)

National Weather Service NEXRAD radar systems used in predicting and monitoring weather patterns would be impacted similarly to HF radars, however, NOAA states impacts to NEXRAD radars are highest within a 1.9 mi (3 km) range and diminish as distance increases. These radar systems would continue to provide sea state, weather forecast, and Hazard Materials Management response support to the region. The number of radars and their coverage area is anticipated to remain at current levels but may grow over time depending on NOAA IOOS Surface Currents Program funding.

3.20.1.6 Scientific Research and Surveys

Research in the GAA includes oceanographic, biological, geophysical, and archaeological surveys focused on the OCS and nearshore environments, and resources that may be affected by offshore wind development. Federal and state agencies, education institutions, and environmental non-governmental organizations participate in ongoing offshore research in the proposed Project Area and surrounding waters.

Current fisheries management and ecosystem monitoring surveys conducted by or in coordination with the NMFS NEFSC would overlap with offshore wind lease areas in Southern New England and 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; (4) the NEFSC Ecosystem Monitoring Program, a more than 40-year shelf ecosystem monitoring program using plankton tows and conductivity, temperature, and depth units; (5) AMAPPS shipboard and aerial surveys; and (6) the NARW Sighting Advisory System, line transect aerial abundance surveys; and (7) the Seal Abundance Survey, a harbor and gray seal stock assessment that uses both manned and uncrewed aircraft. These surveys support management of more than 40 fisheries in the region, more than 30 marine mammal species, and 14 threatened and endangered species (Hare et al. 2022). Additionally, these surveys support numerous other science products produced by NOAA Fisheries, including ecosystem and climate assessments.

A variety of other surveys and scientific assessments are also in progress or planned throughout various areas of the Rhode Island/Massachusetts WEA and the Massachusetts WEA. For example, Woods Hole Oceanographic Institution (WHOI) is conducting ocean surveys with buoys and autonomous underwater vehicles to survey temperature and salinity levels, and the Cox Ledge Study (funded through BOEM) is using an autonomous underwater glider and an acoustic telemetry receiver to detect fish spawning sounds, baleen whales, and tagged fish. These surveys overlap the proposed Project Area. As offshore wind development continues, alternative platforms, sampling designs, and sampling methodologies would be needed to maintain surveys conducted in or near the Project.

3.20.2 Impact Level Definitions for Other Uses (Marine Minerals, Military Use, Aviation, and Scientific Research and Surveys)

This Final EIS uses a four-level classification scheme to analyze potential impact levels for other uses of the alternatives, including the Proposed Action. Table 3.20-1 lists the definitions for both the potential adverse impact levels and potential beneficial impact levels for other uses. Table G-19 in Appendix G identifies potential IPFs, Issues, and Indicators to assess impacts to other uses. Impacts are categorized as beneficial or adverse and may be short-term or long-term in duration. Short-term impacts may occur over a period of a year or less. Long-term impacts may occur throughout the duration of a project.

Table 3.20-1. Definition of Potential Adverse and Beneficial Impact Levels for Other Uses

Impact Level	Definition of Potential Adverse Impact Levels	Definition of Potential Beneficial Impact Levels
Negligible	No measurable impacts or effects to other uses would occur.	No measurable impacts or effects to other uses would occur.
Minor	Most impacts could be avoided with environmental protection measures (EPMs).	A small and measurable benefit for other uses.
Moderate	EPMs would minimize, but not fully resolve impact.	A notable and measurable benefit for other uses.
Major	Impacts would be unavoidable even with EPMs; additional mitigation could be required.	A large local, or notable regional benefit for other uses.

3.20.3 Impacts of Alternative A – No Action on Other Uses (Marine Minerals, Military Use, Aviation, and Scientific Research and Surveys)

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

The Description of the Affected Environment and Future Baseline Conditions section provides an overview of information on past and present activities related to other uses within the vicinity of the Project. Future non-Project actions include offshore wind energy development, undersea transmission lines, gas pipelines, other submarine cables, tidal energy projects, marine minerals use and ocean-dredged material disposal, military uses, marine transportation, fisheries use and management, global climate change, oil and gas activities, and onshore development activities which are discussed in further detail in Appendix E. Impacts associated with future offshore wind activities in relation to other uses are described below.

3.20.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, marine minerals, military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys described in Section 3.20.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing activities within the GAA that would contribute to impacts on other uses would generally be associated with offshore developments and climate change. Ongoing offshore wind activity has the potential to affect ongoing research and surveys within the GAA.

Ongoing offshore wind activities within the GAA that contribute to impacts on other uses include:

- Continued O&M of the Block Island project (5 WTGs) installed in State waters,
- Continued O&M of the CVOW project (2 WTGs) installed in OCS-A 0497, and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of Block Island and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect other uses through the primary IPFs of presence of structures for marine minerals, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys, and presence of structures and traffic for military and national security uses. Ongoing offshore wind activities would have the same type of impacts from presence of structures and traffic that are described in detail in the following section for planned offshore wind activities, but the impacts would be of lower intensity.

3.20.3.2 Cumulative Impacts of the No Action Alternative

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

Under the No Action Alternative, marine minerals, military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys would continue to follow current regional trends and respond to IPFs introduced by other ongoing and future activities.

No future activities related to other uses in the offshore environment, such as the installation of new structures on the OCS outside of planned offshore wind projects, were identified (see Appendix E for a complete description of ongoing and future activities). BOEM anticipates future offshore wind activities to affect other uses through the following primary IPFs.

3.20.3.2.1 Marine Mineral Extraction

Presence of structures: The demand for sand and gravel resources is expected to grow with increasing trends in coastal erosion, storm events, and sea level rise. The GAA contains a large area of available sand and mineral resources (over 4 million cy [3 million metric tons] of sand available for authorized use [USACE 2020]). Future offshore wind project infrastructures, including WTGs and transmission cables, could prevent future marine mineral extraction activities where project footprints would overlap with extraction areas. However, mineral extraction typically occurs within 8 mi (12.9 km) of the shoreline, limiting adverse impacts to cable routes. Additionally, future projects could avoid identified borrow areas by consulting with BOEM Marine Minerals Program and USACE before approving offshore wind cable routes. The adverse impacts on sand and marine mineral extraction of future offshore wind activities are anticipated to be negligible**.**

3.20.3.2.2 National Security and Military Uses

The offshore wind lease area geographic boundaries were developed through coordination with stakeholders to address concerns surrounding overlapping military and security uses. BOEM continues to coordinate with stakeholders to minimize these concerns, as needed.

Presence of structures: The proposed installation of approximately 939 new WTG structures in the Rhode Island/Massachusetts WEA, which currently supports only five offshore WTGs in the BIWF, as well as several meteorological buoys (see Appendix E), would impact military and national security vessels primarily through risk of allision and collision with stationary structures and other vessels. Generally, deep-draft military vessels are not anticipated to transit outside of navigation channels unless necessary for or other non-typical activities. Smaller-draft vessels moving within or near the wind installation have a higher risk of allision with offshore wind structures. Wind energy facility structures would be lighted according to USCG and BOEM requirements at sea level to decrease allision risk. Allision risk would be further mitigated through coordination with stakeholders on WTG layouts to allow for safe navigation through the offshore wind lease areas in the analysis area.

The construction of future offshore wind projects in the GAA would incrementally change navigational patterns and would increase navigational complexity for vessels and military aircraft operating in the region around the wind energy projects. The structures associated with offshore wind energy may necessitate route changes to navigate around the offshore wind lease areas and vessels associated with the construction of a project. Military and national security aircraft would be affected by the presence of tall equipment necessary for offshore wind facility construction, such as stationary lift vessels and cranes, which would increase navigational complexity in the area. Refer to Section 3.19, *Navigation and Vessel Traffic*, for additional discussion of navigation impacts in the offshore wind areas.

Potential measures mitigating risks that offshore wind projects could implement include operational protocols to stop WTG rotation during SAR aircraft operations and implementation of FAA- and BOEM-recommended navigational lighting and marking to reduce the risk of aircraft collisions. Wind energy structures would be visible on military and national security vessel and aircraft radar. Navigational hazards would be eliminated as structures are removed during decommissioning. Due to anticipated coordination with agencies and the mitigation measures described above, the overall impacts on military and national security uses from future offshore wind energy activities are anticipated to be minor to moderate.

Traffic: Impacts on military operations from vessel traffic related to the construction and operation of future offshore wind activities on the OCS are expected to be short-term and localized. Vessel traffic is expected to increase during construction and could peak in 2024 with construction of reasonably foreseeable projects. While construction periods of various wind energy facilities may be staggered, some overlap would result in a cumulative impact to traffic loads.

3.20.3.2.3 Aviation and Air Traffic

Presence of structures: Future offshore wind development could add approximately 939 WTG structures to the offshore environment in the Rhode Island/Massachusetts WEA, not including the 5 WTGs already built in the BIWF (Appendix E). WTGs could have maximum blade tip height of 1,312 ft (357 m) AMSL. As these structures are built, aircraft navigational patterns and complexity would incrementally increase in the region around the offshore wind lease areas, along transit routes between ports and construction sites, and locally around ports. These changes could compress lower-altitude aviation activity into more limited airspace in these areas, leading to airspace conflicts or congestion and increasing collision risks for low-flying aircraft. After all foreseeable future offshore wind energy projects are built, there would still be open airspace available over the open ocean. Navigational hazards and collision risks in transit routes would be reduced as construction is completed.

All stationary structures would have aviation and navigational marking and lighting in accordance with FAA, USCG, and BOEM requirements and guidelines to minimize and mitigate impacts on air traffic. For this reason, the adverse impacts on aviation and airports are anticipated to be minor.

3.20.3.2.4 Cables and Pipelines

Presence of structures: Approximately 939 WTG structures along with approximately 3,069 miles of cables are expected to be installed by 2030 in the Rhode Island/Massachusetts WEA as part of future offshore wind energy project infrastructure. The presence of future offshore wind energy structures could preclude future submarine cable placement within any given development footprint, requiring future cables to route around these areas. However, the placement and presence of these cables would not prohibit the placement of additional cables and pipelines. Following standard industry procedures, cables and pipelines can be crossed without adverse impact. The risk of allision to cable maintenance vessels could increase as more offshore wind energy projects are constructed. However, given the infrequency of required maintenance at any given location along a cable route, this risk is expected to be low. Impacts on submarine cables would be eliminated during conceptual decommissioning of offshore wind farms if export cables associated with those projects are removed. Under the No Action Alternative, minor adverse impacts to cables in the area would be anticipated.

3.20.3.2.5 Radar Systems

Presence of structures: WTGs that are near or in direct line-of-site to land-based radar systems can interfere with the radar signal causing shadows or clutter in the received signal. Construction of approximately 939 WTG structures in the Rhode Island/Massachusetts WEA could lead to localized, long-term, moderate impacts on radar systems. Development of offshore wind projects could incrementally decrease the effectiveness of individual radar systems if the field of WTGs expands within the radar system's coverage area. In addition, large areas of installed WTGs could create a large geographic area of degraded radar coverage that could affect multiple radars. Wind turbines in the maritime environment affect marine vessel radar in a situation-dependent manner, with the most common impact being a substantial increase in strong, reflected energy cluttering the operator's display, leading to complications in navigation decision-making (NAS 2022). Most offshore wind structures would be sited at such a distance from existing and proposed land-based radar systems to minimize interference to most radar systems, but some impacts are anticipated.

BOEM assumes that all offshore wind developments in the GAA would use the developer agreed upon 1 by 1-nm spacing in fixed east-west rows and north-south columns (Baird 2020) and would evaluate each of those individual projects in their respective NEPA analyses. This arrangement would reduce, but not eliminate, navigational complexity and space-use conflicts during the operation phases of the projects. Navigational complexity in the area would increase during construction as offshore wind foundations are installed, would remain constant during simultaneous operations, and would decrease as projects are decommissioned and structures are removed. *Wind Turbine Generator Impacts on Marine Vessel Radar* (BOEM 2022) concluded that general mitigation measures, such as properly trained radar operators, properly installed and adjusted vessel equipment, and reference buoys are practicable options to mitigate WTG impacts on marine vessel radar (NAS 2022).

3.20.3.2.6 Scientific Research and Surveys

Presence of structures: Construction of other wind energy projects between 2023 and 2030 in the GAA would add up to 3,027 WTGs, associated cable systems, and associated vessel activity that would present additional navigational obstructions for sea- and air-based scientific studies. Collectively, these developments would prevent NMFS from continuing ongoing scientific research surveys or protected species surveys under current vessel capacities, would affect monitoring protocols in the GAA, could conflict with state and nearshore surveys, and may reduce future opportunities for other NOAA scientific research studies in the area. This Final EIS incorporates, by reference, the detailed analysis of potential impacts to scientific research and surveys provided in the Vineyard Wind Final EIS in Section 3.12.2.5, *Scientific Research and Surveys* (BOEM 2021). In summary, offshore wind facilities actuate impacts on scientific surveys and advice by preclusion of NOAA survey vessels and aircraft from sampling in survey strata; impacts on the random stratified statistical design that is the basis for assessments, advice, and analyses; alteration of benthic and pelagic habitats and airspace in and around the wind energy development, which would require new designs and methods to sample new habitats; and reduced sampling productivity through navigation impacts of wind energy infrastructure on aerial and vessel surveys. If stock or population changes, biomass estimates, or other environmental parameters differ within the offshore wind lease areas but cannot be observed as part of the surveys, resulting survey indices could be biased and unsuitable for monitoring stock status. NOAA has determined survey activities within offshore wind facilities are outside of safety and operational limits. Survey vessels would be required to navigate around offshore wind projects to access survey locations, leading to a decrease in operational efficiency. The height of turbines would affect aerial survey design and protocols, requiring flight altitudes and transects to change. Scientific survey and protected species survey operations would therefore be reduced or eliminated as offshore wind facilities are constructed (BOEM 2021). Offshore wind facilities would disrupt survey sampling statistical designs, such as random stratified sampling. Impacts to the statistical design of regionwide surveys violate the assumptions of probabilistic sampling methods. Development of new survey technologies, changes in survey methodologies, and required calibrations could help to mitigate losses in accuracy and precision of current practices due to the impacts of wind development on survey strata.

Other offshore wind projects could also require implementation of mitigation and monitoring measures identified in records of decision. Identification and analysis of specific measures are speculative at this time; however, these measures could further affect NOAA's ongoing scientific research surveys or protected species surveys because of the increased vessel activity and/or in-water structures from these other projects.

BOEM is committed to working with NOAA toward a long-term regional solution to account for changes in survey methodologies as a result of offshore wind farms (Hare et al. 2022).

Overall, the No Action Alternative would have major effects on NOAA's scientific research and protected species surveys, potentially leading to impacts on fishery participants and communities; as well as potential major impacts on monitoring and assessment activities associated with recovery and conservation programs for protected species.

3.20.3.3 Conclusions

Impacts of the No Action Alternative

BOEM expects ongoing non-offshore wind and offshore wind activities to have continuing impacts on military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys primarily through presence of structures that introduce navigational complexities and vessel traffic.

BOEM anticipates that the other uses impacts as a result of ongoing non-offshore and offshore wind activities associated with the Alternative A – No Action would be **negligible** for marine mineral extraction, marine and national security uses, aviation and air traffic, cables and pipelines, and radar systems. Military and national security use, aviation and air traffic, vessel traffic, commercial fishing, and scientific research and surveys are expected to continue in the GAA. Impacts of ongoing non-offshore and offshore wind activities on scientific research surveys are anticipated to be **major** adverse due to the impacts of ongoing offshore wind activities.

Cumulative Impacts of the No Action Alternative

BOEM anticipates that the other uses impacts as a result of ongoing and planned activities other than offshore wind would also contribute to impacts on other uses. Planned activities expected to occur in the GAA other than offshore wind include increasing vessel traffic; continued residential, commercial, and industrial development onshore and along the shoreline; and continued development of FAA-regulated structures including cell towers and onshore wind turbines. BOEM anticipates that any issues with aviation routes or radar systems would be resolved through coordination with United States Department of Defense (DoD) or FAA, as well as through implementation of aviation and navigational marking and lighting of structures according to FAA, USCG, and BOEM requirements and guidelines. There are no planned offshore activities anticipated to affect marine mineral extraction or cable and pipeline infrastructure.

BOEM anticipates that the cumulative impact of the No Action Alternative would be **negligible** adverse for marine mineral extraction; **minor** adverse for aviation and air traffic, and cables and pipelines; **moderate** adverse for radar system due to WTG interference; **minor** adverse for military and national security uses except for USCG SAR operations, which would have **major** adverse impacts; and **major** adverse for scientific research and surveys. The presence of stationary structures associated with offshore wind energy projects could prevent or impede continued opportunities for other NOAA scientific research studies in the area. Coordinators of large vessel survey operations or operations deploying mobile survey gear have determined that activities within offshore wind facilities would not be within current safety and operational limits. In addition, changes in required flight altitudes due to the proposed WTG height would affect aerial surveys design and protocols. BOEM acknowledges that NOAA's Office of Marine and Aviation Operations endorses the restriction of large-vessel operation to greater than 1 nm from wind installations due to safety and operational challenges.

3.20.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The number, size, location, and spacing of WTGs;
- Timing of offshore construction and installation activities; and
- Location and route of offshore export cable corridor.

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

- WTG size and location: larger turbines closer to shore could increase effects on land-based radar systems, movements of civilian and military aircraft, and military vessels.
- WTG spacing: Removal of groups of WTGs, creating spacing of greater than 1 nm, could allow for scientific research and surveys in those areas, decreasing the impact.
- Timing of construction: Construction could affect submarine or surface military vessel activity during typical operations and training exercises.

- Offshore cable route options: The route chosen (including variants within the general route) could conflict with marine mineral extraction or cables and pipelines.

3.20.5 Impacts of Alternative B – Proposed Action on Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research, and Surveys)

3.20.5.1 Construction and Installation

3.20.5.1.1 Onshore Activities and Facilities

3.20.5.1.1.1 National Security and Military

Currently, there are no military uses on Long Island. Therefore, the construction of onshore activities and facilities would have no impact on national security and military operations.

3.20.5.1.1.2 Aviation and Air Traffic

Presence of structures: Offshore construction activities would result in WTG components located at onshore staging ports. The presences of these structures could result in aircrafts needing to reroute due to the issuance of notices to airmen. Impacts from WTG components located in staging ports would be short-term, adverse, negligible impacts.

3.20.5.1.2 Offshore Activities and Facilities

3.20.5.1.2.1 Marine Mineral Extraction

Presence of structures: The presence of structures, including transmission cables and WTGs, associated with the Proposed Action has the potential to limit future marine mineral extraction activities. However, there are no BOEM OCS sand and mineral lease areas, and no identified sand resource blocks identified within the SRWF and SRWEC. There are sand borrow areas located within a 1-mi (1.6-km) radius of cables associated with the Proposed Action, but these cables would not directly intersect sand borrow areas. Similarly, construction activities associated with the Proposed Action would not overlap any active dredged material disposal sites. Since the Proposed Action would avoid mineral leases, sand and gravel leases, borrow areas, and ocean disposal areas, potential impacts from the Proposed Action would be negligible.

3.20.5.1.2.2 National Security and Military

Presence of structures: Under the Proposed Action, the addition of up to 94 11-MW WTGs and one OSC-DC structure would increase the risk of collision between military vessels and structures. This risk would be enhanced in bad weather conditions or low visibility. The presence of the WTGs and OSC-DC would increase navigational complexity and could lead to military vessels and aircraft in the vicinity of the SRWF having to change navigational routes and patterns and would increase the risk of collisions within the proposed Project Area. During construction activities and under normal operations, USCG helicopters would continue conducting search and rescue operations as needed. Under the Proposed Action, offshore structures would be visible on military and national security vessel and aircraft radar, which would help minimize the impacts associated with the Project. The presence of structures would result in minor adverse impacts on national security and military operations, with the exception of SAR, on which there would be moderate impacts.

Traffic: Offshore construction activities would result in additional vessels present within the vicinity of the Project. This would increase the potential risk of collision or conflict with military vessels and vessels associated with national security, the potential for military and national security vessels to have to alter navigational routes, and result in congestion at ports utilized for construction activities. During construction and conceptual decommissioning activities, potential impacts would be greater than during O&M activities. Potential impacts from vessel traffic and navigation impacts are discussed in Section 3.19, *Navigation and Vessel Traffic*.

3.20.5.1.2.3 Aviation and Air Traffic

Presence of structures: Under the Proposed Action, up to 94 11-MW WTGs with maximum blade tip heights of up to 787 ft (240 m) AMSL would be added to the GAA. The presence of these structures would increase navigational complexity, resulting in increased risk of collision with structures in the Project vicinity, and could change aircraft navigational patterns around the SRWF. More than 90 percent of existing air traffic within the analysis area, including commercial and military flight operations, would not be impacted by the presence of WTGs because it occurs at altitudes that would not be impacted by the presence of WTGs (BOEM 2021). However, it would be anticipated that low-level flights would be affected by the presence of structures throughout the construction and operation timeframe of the Proposed Action.

To help minimize risk of collisions, WTGs and the OSC-DC would be equipped with lighting and marking to meet FAA and USCG regulations and guidelines to minimize impacts on air traffic. WTGs would be visible on the radar systems of low-lying aircrafts. The presence of offshore structures under the Proposed Action would result in long-term, localized, negligible adverse impacts.

Traffic: Offshore construction activities associated with the Proposed Action would result in a short-term increase in traffic from aircraft. There is the potential for various helicopters and unmanned aircraft to be used to assist in offshore construction activities, including the potential use for crew changes during the installation of the WTGs. However, the Proposed Action anticipates the majority of offshore construction to be supported with vessels. Therefore, impacts to aviation and air traffic during offshore construction activities would be negligible to minor.

3.20.5.1.2.4 Radar Systems

Presence of structures: Sunrise Wind conducted an analysis of radar and navigation aids in the Project vicinity and found that under the Proposed Action either portions of or the entire proposed Project Area are within the line of sight of and would affect the following radar systems: Falmouth ASR-8, Nantucket ASR-9, and Providence ASR-9 (COP, Appendix Y1; Stantec 2022 citing Westlope Consulting 2020). Impacts on the North Truro ARSR-4 and Riverhead SRSR-4 are not expected as the WTGs in the proposed Project Area would not be within line of sight of these radar sites.

Potential impacts to radar systems in the GAA without mitigation efforts include clutter resulting in a partial loss of primary target detection and a number of false primary targets and partial loss of weather detection and false weather indications (COP, Appendix Y1; Stantec 2022 citing Westlope Consulting 2020).

BOEM also completed a study that assessed the impact of offshore wind farms to the U.S. HF Radar National Network and found that offshore wind turbines interfere with the operation of HF radars. There are effective mitigation techniques that can be implemented to help minimize impacts, including updated software (BOEM 2021) paired with in-situ current and wave sensors within and around the periphery of the WEA. Under the Proposed Action, Sunrise Wind would coordinate with the DOD and FAA for air surveillance radar systems, NOAA National Weather Service for weather radar systems, and the NOAA IOOS Surface Currents Program to address potential impacts to HF radar systems and would implement agreed upon steps determined in consultation with each radar system's Federal Program Manager to help minimize these impacts. While impacts to radars related to the presence of offshore structures differ from system to system, impacts would be moderate with appropriate mitigations.

3.20.5.1.2.5 Cable and Pipelines

Presence of structures: Installation of the SRWEC would cross up to eight known telecommunications cables, five of which are in service and three of which are out of service (COP, Figure 3.3.3.-10; Sunrise Wind 2023). Two of the eight cables also have the potential to be crossed by the IAC. The Proposed Action would be designed to minimize, where practicable, crossing existing cables with the routes for the IAC. Sunrise Wind would follow standard industry procedures for crossing utility lines to avoid or minimize adverse impacts from construction activities, which would result in negligible to minor adverse impacts. Additionally, the presence of the Proposed Action's offshore export cables would not prohibit the placement of additional cables and pipelines. Offshore export cables associated with the Proposed Action could be crossed using standard industry protection techniques. Four potential WTG positions within the uniform east-west/north-south grid (1 by 1 nm spacing) were removed due to proximity to existing cables. Sunrise Wind has engaged with each of the identified telecommunication cable owners to discuss crossing and proximity agreements.

3.20.5.1.2.6 Scientific Research and Surveys

Presence of structures: Scientific research and surveys, particularly for NOAA surveys supporting commercial fisheries and protected-species research programs, could be affected during the construction and operation of the Proposed Action; however, research activities may continue within the proposed Project Area, as permissible by survey operators. The Proposed Action would affect survey operations by excluding certain portions of the Lease Area occupied by Project components from sampling, affecting the statistical design of surveys, reducing survey efficiency, and causing habitat alteration within the proposed Project Area that cannot be monitored. This Final EIS incorporates by reference the detailed analysis of potential impacts on scientific research and surveys provided in the Vineyard Wind 1 Final EIS (BOEM 2021). The analysis in the Vineyard Wind 1 Final EIS is summarized above under the discussion of the No Action Alternative in Section 3.19.3, *Impacts of Alternative A – No Action on Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research, and Surveys).*

The Proposed Action would result in up to 94 11-MW WTGs with a maximum blade tip height of 787 ft (240 m) AMSL being installed. Aerial survey track lines for cetacean and sea turtle abundance surveys could not continue at the current altitude (600 ft [183 m] AMSL) within the proposed Project Area because the planned maximum-case scenario for WTG blade tip height would exceed the survey altitude. The increased altitude necessary for safe survey operations could result in lower chances of detecting marine mammals and sea turtles, especially small species. Agencies would need to expend resources to update scientific survey methodologies due to construction and operation of the Proposed Action, as well as to evaluate these changes on stock assessments and fisheries management, resulting in major impacts for scientific research and surveys.

3.20.5.2 Operations and Maintenance

3.20.5.2.1 Onshore Activities and Facilities

Under the Proposed Action, it would not be anticipated that O&M of onshore facilities and activities would result in impacts to other uses.

3.20.5.2.2 Offshore Activities and Facilities

Under the Proposed Action, impacts would be anticipated to be less than or similar to those described for construction activities. Please see the discussion below for further information on how O&M activities would impact other uses.

3.20.5.2.2.1 National Security and Military

Under O&M activities of the Proposed Action, the installation of foundations within the GAA could attract interest for recreational fishing or sightseeing, resulting in vessels that may travel farther offshore than typically occurs. Recreational fishing vessel traffic would be additive to vessel traffic that already transits the leased areas, and could increase demand for USCG SAR operations near the WTGs, with the structures themselves complicating SAR operations. Project Area, which has the potential to cause conflicts of use in the space in these locations. The presence and layout of large numbers of WTGs could make it more difficult for SAR aircraft to perform operations, necessitating changes in USCG SAR operational procedures. USCG SAR activities could be hindered within the SRWF due to navigational complexity and safety concerns of operating among WTGs. The USCG may need to adjust its SAR planning and search patterns to accommodate the WTG layout. This could result in otherwise avoidable loss of life due to maritime incidents, resulting in moderate adverse effects.

3.20.5.2.2.2 Radar Systems

O&M activities of offshore infrastructure associated with the Proposed Action would have minor adverse effects on air traffic control and national defense radar within the line of sight of the offshore infrastructure.

3.20.5.2.2.3 Cables and Pipelines

The presence of offshore structures associated with the Proposed Action, including the OSC-DC and WTGs would increase navigational hazards in the project vicinity, leading to increased risk of collision for vessels conducting O&M activities for existing submarine telecommunication cables. To minimize risk, Sunrise Wind would implement lighting and marking to comply with FAA, USCG, and BOEM guidelines and regulations. Additionally, risk of collision would be low due to the relative infrequency of the need for O&M activities to existing cables and pipelines. This would result in negligible impacts.

3.20.5.2.2.4 Scientific Research and Surveys

The presence of offshore structures associated with the Proposed Action would affect survey operations by excluding certain portions of the Lease Area occupied by Project components from sampling, affecting the statistical design of surveys, reducing survey efficiency, and causing habitat alteration within the proposed Project Area that cannot be monitored. Agencies would need to expend resources to update scientific survey methodologies as well as to evaluate these changes on stock assessments and fisheries management, resulting in major impacts for scientific research and surveys.

3.20.5.3 Conceptual Decommissioning

3.20.5.3.1 Onshore Activities and Facilities

Conceptual decommissioning of the Proposed Action would have similar, negligible adverse impacts to aviation and air traffic as described under construction activities.

3.20.5.3.2 Offshore Activities and Facilities

Conceptual decommissioning of the Proposed Action would have similar, negligible to major adverse and minor beneficial impacts to other uses as described under construction activities.

3.20.5.4 Cumulative Impacts of the Proposed Action

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

Marine Mineral Extraction: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts on marine mineral extraction from ongoing and planned activities would be negligible. BOEM anticipates that other offshore wind projects would be designed to avoid existing and proposed mineral extraction areas through consultation with the BOEM, USACE, and local agencies; therefore, there would be limited to no impacts on future mineral marine extraction.

Military and National Security Uses: In context of reasonably foreseeable environmental trends, the Proposed Action would contribute to impacts on military use from ongoing and planned activities through the construction and operation of offshore structures. While potential impacts on most military and national security uses are anticipated to be minor, installation of up to 1,038 WTGs throughout the GAA would hinder USCG SAR operations across a larger area, potentially leading to increased loss of life.

Aviation and Air Traffic: In the context of reasonably foreseeable environmental trends and planned activities, the Proposed Action and other offshore wind project WTGs would contribute to impacts on aviation and air traffic. Open airspace around the offshore wind lease areas in the GAA would still exist after all foreseeable future offshore wind energy projects are built. BOEM assumes that offshore wind project operators would coordinate with aviation interests throughout the planning, construction, operations, and conceptual decommissioning processes to avoid or minimize impacts on aviation activities and air traffic.

Cables and Pipelines: In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts on cables and pipelines from ongoing and planned activities could result in some localized and long-term impacts. However, these impacts would be negligible because they can be avoided by standard protection techniques.

Radar Systems: In context of reasonably foreseeable environmental trends, the Proposed Action would contribute to the impacts on radar systems from ongoing and planned activities, primarily due to the presence of WTGs within the line of sight causing interference with radar systems. Development of offshore wind projects could incrementally decrease the effectiveness of individual radar systems if the field of WTGs could create a large geographic area of degraded radar coverage that could affect multiple radars.

Scientific Research and Surveys: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts on scientific research and surveys from ongoing and planned activities would be long-term and major, particularly for NOAA surveys that support commercial fisheries and protected-species research programs. The entities conducting scientific research and surveys would have to make significant investments to change methodologies to account for areas occupied by offshore energy components, such as WTGs and cable routes, that are no longer able to be sampled.

3.20.5.5 Conclusions

Impacts of the Proposed Action

Under the Proposed Action, up to 94 11-MW WTGs with a maximum blade tip of 787 ft (240 m) AMSL would be installed, operate, and eventually be decommissioned within the proposed Project Area. The presence of these structures would introduce navigational complexity and increased vessel traffic in the area that would continue to have short-term to long-term impacts that range from negligible to major on marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys.

Marine Mineral Extraction: The SRWF and offshore export cable routes for the Proposed Action would avoid sand, gravel, borrow, and ocean disposal areas, resulting in **negligible** potential adverse impacts.

Military and National Security Uses: The installation of WTGs in the proposed Project Area would result in increased navigational complexity and increased allision risk, creating potential **major** adverse impacts on USCG SAR operations and potential **minor** impacts on all other military and national security uses.

Aviation and Air Traffic: Potential **minor** impacts on low-level flights would occur, primarily due to the installation of WTGs in the Project Area and changes in navigation patterns. Potential impacts on commercial and military flight operations are not anticipated, as WTGs would be constructed under the listed FAA flight level ceiling.

Cables and Pipelines: Potential impacts on cables and pipelines would be **negligible** due to the use of standard protection techniques to avoid impacts.

Radar: Potential **minor** adverse impacts on radar systems would primarily be caused by the presence of WTGs within their line of sight or over the horizon coverage area causing interference with radar systems. Options are available to minimize or mitigate impacts and Sunrise Wind would continue to coordinate with the FAA, DOD, and NOAA on impacts.

Scientific Research and Surveys: Potential impacts on scientific research and surveys would generally be **major**, particularly for NOAA surveys supporting commercial fisheries and protected-species research programs. The presence of structures would exclude certain areas within the proposed Project Area occupied by Project components (e.g., WTG foundations, cable routes) from potential vessel and aerial sampling, and by impacting survey gear performance, efficiency, and availability.

In summary, BOEM anticipates that the contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing activities would range from **negligible** to **major** adverse depending on the other uses.

Cumulative Impacts of the Proposed Action

In context of reasonably foreseeable environmental trends in the area, the contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing and planned activities would range from **negligible** to **major** adverse depending on the other uses. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with ongoing and planned activities would be **negligible** for marine mineral extraction and cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys. The presence of structures associated with the Proposed Action and increased risk of allisions are the primary driver for impacts on other marine uses. Impacts on NOAA scientific research and surveys would qualify as major because entities conducting surveys and scientific research would have to make significant investments to change methodologies to account for unsampleable areas, with potential long-term and irreversible impacts on fisheries and protected-species research as a whole, as well as on the commercial fisheries community. There could be impacts on other types of surveys, and increased opportunities to study impacts of offshore wind development on a variety of resources.

3.20.6 Alternative C-1 – Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions

The impacts resulting from individual IPFs associated with the construction and installation, O&M, and decommissioning of the Project under Alternative C-1 would be similar to those described under the Proposed Action. Under Alternative C-1, 8 WTG positions would be eliminated from NMFS's Priority Areas 1, 2, 3, and/or 4 to minimize impacts to fisheries habitat.

3.20.6.1 Construction and Installation

3.20.6.1.1 Onshore Activities and Facilities

Alternative C-1 would be similar in effect to the Proposed Action for onshore activities and facilities. The presence of WTG components located at onshore staging ports would cause short-term, adverse, negligible impacts. However, the impacts would be slightly less due to the reduced number of WTGs.

3.20.6.1.2 Offshore Activities and Facilities

Impacts to offshore activities and facilities related to construction and installation for marine mineral extraction, national security and military, aviation and air traffic, radar systems, cables and pipelines, and scientific research and surveys would be similar as those described under the Proposed Action. Cable emplacement and maintenance, presence of structures, and traffic would still be the IPFs that would affect other uses associated with Alternative C-1.

Impacts of Alternative C-1 would range from negligible for marine mineral extraction and cables and pipelines to major adverse impacts to scientific research and surveys and USCG SAR operations. Minor adverse impacts would occur for aviation and air traffic, national security and military uses, and radar systems.

3.20.6.2 Operations and Maintenance

3.20.6.2.1 Onshore Activities and Facilities

Alternative C-1 would not affect the Project's onshore facilities and should result in very similar O&M needs as the Proposed Action. Therefore, it is not anticipated that O&M of onshore facilities and activities would result in any impacts to other uses.

3.20.6.2.2 Offshore Activities and Facilities

Under Alternative C-1, impacts to other uses due to O&M would be anticipated to be similar to those described under the Proposed Action.

3.20.6.3 Conceptual Decommissioning

3.20.6.3.1 Onshore Activities and Facilities

Conceptual decommissioning of Alternative C-1 would have similar, negligible adverse impacts to aviation and air traffic as described under construction activities of the Proposed Action.

3.20.6.3.2 Offshore Activities and Facilities

Under Alternative C-1, conceptual decommissioning of offshore facilities would have similar, negligible to major adverse and minor beneficial impacts to other uses as described under construction activities.

3.20.6.4 Cumulative Impacts of Alternative C-1

The cumulative impacts of Alternative C-1 considered the impacts of Alternative C-1 in combination with other ongoing and planned wind activities. Cumulative impacts would be similar to those described for the Proposed Action.

3.20.6.5 Conclusions

Impacts of Alternative C-1

Under Alternative C-1, 8 fewer WTG positions would be available for installing WTGs, although the total number of WTGs installed would be the same as the Proposed Action. As such, the construction and installation of offshore activities and facilities would be the same as anticipated for the Proposed Action. The impacts of Alternative C-1 resulting from individual IPFs would be **negligible** for marine mineral extraction, cables and pipelines; **minor** for aviation and air traffic, most military and national security uses, and radar systems; **moderate** for USCG SAR operations; and **major** for scientific research and surveys.

Cumulative Impacts of Alternative C-1

In context of reasonably foreseeable environmental trends, the contribution of Alternative C-1 to the individual IPFs resulting from ongoing and planned activities would be similar to that of the cumulative impacts of the Proposed Action. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with Alternative C-1 when combined with ongoing and planned activities would be **negligible** for marine mineral extraction and cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys.

3.20.7 Alternative C-2 – Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions and Relocation of up to 12 WTG Positions to the Eastern Side of the Lease Area

The impacts resulting from individual IPFs associated with the construction and installation, O&M, and decommissioning of the Project under Alternative C-2 would be similar to those described under the Proposed Action. Under Alternative C-2, up to 8 WTGs would be removed from Priority Area 1 and up to an additional 12 WTG positions would be relocated to the eastern side of the Lease Area from Priority Areas 1, 2, 3, and/or 4 to minimize impacts to fisheries habitat.

3.20.7.1 Construction and Installation

3.20.7.1.1 Onshore Activities and Facilities

The Fisheries Habitat Impact Minimization Alternative C-2 would be similar in effect to the Proposed Action on onshore activities and facilities. The presence of WTG components located at onshore staging ports would cause short-term, adverse, negligible impacts to. However, the impacts would be slightly less due to the reduced number of WTGs.

3.20.7.1.2 Offshore Activities and Facilities

Impacts to offshore activities and facilities related to construction and installation for marine mineral extraction, national security and military, aviation and air traffic, radar systems, cables and pipelines, and scientific research and surveys would be similar as those described under the Proposed Action. Cable emplacement and maintenance, presence of structures, and traffic would still be the IPFs that would affect other uses associated with Alternative C-2. However, due to fewer WTGs, less IAC would be needed, which would result in a decreased disturbance impact compared to the Proposed Action.

Impacts of Alternative C-2 would range from negligible for marine mineral extraction and cables and pipelines to major adverse impacts to USCG SAR operations and scientific research and surveys. Minor adverse impacts would occur for aviation and air traffic, most national security and military uses, and radar systems.

3.20.7.2 Operations and Maintenance

3.20.7.2.1 Onshore Activities and Facilities

Alternative C-2 would not affect the Project’s onshore facilities and should result in very similar O&M needs as the Proposed Action. Therefore, it is not anticipated that O&M of onshore facilities and activities would result in any impacts to other uses.

3.20.7.2.2 Offshore Activities and Facilities

Under Alternative C-2, impacts would be anticipated to be similar to those described under the Proposed Action. Fewer WTGs and less IAC would require slightly less O&M activities.

3.20.7.3 Conceptual Decommissioning

3.20.7.3.1 Onshore Activities and Facilities

Conceptual decommissioning of Alternative C-2 would have similar, negligible adverse impacts to aviation and air traffic as described under construction activities of the Proposed Action.

3.20.7.3.2 Offshore Activities and Facilities

Under Alternative C-2, conceptual decommissioning of offshore facilities would have similar, negligible to major adverse and minor beneficial impacts to other uses as described under construction activities.

3.20.7.4 Cumulative Impacts of Alternative C-2

The cumulative impacts of Alternative C-2 considered the impacts of Alternative C-2 in combination with other ongoing and planned wind activities. Cumulative impacts would be similar to those described for the Proposed Action.

3.20.7.5 Conclusions

Impacts of Alternative C-2

Under the C-2 alternative, BOEM considers reducing the number of WTGs from 94 to 86. Up to 8 WTGs would be removed from Priority Areas 1, 2, 3, and/or 4. The construction and installation of offshore activities and facilities would be less due to the reduced mileage of IAC and fewer WTGs. The overall level of impact would remain similar to the Proposed Action, and the impacts of each alternative alone resulting from individual IPFs associated with these alternatives would be **negligible** for marine mineral extraction, cables and pipelines; **minor** for aviation and air traffic, military and national security uses, and radar systems; **moderate** for USCG SAR operations; and **major** for scientific research and surveys.

Cumulative Impacts of Alternative C-2

In context of reasonably foreseeable environmental trends, the contribution of Alternative C-2 to the individual IPFs resulting from ongoing and planned activities would be similar to that of the cumulative impacts for the Proposed Action. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with Alternative C-2 when combined with ongoing and planned activities would be **negligible** for marine mineral extraction and cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys. These impact ratings are primarily driven by the presence of offshore structures such as WTGs in the offshore wind lease areas.

3.20.8 Alternative C-3 - Reduced Layout from Priority Areas Considering Feasibility due to Glauconite Sands

Under the Fisheries Habitat Impact Minimization Alternative C-3, the construction, O&M, and eventual decommissioning of the 11-MW WTGs and an OCS within the proposed Project Area and associated inter-array and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, Alternative C-3 was developed to address concerns regarding pile refusal due to glauconite sands in the southeastern portion of the Lease Area while still minimizing impacts to benthic and fisheries resources. Alternative C-3a, C-3b, and C-3c described in Section 3.7.8, *Benthic Resources*, consider different WTG configurations to avoid sensitive habitats and engineering constraints while still meeting the NYSERDA OREC. This alternative only considered removal of WTGs from Priority Area 1 based on consultation with NMFS. Areas with high density of boulder, complex habitat, and data suggesting Atlantic cod aggregation and spawning was considered when determining which WTGs to remove.

3.20.8.1 Construction and Installation

3.20.8.1.1 Onshore Activities and Facilities

Alternative C-3 would be similar in effects. However, due to fewer WTGs, less IAC would be needed, which would result in a decreased disturbance impact compared to the Proposed Action.

Impacts of Alternative C-3 would range from negligible for marine mineral extraction and cables and pipelines to major adverse impacts to USCG SAR operations and scientific research and surveys. Minor adverse impacts would occur for aviation and air traffic, most national security and military uses, and radar systems.

3.20.8.2 Operations and Maintenance

3.20.8.2.1 Onshore Activities and Facilities

Alternative C-3 would not affect the Project's onshore facilities and should result in very similar O&M needs as the Proposed Action. Therefore, it is not anticipated that O&M of onshore facilities and activities would result in any impacts to other uses.

3.20.8.2.2 Offshore Activities and Facilities

Under Alternative C-3, impacts would be anticipated to be similar to those described under the Proposed Action. Fewer WTGs and less IAC would require slightly less O&M activities.

3.20.8.3 Conceptual Decommissioning

3.20.8.3.1 Onshore Activities and Facilities

Conceptual decommissioning of Alternative C-3 would have similar, negligible adverse impacts to aviation and air traffic as described under construction activities of the Proposed Action.

3.20.8.3.2 Offshore Activities and Facilities

Under Alternative C-3, conceptual decommissioning of offshore facilities would have similar, negligible to major adverse and minor beneficial impacts to other uses as described under construction activities.

3.20.8.4 Cumulative Impacts of Alternative C-3

The cumulative impacts of Alternative C-3 considered the impacts of Alternative C-3 in combination with other ongoing and planned wind activities. Cumulative impacts would be similar to those described for the Proposed Action.

3.20.8.5 Conclusions

Impacts of Alternative C-3

Under the C-3 alternative, BOEM considers reducing the number of WTGs from 94 WTGs to up to 87 WTGs. The construction and installation of offshore activities and facilities would be less due to the reduced mileage of IAC and fewer WTGs. The overall level of impact would remain similar to the Proposed Action, and the impacts of each alternative alone resulting from individual IPFs associated with these alternatives would be **negligible** for marine mineral extraction, cables and pipelines; **minor** for aviation and air traffic, military and national security uses, and radar systems; **moderate** for USCG SAR operations; and **major** for scientific research and surveys.

Cumulative Impacts of Alternative C-3

In context of reasonably foreseeable environmental trends, the contribution of Alternative C-3 to the individual IPFs resulting from ongoing and planned activities would be similar to that of the cumulative impacts for the Proposed Action. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with Alternative C-3 when combined with ongoing and planned activities would be **negligible** for marine mineral extraction and cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys. These impact ratings are primarily driven by the presence of offshore structures such as WTGs in the offshore wind lease areas.

3.20.9 Comparison of Alternatives

Construction, O&M, and decommissioning of Alternatives B, C-1, C-2 and C-3 would have the same overall negligible to major adverse impacts on other uses. Table 3.20-2 provides an overall summary of alternative impacts.

Table 3.20-2. Comparison of Impacts on Other Uses

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
No Action Alternative: BOEM anticipates that the other uses impacts as a result of ongoing non-offshore and offshore wind activities associated with the Alternative A – No Action would be **negligible** for marine mineral extraction, marine and national security uses, aviation and air traffic, cables and pipelines, and radar systems. Military and national security use, aviation and air traffic, vessel traffic, commercial fishing, and scientific research and surveys are expected to continue in the GAA. Impacts of ongoing non-offshore and offshore wind activities on scientific research surveys are anticipated to be **major** due to the impacts of ongoing offshore wind activities.	*Proposed Action:* **Negligible** for marine mineral extraction, cables and pipelines; **minor** for aviation and air traffic, most military and national security uses, and radar systems; **moderate** for United States Coast Guard (USCG) Search and rescue (SAR) operations; and **major** for scientific research and surveys. *Cumulative Impacts of the Proposed Action:* Overall cumulative adverse impacts would be **negligible** for marine mineral extraction, and cables and pipelines; **minor** for aviation and air traffic, and most military and national security uses; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys.	*Alternative C-1:* **Negligible** for marine mineral extraction, cables and pipelines; **minor** for aviation and air traffic, most military and national security uses, and radar systems; **moderate** for United States Coast Guard (USCG) Search and rescue (SAR) operations; and **major** for scientific research and surveys. *Cumulative Impacts of Alternative C-1:* Overall cumulative adverse impacts would be **negligible** for marine mineral extraction, and cables and pipelines; **minor** for aviation and air traffic, and most military and national security uses; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys.	*Alternative C-2:* **Negligible** for marine mineral extraction, cables and pipelines; **minor** for aviation and air traffic, most military and national security uses, and radar systems; **moderate** for United States Coast Guard (USCG) Search and rescue (SAR) operations; and **major** for scientific research and surveys. *Cumulative Impacts of Alternative C-2:* Overall cumulative adverse impacts would be **negligible** for marine mineral extraction, and cables and pipelines; **minor** for aviation and air traffic, and most military and national security uses; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys..	*Alternative C-3*: **Negligible** for marine mineral extraction, cables and pipelines; **minor** for aviation and air traffic, most military and national security uses, and radar systems; **moderate** for United States Coast Guard (USCG) Search and rescue (SAR) operations; and **major** for scientific research and surveys. *Cumulative Impacts of Alternative C-3:* Overall cumulative adverse impacts would be **negligible** for marine mineral extraction, and cables and pipelines; **minor** for aviation and air traffic, and most military and national security uses; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys.

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
Cumulative Impacts of the No Action Alternative: BOEM anticipates that the overall adverse cumulative impacts associated with Alternative A, the No Action Alternative, when combined with all other planned activities (including offshore wind) in the GAA would be **negligible** for marine mineral extraction; **minor** for aviation and air traffic, cables and pipelines; **moderate** for radar systems; **minor** for military and national security; **moderate** for SAR activities; and **major** for scientific research and surveys.				

3.20.10 Summary of Impacts of the Preferred Alternative

BOEM has identified Alternative C-3b as the Preferred Alternative as depicted in Figure 2.1-10. Alternative C-3b would include installation of up to 84 WTGs, which is 10 fewer WTGs than the maximum WTGs proposed under the PDE of the Proposed Action. The Preferred Alternative would result in **negligible** impacts to marine mineral extraction and cables and pipelines. However, the presence of WTGs would result in **minor** impacts to aviation and air traffic, military and national security uses, and radar systems. **Moderate** impacts to USCG SAR operations and **major** impacts to scientific research and surveys are expected due to the presence of SRWF WTGs.

3.20.11 Proposed Mitigation Measures

The mitigation measures listed in Table 3.20-3 are recommended for inclusion in the Preferred Alternative.

Table 3.20-3. Proposed Mitigation Measures: Other Uses

Measure	Description	Effect

Mitigation for ARSR-4 and ASR-8/9 radars	Operational mitigations identified for impacts on ARSR-4 and ASR-8/9:
	• Passive aircraft tracking using ADS-B or signal/transponder
	• Increasing aircraft altitude near radar
	• Sensitivity time control (range-dependent attenuation)
	• Range azimuth gating (ability to isolate/ignore signals from specific range-angle gates)
	• Track initiation inhibit, velocity editing, plot amplitude thresholding (limiting the amplitude of certain signals)
	• Modification mitigations for ARSR-4 and for ASR-8/9 systems:
	  ○ Utilizing the dual beams of the radar simultaneously
	  ○ In-fill radars
		Would reduce and/or mitigate the negative impacts of the presence of WTGs on ARSR-4 and ASR-8/9 radars.

Mitigation for oceanographic high frequency radars	To mitigate operation impacts on oceanographic high-frequency radars, the following options have been identified:
	• Data sharing from turbine operators to include the following:
	  ○ Sharing real-time telemetry of surface currents measured at locations in the Project with radar operators
	  ○ Sharing time-series of blade rotation rates and nacelle bearing angles of each of the Project's turbines with radar operators to aid interference mitigation
	• Wind farm curtailment / curtailment agreement
	Additional modifications identified for oceanographic high-frequency radar systems to mitigate impacts:
	• Signal processing enhancements
	• Antenna modifications
		Would reduce and/or mitigate the negative impacts of the presence of WTGs on oceanographic high-frequency radars.

Mitigation for NEXRAD weather radar systems	Operational mitigations to NEXRAD weather radar systems include: Wind farm curtailment/curtailment agreement Research is being conducted to determine whether impacts on weather radar can be mitigated by using phased array radars to achieve a null in the antenna radiation pattern in the direction of the wind turbine	Would reduce and/or mitigate the negative effects of the presence of WTGs on NEXRAD weather radar systems.
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.	Would eliminate any possibility of DOFS technology being used to conduct surveillance on U.S. Government operations.
Federal survey mitigation implementation	Consistent with NMFS and BOEM Survey Mitigation strategy actions in the NOAA Fisheries and BOEM Federal Survey Mitigation Implementation Strategy – Northeast U.S. Region (Hare et al. 2022), within 120 calendar days of COP Approval,	Would reduce some of the impacts of the SRWF on NOAA research and survey activities and would allow

Measure	Description	Effect
strategy for the northeastern U.S.	the Lessee must submit to BOEM a survey mitigation agreement between NMFS and the Lessee. The survey mitigation agreement must describe how the Lessee will mitigate the impacts of the SRWF on the seven NMFS surveys. The Lessee must conduct activities in accordance with such agreement. If the Lessee and NMFS fail to reach a survey mitigation agreement, then the Lessee must submit a Survey Mitigation Plan to BOEM and NMFS that is consistent with the mitigation activities, actions, and procedures within 180 days of COP approval. BOEM will review the Survey Mitigation Plan in consultation with NMFS Northeast Fisheries Science Center (NEFSC), and the Lessee must resolve comments to BOEM's satisfaction and must conduct activities in accordance with the plan. As soon as reasonably practicable, but no later than 30 days after the issuance of the SRWF's COP Approval, the Lessee must initiate coordination with NMFS NEFSC to develop the survey mitigation agreement described above. Mitigation activities specified under the agreement will be designed to mitigate the SRWF impacts on the following NMFS NEFSC surveys: (a) Spring Bottom Trawl survey; (b) Autumn Multi-species Bottom Trawl survey; (c) Ecosystem Monitoring survey; (d) NARW aerial survey; (e) Aerial marine mammal and sea turtle survey; (f) Shipboard marine mammal and sea turtle survey; (g) Atlantic surfclam and ocean quahog survey; (h) Atlantic sea scallop survey; and (i) seal survey. At a minimum, the survey mitigation agreement will describe actions needed and the means to address impacts on the affected surveys due to the preclusion of sampling platforms and impacts on statistical designs. NMFS has determined that the SRWF area is a discrete stratum for surveys that use a random stratified design. This agreement may also consider other anticipated SRWF impacts on NMFS surveys, such as changes in habitat and increased operational costs due to loss of sampling efficiencies. The survey mitigation agreement must identify activities that will result in the generation of data equivalent to data generated by NMFS's affected surveys for the duration of the SRWF. The survey mitigation agreement must describe the implementation procedures by which the Lessee will work with NEFSC to generate, share, and manage the data required by NEFSC for each of the surveys impacted by the SRWF, as mutually agreed upon between the Lessee and NMFS/NEFSC. The survey mitigation agreement must also describe the Lessee's participation in the NMFS NEFSC Northeast Survey Mitigation Program to support activities that address regional-level impacts for the surveys listed above.	NOAA to continue to meet its mission objectives. Survey-specific mitigation plans have the potential to allow survey activities to continue in some capacity; however, individual survey mitigation plans have not been developed and funding is not currently available to support survey mitigation plans to date.

3.20.11.1 Effect of Measures Incorporated into the Preferred Alternative

The mitigation measures listed in Table 3.20-3 are recommended for inclusion in the Preferred Alternative. For impacts on ARSR-4 and ASR-8/9 radar systems, operational mitigations, such as increasing aircraft altitude near the radar and range azimuth gating (the ability to isolate/ignore signals from specific angle gates), may be implemented. Additionally, modification mitigations have been identified such as utilizing dual beams of the radar simultaneously, which would result in improvements in detection by providing elevation data to give spatial information to mitigate the clutter from wind farms. For impacts on NEXRAD systems, operational mitigations identified include a wind farm curtailment agreement to stop wind farm operations during critical weather events. Research shows that impacts on weather radar can be mitigated by employing adaptive clutter filters, changing the radar scan strategy to pass over areas with wind turbines, using phased array radars to achieve a null in the antenna radiation pattern in the direction of the wind turbine, or curtailment (Colburn et al. 2020). Operational mitigation for ARSR-4 and ASR-8/9 radar systems may not be optimal but still would provide limited reduction in impacts; however, the proposed modification mitigations can provide meaningful decreases in impacts. Because of the infrastructure, complexity, and expense of the NEXRAD systems, mitigation of wind turbine interference presents complex difficulties (Colburn et al. 2020). Modification mitigation is unlikely for these systems; however, operational mitigations may reduce impacts in specific situations.

There are 13 NMFS scientific surveys that overlap with wind energy development in the northeast U.S. region. Seven of these surveys overlap with the SRWF. In response to major impacts on NOAA surveys identified during the environmental review of the first offshore wind energy project in federal waters, BOEM and NOAA have agreed to develop and implement the NOAA Fisheries and BOEM Federal Survey Mitigation Program (Hare et al. 2022). Consistent with NMFS and BOEM survey mitigation strategy actions (Hare et al. 2022) in the NOAA Fisheries and BOEM Federal Survey Mitigation Implementation Strategy – Southern New England and mid-Atlantic regions, within 120 calendar days of COP approval, the Lessee must submit to BOEM a survey mitigation agreement between NMFS and the Lessee. The survey mitigation agreement must describe how the Lessee would mitigate SRWF impacts on the seven NMFS surveys. The Lessee must conduct activities in accordance with such agreement. If, after consultation with NMFS NEFSC, BOEM deems the survey mitigation agreement acceptable, the mitigation would be considered required as a term and condition of Sunrise Wind's COP approval. Potential impacts on surveys would continue to be documented during the environmental review process and considered in the approval of wind energy lease areas. If the Lessee and NMFS fail to reach a survey mitigation agreement, then the Lessee must submit a Survey Mitigation Plan to BOEM and NMFS that is consistent with the mitigation activities, actions, and procedures within 180 days of COP approval. BOEM would review the Survey Mitigation Plan in consultation with NEFSC, and the Lessee must resolve comments to BOEM's satisfaction and conduct activities in accordance with the plan. As soon as reasonably practicable, but no later than 30 days after the issuance of the Sunrise Wind COP approval, the Lessee must initiate coordination with NMFS NEFSC to develop the survey mitigation agreement described above. Mitigation activities specified under the agreement must be designed to mitigate the impacts of the SRWF on the following NMFS NEFSC surveys: (a) Spring Bottom Trawl survey; (b) Autumn Multi-species Bottom Trawl survey; (c) Ecosystem Monitoring survey; (d) NARW aerial survey; (e) Aerial marine mammal and sea turtle survey; (f) Shipboard marine mammal and sea turtle survey; (g) Atlantic surfclam and ocean quahog survey; (h) Atlantic sea scallop survey; and (i) Seal survey. At a minimum, the survey mitigation agreement must describe actions and the means to address impacts on the affected surveys due to the preclusion of sampling platforms and impacts on statistical designs. NMFS has determined that the SRWF area is a discrete stratum for surveys that use a random stratified design. This agreement may also consider other anticipated SRWF impacts on NMFS surveys, such as changes in habitat and increased operational costs due to loss of sampling efficiencies. The survey mitigation agreement must identify activities that would result in the generation of data equivalent to data generated by NMFS's affected surveys for the duration of the SRWF. The survey mitigation agreement must describe the implementation procedures by which the Lessee would work with NEFSC to generate, share, and manage the data required by NEFSC for each of the surveys affected by the SRWF, as mutually agreed upon between the Lessee and NMFS/NEFSC. The survey mitigation agreement must also describe the Lessee's participation in the NMFS NEFSC Northeast Survey Mitigation Program to support activities that address regional-level impacts for the surveys listed above. The implementation strategy is intended to guide implementation of the mitigation program through the duration of wind energy development in the northeast U.S. region.

These measures, if adopted, would have the effect of reducing the overall impact to radar systems to minor. Some impacts would remain, as the mitigation measures would not fully eliminate the potential line-of-sight impacts of the WTGs on radar systems. The impact levels to cables and pipelines, aviation and air traffic, marine mineral extraction, most military and national security uses, USCG SAR operations, and scientific research and surveys would remain unchanged.

3.21 Recreation and Tourism

Please see Appendix Q, Section 3.21 for the analysis of the Recreation and Tourism resource.

3.22 Scenic and Visual Resources

This section discusses potential impacts on seascape, ocean, and landscape character, as well as potential scenic and visual view impacts associated with the proposed Project, alternatives, and ongoing and planned activities in the scenic and visual resources GAA. This section also addresses non-historic visual resources; historic visual resources are addressed in the Section 3.15, *Cultural Resources*. A HRVEA was completed to assess the proposed Project's potential visual effects on the qualities that qualify above-ground historic resources for the NRHP, Identifying 307 historic resources within the APE for viewshed resources. The results of this analysis are included in Section 3.15, *Cultural Resources*. As described in the COP visual impact assessment (VIA) (COP Appendix Q1, EDR 2022b), the geographic visual study area (VSA) for the Sunrise project encompasses a 40-mi (64.4-km) radius from the outside perimeter of the Proposed Action and estimates the radius as the maximum threshold of potential visibility based on human vision, size of the turbines, and curvature of the earth (Appendix D, Figure D-19). The visual GAA includes approximately 6,854 mi^2 (17,751 km^2) of ocean, 685 mi^2 (1,774 km^2) of land (including inland water bodies), and over 615 linear mi (990 linear km) of shoreline in Rhode Island, Massachusetts, Connecticut, and New York. The COP Visual Resources Assessment (VRA) (COP Appendix Q2, EDR 2022c) identified the onshore VSA with a 3-mi radius around the proposed OnCS-DC site (Union Avenue site); however, did not include the land areas associated with the cable routes and cable landfall area, which are also outside of the COP VIA identified VSA. Therefore, for this EIS, the onshore GAA is identified to encompass an approximate 3-mi- (4.8-km) radius around the proposed OnCS-DC site, approximately 31 mi^2 (81 km^2), and also includes portions of the towns of Brookhaven and Islip along with small portions of the villages of Lake Grove and Patchogue, and the cable landfall and cable routes to the OnCS-DC site, as described in Appendix D, Figure D-18, and Section 3.22.1. Table 3.22-1 provides a summary of the states, counties, and towns located within the defined VSA for both the onshore and offshore components.

Table 3.22-1. States, Counties, and Towns within the Visual Study Area

State	County	Town(s)
New York	Suffolk	Brookhaven, East Hampton, Islip, Southold
Connecticut	New London	North Stonington, Stonington
Massachusetts	Barnstable	Falmouth, Mashpee
	Bristol	Dartmouth, Fairhaven, Fall River, New Bedford, Westport
	Dukes	Aquinnah, Chilmark, Edgartown, Gosnold, Oak Bluffs, Tisbury, West Tisbury
	Nantucket	Nantucket
	Plymouth	Mattapoisett
Rhode Island	Kent	East Greenwich, West Greenwich
	Newport	Jamestown, Little Compton, Middletown, Newport, Portsmouth, Tiverton
	Washington	Charlestown, Exeter, Hopkinton, Narragansett, New Shoreham, North Kingstown, Richmond, South Kingstown, Westerly

Source: EDR 2022b COP VIA, Appendix Q1, amended by BOEM.

This analysis of scenic and visual resources considers methodologies provided in the *Assessment of Seascape, Landscape, and Visual Impacts (SLVIA) of Offshore Wind Developments on the Outer Continental Shelf of the United States* (BOEM 2021) and the *Guidelines for Landscape and Visual Impact Assessment - 3rd Edition* (Landscape Institute and Institute of Environmental Management and Assessment 2016). The BOEM SLVIA (2021) describes the methodology for seascape, landscape, and visual impact assessment that BOEM applies to identify the potential impacts of offshore wind energy developments in federal waters on the OCS of the United States. The SLVIA has two parts, including the seascape and landscape impact assessment (SLIA) and VIA. The SLIA analyzes and evaluates impacts of the proposed Project on both the physical elements and distinctive features that make up a landscape or seascape character, and the aesthetic, perceptual, and experiential aspects of the landscape or seascape that make it distinctive. The VIA analyzes and evaluates the impacts from selected viewpoints (i.e., key observation points [KOPs]) on people who are likely to be at that viewpoint (viewers) due to the change in the composition of the view as a result of the proposed Project.

3.22.1 Description of the Affected Environment and Future Baseline Conditions

The *Description of the Affected Environment and Future Baseline Conditions* section provides an overview of information on past and present activities related to scenic and visual resources. Future non-Project actions include offshore wind energy development, undersea transmission lines, gas pipelines, other submarine cables, tidal energy projects, marine minerals use and ocean-dredged material disposal, military uses, marine transportation, fisheries use and management, global climate change, oil and gas activities, and onshore development activities which are discussed in further detail in Appendix E. Impacts associated with future offshore wind activities in relation to scenic and visual resources are described below.

SLIA Factors

The SLIA assesses the potential impacts of the proposed Project on the physical elements and features that make up a landscape or seascape character units, including the ocean character area (OCA), seascape character area (SCA) and landscape character area (LCA). The OCAs include the area within the Project viewshed but outside of the SCAs within the viewshed and includes the offshore components of the open ocean areas. The SCAs include the discrete areas of coastal landscape (estimated at approximately up to 3 nm / 3.45 mi (5.6 km) from shoreline), and adjoining areas of open water where there is a share intervisibility between the land and sea that includes an area of the sea, a length of coastline, and an area of land. The LCAs include the inland areas that may be affected by the proposed Project but do not include the coastline or sea components (BOEM 2021).

This section summarizes the seascape, ocean, landscape, and viewer baseline conditions within the VSA GAA area as described in the COP, Appendix Q1, Offshore Visual Impacts Assessment (EDR 2022b). The COP refines the potential areas of impact based on the assessment of the zone of visual influence (ZVI)[30] which is defined as the potential visibility of the Project facilities within the viewshed based on a viewshed model that considered vegetation, buildings/structures, and the curvature of the earth in order to delineate those areas that may have potential views of the highest portions of the WTGs (i.e., blade tips in the upright position). The COP offshore VIA considered the PDE approach to Project

[30] The COP V2 April 2022 VIA also refers to the ZVI as Preliminary Area of Potential Effect (PAPE).

facilities and activities with up to 122 WTGs, with a maximum potential height of 968 ft (295 m) AMSL and three offshore platform locations[31].

The COP VIA defines the VSA in terms of land cover and landscape similarity zones (LSZ)[32] based on the similarity of visual features, such as landform, vegetation, water, and land use patterns, and defined 17 LSZs within the VSA (COP Appendix Q1, EDR 2022b). The LSZs provide a framework for the analysis of existing visual resources and viewer circumstances and further refinement of the existing landscape description. Generally, SCAs and LSZs include ocean, shoreline, marsh, and bays, and inland areas, as summarized in Table 3.22-2, and water, landforms, vegetation, and built structures as summarized in Table 3.22-3.

Table 3.22-2. General Land and Water Areas and Landscape Similarity Zones

Land and Water Areas	Character Units	Characteristics
Atlantic Ocean	OCA/SCA	Ocean
Shoreline	SCA/LCA	Jetty/Seawall, Beachfront, Coastal Dune, Boardwalk, Island Community
Marsh and Bay	SCA	Marshland, Bay/Shoreline, Ridges
Inland	LCA	Mainland

Source: Sunrise Wind 2023

Notes: LCA = landscape character area; OCA = ocean character area; SCA = seascape character area

Table 3.22-3. General Landform Water, Vegetation and Structure Categories

Category	Landscape Features
Landform	Flat shorelines to gently sloping beaches, dunes, islands, and inland topography
Water	Ocean, bay, estuary, tidal river, river, and stream water patterns
Vegetation	Tidal salt marshes and estuarine biomes, beach grass, meadows, and maritime forests
Structures	Buildings, plazas, signage, walks, parking, roads, trails, seawalls, jetties, and infrastructure

Source: Sunrise Wind 2023

[31] The VIA considered the original proposal of 122 WTGs and 3 offshore platforms. Subsequent to the COP Offshore Visual Impacts Assessment, Sunrise Wind has modified the proposed turbine array to include up to 94 WTGs in 102 positions with a maximum height of 787 ft (240 m) AMSL and one OCS-DC. The VIA states that the design changes are anticipated to result in the same or lower impacts than those presented in the VIA report.

[32] Landscape Similarity Zones provided in the COP (Sunrise Wind 2023) have been characterized by associated OCA, SCA and LCA character areas (BOEM 2021).

Table 3.22-4 provides a summary of, and Figures in Appendix I, Attachment I-1 provide the locations of the land cover categories identified in the COP based on the USGS National Land Cover Dataset and the associated LSZs, Character Units (OCA, SCA, LCA), and estimated acreages within the VSA and ZVI as provided in the COP Appendix Q1, (EDR 2022b) and supplemental information (EDR 2022a). Representative photographs and additional descriptions of the LSZs are provided in the COP VIA, Appendix Q1 (EDR 2022b).

Table 3.22-4. Physiographic Areas and Landscape Similarity Zones

Land Cover Category	Landscape Similarity Zones[1]	Character Units	Acres within the VSA	Square Miles within the VSA	Acres within the ZVI	Square Miles within the ZVI	Percent of ZVI within the VSA
Open Water	Open Water/Ocean Zone	OCA	4,564,040	7,131	4,384,203	6,850	96.1
Open Water	Inland Lakes and Ponds	LCA	23,371	37	3,529	6	15.1
Agriculture/ Open Developed	Agricultural, Maintained Recreation Area Highway Transportation, Rural Residential, Shoreline Residential	LCA/SCA	76,140	119	4,515	7	26.6
Developed	Highway Transportation, Rural Residential, Shoreline Residential, Suburban Residential, Developed Waterfront, Village Town Center, Commercial	LCA/SCA	70,130	110	1,964	3	8.6
Emergent Herbaceous Wetland	Salt Pond Tidal Marsh	LCA	14,814	23	1,541	2	10.4
Exposed Sand/Soil	Shoreline Beach, Coastal Dunes, Coastal Bluff	SCA	12,887	20	5,337	8	41.4
Forest/Scrub	Forest, Coastal Scrub Shrub	LCA/SCA	243,964	381	3,150	5	8.5
		Total	**5,005,346**	**7,821**	**4,404,239**	**6,881**	**N/A**

Source: Request for Information Response (EDR 2022a); Landscape Similarity Zones provided in the COP (Sunrise Wind 2023) have been characterized by associated OCA, SCA and LCA character areas (BOEM 2021).

Notes: LCA = landscape character area; OCA = ocean character area; SCA = seascape character area; ZVI = zone of visual influence

Existing scenic and visually sensitive resources (VSRs) within the VSA identified in the COP VIA, Appendix Q1 (EDR 2022b) include locations that may be particularly sensitive to visual change and/or that have been identified by national, state, or local governments, organizations, and/or Native American tribes as important sites which are afforded some level of recognition or protection. These areas can include historic resources, designated scenic areas and scenic byways; national, state and local parks, forests and wildlife management areas; public recreation trails, areas and beaches; lighthouses and seaports. Table 3.22-5 provides a summary of identified sensitive resources within the VSA and ZVI and Appendix I, Attachment I-1 provides maps denoting the locations of the VSRs within the ZVI. See also discussion of historic visual resources in Section 3.15, *Cultural Resources*. The COP VIA and supplemental materials (EDR 2022b) provide further description and details of the identified VSRs, including a summary table provided in Appendix A2 of the COP VIA Appendix Q1 (EDR 2022b) (see also Appendix I, Attachment I-2 of this EIS).

Table 3.22-5. Identified Existing Scenic and Visually Sensitive Resources within the Visual Study Area

Visually Sensitive Resource (VSR) Type	Acres within the VSA	Acres within the ZVI	Percent of ZVI within the VSA
National Historic Landmarks	11,012	2,482	22.5
Properties Listed on the National or State Registers of Historic Places	3,881	446	11.5
Properties Determined Eligible for the National or State Registers of Historic Places	7,209	689	9.6
National Natural Landmarks	350	263	75.3
State Scenic Areas	104,685	17,028	16.3
National Wildlife Refuges	93,342	2,367	2.5
State Wildlife Management Areas	1,452	224	15.4
National Parks	18	0	2.1
State Parks	9,803	3,000	30.6
State Nature and Historic Preserves	248	<1	0.0
State Forests	5,302	3	0.1
State Beaches	4,188	991	23.7
Highways Designated or Eligible as Scenic	451	40	8.9
National Historic Trails	242	0	0.1
National Recreation Trails	89	64	72.2
State Fishing and Boating Access	241	70	29.0
Lighthouses (non-State/NRHP-Listed)	7	6	80.8
Public Beaches	3,716	982	26.4
Ferry Routes	7,714	5,146	66.7
Seaports	54	0	0.6
Other State- Owned Environmental Land with Public Access	7,769	252	3.2
Environmental Justice Areas[1]	35,560	3,388	9.5
Total	**297,333**	**37,441**	**N/A**

Source: Request for Information Response (EDR 2022a)

Notes: NRHP = National Register of Historic Places; VSA = visual study area; VSR = visually sensitive resource; ZVI = zone of visual influence

[1] Environmental justice impacts are further discussed in Section 3.17*, Environmental Justice*.

SLIA Impact Analysis Considerations

The SLIA analyzes and evaluates impacts of the proposed Project on both the physical elements and distinctive features that make up a landscape or seascape character, and the aesthetic, perceptual, and experiential aspects of the landscape or seascape that make it distinctive. The impact assessment on the landscape, seascape, and ocean characteristic is based on the sensitivity of the receptor and the magnitude of the character changes from the Proposed Action (BOEM 2021). The sensitivity of the seascape, ocean, and landscape features to change is defined by combining the judgements of the susceptibility of the receptor to impact and the perceived societal value of that receptor (BOEM 2021). The magnitude of the impact is determined by considering the size and scale of the change as a result of the Proposed Action to existing conditions, considering the geographic extent of the area, and duration and reversibility of the potential impacts (BOEM 2021). This analysis considers shoreline and landform features associated with the seascape, ocean, and landscape areas, such as whether the shoreline is a complex or simple straight shoreline; degree of ocean view and vistas, such as narrow or panoramic view; distinctiveness of the features, such as distinctive features of local or national significance; and natural and development patterns, such as degree of man-made versus natural elements. Information describing the seascape and landscape character is used to identify potential impacts from the proposed development. Table 3.22-6 summarizes the visual characteristics and features of the seascape, ocean, and landscape conditions within the GAA.

Table 3.22-6. Seascape, Ocean, and Landscape Conditions

Category	Description
Seascape	Intervisibility within coastal and adjacent marine areas within the 40-mi (64.4-km) GAA by pedestrians and boaters.
Seascape Features	Physical features range from built elements, landscape, dunes, and beaches to flat water and ripples, waves, swells, surf, foam, chop, and whitecaps.
Seascape Character	Experiential characteristics stem from built and natural landscape forms, lines, colors, and textures to the foreground water's tranquil, mirrored, and flat; active, rolling, and angular; vibrant, churning, and precipitous. Forms range from horizontal planar to vertical structures', landscapes', and water's slopes; lines range from continuous to fragmented and angular; colors of structures, landscape, and the water's foam, and spray reflect the changing colors of the daytime and nighttime, built environment, land cover, sky, clouds, fog, and haze; and textures range from mirrored smooth to disjointed coarse.
Ocean	Intervisibility within the ocean that is beyond the seascape area and within the 40-mi (64.4-km) GAA from seagoing vessels, including recreational cruising and fishing, commercial "cruise ship" routes, commercial fishing activities, tankers, and cargo vessels; and air traffic over and near the WTG array and cable routes.
OceanFeatures	Physical features range from flat water to ripples, waves, swells, surf, foam, chop, and whitecaps.
OceanCharacter	Experiential characteristics range from tranquil, mirrored, and flat; to active, rolling, and angular; to vibrant, churning, and precipitous. Forms range from horizontal planar to vertical slopes; lines range from continuous and horizontal to fragmented and angular; colors of water, foam, and spray reflect the changing colors of sky, clouds, fog, haze, and the daytime and nighttime, built environment and land cover; and textures range from mirrored smooth to disjointed coarse.
Landscape	Intervisibility within the adjacent inland areas, seascape, and ocean; nighttime views diminished by ambient light levels of shorefront development; open, modulated, and closed

Category	Description
	views of water, landscape, and built environment; and pedestrian, bike, and vehicular traffic throughout the region.
Landscape Features	Natural elements: landward areas of barrier islands, bays, marshlands, shorelines, vegetation, tidal rivers, flat topography, and natural areas. Built elements: boardwalks, bridges, buildings, gardens, jetties, landscapes, life-saving stations, umbrellas, lighthouses, parks, piers, roads, seawalls, skylines, trails, single-family residences, commercial corridors, village centers, mid -rise motels, moderate to high-density residences.
Landscape Character	Tranquil and pristine natural to vibrant and ordered, to chaotic and disordered.

Source: BOEM Ocean Wind 2022; BOEM 2021

The sensitivity of the seascape, ocean and landscape character is defined by its innate features, elements, and susceptibility to change, and its perceived value to residents and visitors. Table 3.22-7 provides a summary of sensitivity rating criteria related to the seascape, ocean, and landscape character of high, medium, or low sensitivity. The sensitivity ratings within the GAA are summarized in Table 3.22-7. Based on assessment of potential sensitivity of the existing seascape, ocean, and landscape character within the GAA, the sensitivity rating for all of the seascape and ocean settings would be high, and for the landscape settings would range from high to low sensitivity ratings (see Appendix I Attachment I-2).

Table 3.22-7. Seascape, Ocean, and Landscape Character Units' Sensitivity Rating Factors

Category	Landscape Similarity Zones	Sensitivity Rating[1] Factor Description
Ocean Character Unit		
High	Open Water/Ocean Zone	Ocean character is highly vulnerable to the type of change proposed, distinctive, and highly valued by residents and visitors.
Medium		Ocean character is reasonably resilient to the type of change proposed, moderately distinctive,and moderately valued by residents and visitors.
Low		Ocean character is unlikely to be affected by the type of change proposed, common, andunimportant to residents and visitors.
Seascape Character Unit		
High	Shoreline Beach, Coastal Dunes, Coastal Bluff, Coastal Scrub Shrub, Shoreline Residential, Maintained Recreation Area, Developed Waterfront	Seascape character is highly vulnerable to the type of change proposed, distinctive, and highly valued byresidents and visitors.
Medium		Seascape character is reasonably resilient to the type of change proposed, moderately distinctive, and moderately valued by residents and visitors.
Low		Seascape character is unlikely to be affected by the type of change proposed, common, and unimportant to residents and visitors.
Landscape Character Unit		
High	Agricultural, Maintained Recreation Area Highway Transportation, Rural Residential, Suburban Residential, Developed Waterfront, Village Town Center, Commercial, Forest	Landscape characteristics are highly vulnerable to the type of change proposed or within a designatedscenic or historic landscape.
Medium		Landscape characteristics are reasonably resilient to the type of change proposed, or within alandscape of locally valued scenic quality.
Low		Landscape characteristics are unlikely to be affected by the type of change proposed, or within alandscape of minimal scenic value.

References: EDR 2022c; BOEM Ocean Wind 2022
[1] Sensitivity rating includes consideration of both susceptibility and value factors per BOEM 2021.

VIA Factors

The VIA defines the physiographic categories of VSA based on major differences in landscape structure that define the physical character to include islands, mainland, and Atlantic Ocean. The islands physiographic areas include areas such as Long Island, Block Island Long Island, Block Island, Conanicut Island, Prudence Island, Aquidneck Island, the Elizabeth Islands, Martha's Vineyard, Nantucket, and several smaller islands scattered along the coast of Connecticut, Massachusetts, and Rhode Island. The islands physiographic areas were estimated to encompass approximately 204.6 mi^2 (530 km^2) of land within the VSA, and 22.2 mi^2 (57.45 km^2) within the ZVI. The mainland areas include elevations ranging from sea level along the coast to a high point of 528.2 ft (161 m) AMSL in the Town of Exeter, Washington County, Rhode Island. The mainland areas within the VSA include approximately 480.2 mi^2 (1,244 km^2), including approximately 33.2 mi^2 (86 km^2) in Connecticut, 340.5 mi^2 (882 km^2) in Rhode Island, and 106.5 mi^2 (276 km^2) in Massachusetts. The mainland areas within the ZVI encompasses approximately 10.4 mi^2 (27 km^2) of mainland: including Massachusetts at 4.9 mi^2 (13 km^2), Rhode Island at 5.5 mi^2 (14 km^2), and Connecticut at less than 0.1 mi^2 (less than 1 km^2). No mainland New York areas occur within the VSA or ZVI. The Atlantic Ocean areas within the VSA include Rhode Island Sound, Block Island Sound, Narragansett Bay, Fischer's Island Sound, Buzzards Bay, Mount Hope Bay, Vineyard Sound, Nantucket Sound, and other bays and coves, and encompass approximately 7,131.3 mi^2 (18,470 km^2) within the VSA and approximately 6,850.3 mi^2 (17,742.2 km^2) within the ZVI (96.2 percent).

VIA Impact Analysis Considerations

The VIA analyzes and evaluates the impacts from selected viewpoints (i.e., KOPs) on people who are likely to be at that viewpoint (viewers) due to the change in the composition of the view as a result of the proposed Project. The potential scenic and visual impacts can also be influenced by the magnitude of the scale of the Project features relative to the viewer, such as distance to the nearest WTG and visibility threshold, and geographic extent, such as vertical and horizontal scale of the Project features in relation to the viewing location. Impacts are determined through evaluation sensitivity factors (susceptibility to change and value attached to views) and magnitude of change (size and scale of change, geographic extent, and duration of impact), which considers number of viewers, viewer expectations, viewer activity, frequency and duration of the views, viewer familiarity with view settings, viewer concern for these settings, and viewing location and proximity to the Project features. Viewer expectations can be influenced by viewer activity. Changes to the visual setting may affect the experiential quality of certain passive activities while the character change may be unnoticed when viewers are engaged in more active activities. Viewer activity within the VSA can range from local residents with views from residential, commercial, and shoreline areas; individuals traveling through the area via walking, vehicle, public transportation, or boat (offshore); individuals participating in recreational activities, including tourists and those on vacation; and fishing community engaging in both onshore and offshore commercial fishing activities. The viewer sensitivity can also be influenced by the proximity of the Project to the viewer, such as elevation and viewing angle of the viewer and distance from the viewer to the Project features.

Daytime and nighttime views of the Project features can range from immediate foreground (such as from offshore viewing from fishing boats, cruise ships, or pleasure craft) to extended background views distances. The COP V2 VIA, Appendix Q1 (EDR 2022b) identifies three distinct distance zones for the VSA, including foreground-middle ground (project features at distances from 0 to 5 mi [0 to 8 km]); background (project features at distances of greater than 5 mi [8 km] to 15 mi [24.1 km] distances), and extended background (project features at distances greater than 15 mi [24.1 km]). View distances from onshore to offshore to the proposed Project WTGs and OCS-DC would range from approximately 15 mi (24.1 km) to approximately 40 mi (64.4 km). As measured to the nearest WTG, the proposed Project would be located approximately 30.5 mi (49 km) from Long Island, 16.7 mi (26.9 km) from Block Island, 25.5 mi (41 km) from mainland Rhode Island, 31.8 mi (51.2 km) from mainland Massachusetts, 18.8 mi (30.3 km) from Martha's Vineyard, and 34.4 mi (55.4 km) from Nantucket (COP VIA, Appendix Q1; EDR 2022b).

As stated in the BOEM SLVIA (2021) guidelines and by Sullivan et al. (2013), offshore wind facilities reaching heights of 502 ft (153 m) to the tip of blade can be visible for distances exceeding 25 mi (40.2 km). Sullivan et al. (2013) indicated that offshore wind facilities reaching heights of 502 ft (153 m) to the tip of blade were estimated to be a major focus of visual attention at distances up to 10 mi (16.1 km), noticeable to casual observers at distances up to 18 mi (29 km) and were visible with extended viewing at distances beyond 25 mi (40.2 km). In addition, Sullivan et al. (2013) estimated that wind turbine blade movement is visible at distances as far as 24 mi (38.6 km), and nighttime with aerial hazard navigation lighting was visible at distances greater than 24 mi (38.6 km). However, the Sullivan et al. (2013) assessment was based on review of WTGs smaller in height (i.e., tallest wind turbine observed was approximately 502 ft [153 m] AMSL) than those proposed at the SRWF. The COP VIA considered the extended height of the WTGs (PDE height of 968 ft [295 m] AMSL) and assessment of potential beach-level and earth curvature factors and estimated the maximum threshold of potential visibility at a distance of 40 miles (64.4 km) (COP VIA, Appendix Q1; see inset 1.2-1; EDR 2022b); which informed and is consistent with the VSA area of potential impact.

Generally, at distances of 15 miles (24.1 km) or closer the WTGs and OCS-DC may appear dominant in form and visual contrast. WTGs located within viewing distances from 0-15 miles (0-24.1 km) would be within foreground level visual prominence, distances from 16-25 miles (25.7-40.2 km) as middle-ground and background visual prominence, and greater than 25 miles (40.2 km) would be considered extended background level visual prominence. The visibility and noticeability of Project features can be affected by factors such as time of day, view angle, sun angle, atmospheric conditions, elevation and viewing angle of the viewer, and distance from the viewer to the Project features. Visual contrast of WTGs and OCS-DC would vary throughout the day depending on whether the WTGs and OCS-DC are backlit, side-lit, or front-lit and based on the visual character and atmospheric conditions of the horizon backdrop. Variations of these factors throughout the course of the day would result in modification of the potential visual impacts ranging from periods of moderate to major visual effects, such as during sunset conditions with backlighting of Project features, while at other times of day would have minor or negligible effects, such as hazy atmospheric conditions and Project features within a background or extended background view.

Visibility of Project features can be affected by weather conditions, waves on the ocean surface, humidity levels, and air pollution. In the Project vicinity, National Climatic Data Center weather data were collected from the Newport and Block Island stations from January 1, 2010, to December 31, 2016. These data indicate that during daylight hours, clear skies, defined as 0-30 percent cloud cover, occur on average 42 percent of the time, partly cloudy conditions occurred approximately 4 percent of the time, and overcast sky conditions occurred approximately 52 percent of the time (South Fork Wind 2018).

NOAA's National Data Buoy Center Station 44017 at Montauk Point, New York collected minimum and maximum air temperatures of 7.2°F and 80.6°F (-13.8°C and 27°C), with a mean air temperature range between 34.3°F and 72.3°F (1.3°C and 22.4°C) (NOAA NDBC 2020; COP VIA Appendix Q1, Figure 4.3.1-14; EDR 2022b). A study conducted by Merrill (2010) assessed potential fog development from Buzzard's Bay Tower (west of the Elizabeth Islands) and Martha's Vineyard Coastal Observatory (1.9 mi [3 km] offshore). The results of this study indicated that in the Project vicinity, the summer period has the highest potential for fog development, with 10 potential days in June compared to 1 to 4 potential days during each of the winter months. In the vicinity of the SRWF, ocean waves generally move from the south with average wave heights ranging from 3.3 to 9.8 ft (1 to 3 m), with the highest storm waves up to 30 ft (9 m) high (RI CRMC 2010). Relative sea level rise is forecasted to increase by 3.3 mm/year based on data trends recorded at NOAA Station 8510560 in Montauk, New York, which could influence the waves surrounding the project.

View receptor and sensitivity is based on the engagement of the people viewing the Project and the viewer expectations. Table 3.22-8 summarizes sensitivity criteria for the VIA assessment of impacts.

Table 3.22-8. VIA View Receptor Sensitivity Ranking Criteria

Sensitivity Level	Sensitivity Criteria
High	Susceptibility: Residents with views of the Project from their homes; visitors to historic or culturally important sites, where views of the surroundings are an important contributor to the experience; people who regard the visual environment as an important asset to their community, churches, schools, cemeteries, public buildings, and parks; and people traveling on scenic highways and roads, or walking on beaches and trails, specifically for enjoyment of views. Value: association with a strong cultural, historic, religious, or spiritual connection to landscape or seascape views; designation as a scenic viewpoint or designated scenic area or roadway; viewers engaged in outdoor recreation whose attention or interest is focused on the seascape and landscape and on particular views.
Medium	Susceptibility: People engaged in outdoor recreation whose attention or interest is unlikely to be focused on the landscape and on particular views because of the type of activity; people at their places of livelihood, commerce. Value: personal needs (inside or outside) whose attention is generally focused on that engagement, not on scenery, and where the seascape and landscape setting are not important to the quality of their activity, generally, those commuters and other travelers traversing routes that are dominated by non-scenic developments.
Low	People who regard the visual environment as an unvalued asset.

Sources: BOEM 2021, BOEM Ocean Wind 2022.

The COP VIA Appendix Q1 (EDR 2022b) identifies 40 representative KOPs within the VSA for assessment and evaluation, including development of computer simulations of representative conditions, such as daytime, nighttime, and sunset conditions. The KOPs provide representative viewing locations where individual or groups viewing experiences may be affected by the proposed Project WTGs and OCS-DC. Table 3.22-9 provides a summary of KOPs, and Figure 2.2-1, Key Observation Points, in the COP VIA Appendix Q1 (EDR 2022b) and Appendix I, Attachment I-1, for location of the KOPs.

Table 3.22-9. Representative Key Observation Points within the Visual Study Area

KOP ID	KOP Name	Location	Landscape Similarity Zones	Character Units	Distance to SRWF (miles/km)	Viewer Type	Visually Sensitive Resources
New York							
LI01	Camp Hero State Park Overlook	Town of East Hampton, Suffolk County, New York	Coastal Bluff	LCA/SCA	31.2/50.2	Resident, Tourist	State Park, State Area of Scenic Significance
LI04	Montauk Point State Park	Town of East Hampton, Suffolk County, New York	Maintained Recreation Area	LCA/SCA	30.6/49.2	Local Residents, Tourists/Vacationers, Fishing Community	State Park, Lighthouse, State Scenic Area, State Area of Scenic Significance
Massachusetts							
CI01	Cuttyhunk Island	Town of Gosnold, Dukes County, Massachusetts	Coastal Scrub/Shrub	LCA/SCA	25.8/41.5	Local Residents, Tourists/Vacationers	State Scenic Area
MM01	Gooseberry Island	Town of Westport, Bristol County, Massachusetts	Coastal Scrub/Shrub	LCA/SCA	30.7/49.4	Local Residents, Tourists/Vacationers	Multiple, Public Beach, State Reservation, State Scenic Area
MM04	Nobska Lighthouse	Town of Falmouth, Barnstable County, Massachusetts	Maintained Recreation Area	LCA/SCA	34.7/55.8	Local Residents, Tourists/Vacationers	Nobska Point Lighthouse
MM06	Demarest Lloyd State Park	Town of Dartmouth, Bristol County, Massachusetts	Shoreline Beach, Coastal, Scrub/Shrub	LCA/SCA	33.1/53.3	Local Residents, Tourists/Vacationers	Public Beach, State Park, State Scenic Area
MM07	Fort Taber District	Town of New Bedford, Bristol County, Massachusetts	Maintained Recreation Area	LCA/SCA	37.8/60.8	Local Residents, Tourists/Vacationers	Lighthouse, Public Beach
MV02	Philbin Beach	Town of Aquinnah, Dukes County, Massachusetts	Shoreline Beach	LCA/SCA	21.0/33.8	Local Residents, Tourists/Vacationers	Public Beach, State Scenic Area
MV03	Lucy Vincent Beach	Town of Chilmark, Dukes County, Massachusetts	Coastal Bluffs	LCA/SCA	22.0/35.4	Local Residents, Tourists/Vacationers	Public Beach, State Scenic Area
MV05	Moshup Beach	Town of Aquinnah, Dukes County, Massachusetts	Coastal Dunes	LCA/SCA	21.2/34.1	Local Residents, Tourists/Vacationers	Public Beaches, State Scenic Areas
MV07	Aquinnah Overlook	Town of Aquinnah, Dukes County, Massachusetts	Coastal Bluff	LCA/SCA	21.5/34.6	Local Residents, Tourists/Vacationers	National Natural Landmark, State Scenic Areas, Historic Site, Lighthouse, Public Beaches

KOP ID	KOP Name	Location	Landscape Similarity Zones	Character Units	Distance to SRWF (miles/km)	Viewer Type	Visually Sensitive Resources
MV09	Gay Head Lighthouse	Town of Aquinnah, Dukes County, Massachusetts	Maintained Recreation Area	LCA/SCA	21.6/34.8	Local Residents, Tourists/Vacationers	National Natural Landmark, State Scenic Areas, Historic Site, Lighthouse, Public Beaches
MV10	South Beach State Park	Town of Edgartown, Dukes County, Massachusetts	Shoreline Beach	SCA	27.1/43.6	Local Residents, Tourists/Vacationers	State Park
MV11	Wasque Point	Town of Edgartown, Dukes County, Massachusetts	Shoreline Beach	SCA	29.4/47.3	Local Residents, Tourists/Vacationers	Public Beach
MV12	Peaked Hill	Town of Chilmark, Dukes County, Massachusetts	Forest	LCA	22.9/36.9	Local Residents, Tourists/Vacationers	Tribal Significance
MV13	Edwin D Vanderhoop	Town of Aquinnah, Dukes County, Massachusetts	Coastal Bluff	LCA/SCA	21.5/34.6	Local Residents, Tourists/Vacationers	National Natural Landmark, State Scenic Areas, Lighthouse
NI10	Madaket Beach	Town of Nantucket, Nantucket County, Massachusetts	Shoreline Beach	LCA/SCA	37.0/59.5	Local Residents, Tourists/Vacationers	Public Beach, Historic District
NL01	Nomans Land Island	Town of Chilmark, Dukes County, Massachusetts	Coastal Bluff	LCA/SCA	15.6/25.1	No Access	National Wildlife Refuge
Rhode Island							
AI01	Brenton Point State Park	Town of Newport, Newport County, Rhode Island	Maintained Recreation Area	LCA/SCA	28.9/46.5	Local Residents, Tourists/Vacationers, Fishing Community	State Park, State Scenic Area, Historic District, State Boat Access
AI03	Newport Cliff Walk	Town of Newport, Newport County, Rhode Island	Shoreline Residential, Maintained Recreation Area	LCA/SCA	28.6/46.0	Local Residents, Tourists/Vacationers	National Recreation Trail, State Scenic Area, Historic District
AI05	Sachuest Point National Wildlife Refuge	Town of Middletown, Newport County, Rhode Island	Coastal Scrub/Shrub	LCA/SCA	29.8/48.0	Local Residents, Tourists/Vacationers	National Wildlife Refuge, Scenic Area
AI06	Sachuest Beach (Second)	Town of Middletown, Newport County, Rhode Island	Shoreline Beach	LCA/SCA	30.9/49.7	Local Residents, Tourists/Vacationers	Scenic Highway, Public Beach, Bird Sanctuary
AI07	Hanging Rock	Town of Middletown, Newport County, Rhode Island	Coastal Scrub/Shrub	LCA/SCA	31.1/50.1	Local Residents, Tourists/Vacationers	Scenic Highway, Public Beach, Bird Sanctuary

KOP ID	KOP Name	Location	Landscape Similarity Zones	Character Units	Distance to SRWF (miles/km)	Viewer Type	Visually Sensitive Resources
AI09	Easton's Beach	Town of Newport, Newport County, Rhode Island	Shoreline Beach	SCA	30.9/49.7	Local Residents, Tourists/Vacationers	National Recreation Trail, Historic District, Public Beach
BI02	Great Salt Pond	Town of New Shoreham, Washington County, Rhode Island	Commercial Waterfront	LCA/SCA	20.1/32.3	Local Residents, Tourists/Vacationers	National Wildlife Refuge, Boat/Fish Access, Public Beach, State Scenic Area, Ferry Route
BI04	Southeast Lighthouse	Town of New Shoreham, Washington County, Rhode Island	Maintained Recreation Area, Coastal Bluff	LCA/SCA	16.9/27.2	Local Residents, Tourists/Vacationers	Public Beach, State Scenic Area, National Historic Landmark
BI06	New Shoreham Beach	Town of New Shoreham, Washington County, Rhode Island	Shoreline Beach	SCA	17.8/28.6	Local Residents, Tourists/Vacationers	Boat/Fish Access, Lodges, and Cottages
BI08	Fred Benson Beach	Town of New Shoreham, Washington County, Rhode Island	Shoreline Beach	SCA	19.0/30.6	Local Residents, Tourists/Vacationers	State Scenic Areas, Public Beach, Roadway
BI12	Clayhead Trail	Town of New Shoreham, Washington County, Rhode Island	Coastal Bluff	LCA/SCA	19.5/31.4	Local Residents, Tourists/Vacationers	Trail, Roadway
BI16	Mohegan Bluffs	Town of New Shoreham, Washington County, Rhode Island	Shoreline Beach, Coastal Bluff	LCA/SCA	17.2/27.7	Local Residents, Tourists/Vacationers	State Scenic Areas, Public Beach, State Recreation Land, Boat/Fish Access
C01	Beavertail Lighthouse	Town of Jamestown, Newport County, Rhode Island	Maintained Recreation Area	LCA/SCA	29.5/47.5	Local Residents, Tourists/Vacationers	State Park, Boat/Fish Access, Scenic Area, Lighthouse
RI01	Watch Hill Lighthouse	Town of Westerly, Washington County, Rhode Island	Maintained Recreation Area, Shoreline Residential	LCA/SCA	36.0/57.9	Local Residents, Tourists/Vacationers	State Scenic Area, Historic District, Lighthouse
RI02	Weekapaug Breachway	Town of Westerly, Washington County, Rhode Island	Shoreline Beach	SCA	33.0/53.1	Local Residents, Tourists/Vacationers	State Scenic Area, State Boat/Fish Access, National Wildlife Refuge, Public Beach
RI03	Point Judith Lighthouse	Town of Narragansett, Washington County, Rhode Island	Maintained Recreation Area	LCA/SCA	25.7/41.4	Local Residents, Tourists/Vacationers	State Scenic Area, Wildlife Management Area, Lighthouse

KOP ID	KOP Name	Location	Landscape Similarity Zones	Character Units	Distance to SRWF (miles/km)	Viewer Type	Visually Sensitive Resources
RI04	South Shore Beach	Town of Little Compton, Newport County, Rhode Island	Shoreline Beach, Shoreline Residential	LCA/SCA	31.6/50.9	Local Residents, Tourists/Vacationers	State Scenic Area, Public Beach
RI06	Trustom Pond NWR	Town of South Kingstown, Washington County, Rhode Island	Salt Pond/Tidal Marsh	LCA/SCA	29.0/46.7	Local Residents, Tourists/Vacationers	National Wildlife Refuge, Public Beach, State Scenic Area
RI08	Scarborough Beach	Town of Narragansett, Washington County, Rhode Island	Shoreline Beach	SCA	27.1/43.6	Local Residents, Tourists/Vacationers	National Wildlife Refuge, Public Beach, State Lands
RI09	Narragansett Beach	Town of Narragansett, Washington County, Rhode Island	Shoreline Beach	SCA	29.7/47.8	Local Residents, Tourists/Vacationers	National Wildlife Refuge, Public Beach, State Scenic Area
RI11	Matunuck Beach	Town of South Kingstown, Washington County, Rhode Island	Developed Waterfront, Shoreline Beach	LCA/SCA	28.0/45.1	Local Residents, Tourists/Vacationers	National Wildlife Refuge, Public Beach
RI12	Ninigret National Wildlife Refuge	Town of Charlestown, Washington County, Rhode Island	Shoreline Beach	SCA	30.5/49.1	Local Residents, Tourists/Vacationers, Fishing Community	National Wildlife Refuge, State Lands

Source: COP VIA Appendix Q1 EDR 2022b

Notes: KOP = key observation point; LCA = landscape character area; OCA = ocean character area; SCA = seascape character area; SRWF = Sunrise Wind Farm; VSA = visual study area

Onshore Area

This section summarizes the onshore visual GAA baseline conditions associated with the proposed landfall area, cable location, and OnCS-DC facility as described in COP VRA, Appendix Q2, Onshore Visual Resource Assessment (EDR 2022c).

Onshore project infrastructure would be located in the Town of Brookhaven, Suffolk County, New York, on the south shore of Long Island. Brookhaven is characterized by unique hamlets, villages, and communities; two world renowned research centers, Stony Brook University and Brookhaven National Laboratory; popular beaches; and recreation areas (Brookhaven 2022). The western portion of Brookhaven has a much higher concentration of development, whereas the eastern portion has more areas allocated for recreation and open space (Suffolk County 2016). The town land uses that constitute the most acreage are preserved recreation and open space (43 percent), low-density and medium-density housing (21 percent), and vacant land (10 percent) (Suffolk County 2020).

Landfall of the SRWEC would occur at Smith Point County Park, which includes public access to the beach and camping facilities and is located on the Fire Island National Seashore barrier island in the Town of Brookhaven (Suffolk County Parks 2018). Smith Point County Park while not owned by the federal government, is located within the Fire Island National Seashore boundaries, and adjacent to the Otis Pike Wilderness (see Figure 3.18-1 in Section 3.18, *Land Use and Coastal Infrastructure*). Within Smith Point County Park's borders, the TWA Flight 800 International Memorial is located. This space memorializes the victims of TWA Flight 800, which crashed off Fire Island on July 17, 1996 (NPS 2023).

Fire Island is an approximately 30-mile-long (48.3-km-long) island that is separated from Long Island by the Great South Bay. This area is characterized by dynamic barrier island beaches, an ancient maritime forest, and historic resources, and contains the 26-mile-long (41.8-km-long) protected Fire Island National Seashore (National Park Foundation 2022). This area is a popular recreation and tourism destination, where many visitors go to enjoy the nature and scenic quality.

The Fire Island National Seashore has communities, the Otis Pike Wilderness area, natural areas, and historical and cultural resources within its boundaries. More than three-quarters of Fire Island National Seashore is marine or estuarine habitat, with 14,644 ac (5,926 ha) of the park consisting of open water. The Seashore boundary extends 1,000 ft (304.8 m) into the Atlantic Ocean from Moriches Inlet to Robert Moses State Park, and up to 4,000 ft (1,219.2 m) into the Great South Bay, and Bellport, Narrow and Moriches Bay (NPS 2022). Fire Island National Seashore was established "[f]or the purpose of conserving and preserving for the use of future generations certain relatively unspoiled and undeveloped beaches, dunes, and other natural features within Suffolk County, New York, which possess high values to the Nation as examples of unspoiled areas of great natural beauty in close proximity to large concentrations of urban population." (16 *USC* 459I).

The Otis Pike Fire Island High Dune Wilderness Act (enacted December 23, 1983) designated approximately 1,363 ac (551.5 ha) of the Fire Island National Seashore as federally designated wilderness (Otis Pike Wilderness Area) and later expanded the wilderness area to an additional 18 ac (7.3 ha). The Otis Pike Wilderness area is the smallest wilderness area managed by the National Park Service and the only federally designated wilderness area in the state of New York. The Otis Pike Wilderness is located directly west of Smith County Park, and in an area where, per enabling legislation for the Fire Island

National seashore, “every effort shall be exerted to maintain and preserve” this area of the seashore “in as nearly [its] present state and condition as possible” (16 *USC* 459e-6(b)).

From Smith Point County Park, the onshore transmission cable would be routed through the western side of Brookhaven until it reaches the OnCS-DC. The OnCS-DC for the Project is proposed to be located on two parcels, with an operational footprint of 6 ac (2.4 ha) and a maximum disturbance area of approximately 7 ac (2.8 ha) in size. This site is currently being used for industrial/commercial purposes and is in a location that is zoned for industrial and commercial uses.

Local communities identify important scenic and visual resources in their communities in local comprehensive plans, recreation and open space plans, local waterfront revitalization plans (NYS only), and conservation plans. In reviewing these resources, 11 municipalities were identified as having greater than 5 percent of their land area within the ZVI and are listed in Table 3.22-10. Each of the 11 listed municipalities have some level of comprehensive plan or open space recreation plan that provide general, high-level discussion about the protection of scenic and historic resources (COP VIA Appendix Q1; EDR 2022b). Several of the plans identify potential risks to historic and scenic resources, including the risk of flooding from climate change and sea level rise and development or change of existing historic properties.

Table 3.22-10. Municipalities with Greater than 5 Percent ZVI Content

Municipality	Percent within ZVI
Gosnold, Dukes County, MA	20.3%
Aquinnah, Dukes County, MA	18.0%
Edgartown, Dukes County, MA	8.5%
Nantucket, Nantucket County, MA	6.7%
West Tisbury, Dukes County, MA	5.3%
New Shoreham, Washington County, RI	10.0%
Newport, Newport County, RI	9.8%
Little Compton, Newport County, RI	9.3%
Middletown, Newport County, RI	9.1%
Narragansett, Washington County, RI	5.7%

3.22.2 Impact Level Definitions for Visual Resources

This Final EIS uses a four-level classification to analyze potential impact levels for scenic and visual resources of the alternatives, including the Proposed Action. Table 3.22-11 lists the definitions for the potential adverse impact levels for scenic and visual resources under the SLIA and the VIA. Table G-21 in Appendix G identifies potential IPFs, issues, and indicators to assess impacts to scenic and visual resources. Impacts are categorized as beneficial or adverse and may be short-term or long-term in duration. Short-term impacts may occur over a period of less than five years. Long-term impacts may occur over a period ranging from 5 years to 30 years, and impacts that occur longer than 30 years are considered permanent. The analysis for scenic and visual resources helps to inform the impact assessment to recreation and tourism viewscape and settings, Section 3.21, *Recreation and Tourism*. Appendix I contains additional analysis of the LSZs, scenic resources, and representative key observation points and viewer experiences that would be affected by the Proposed Action and Alternatives. Visual simulations of the No Action Alternative and Proposed Action alternative are provided in the COP VIA, Appendix Q1 (EDR 2022b) and Appendix I, Attachment I-3 of this EIS.

Table 3.22-11. Potential Adverse and Beneficial Impact Level Definitions for Visual Resources

Impact Level	Definition of Potential Adverse Impact Levels	Definition of Potential Beneficial Impact Levels
SLIA		
Major	SLIA: The project would introduce features that would have dominant levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The project would introduce a visual character that is inconsistent with the character of the unit, which may have a major negative effect to the unit's features, elements, or key qualities. The concern for change (susceptibility/value) to the character unit is high.	N/A
Moderate	SLIA: The project would introduce features that would have medium to large levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The project would introduce a visual character that is inconsistent with the character of the unit, which may have a moderate negative effect to the unit's features, elements, or the key qualities. In areas affected by large magnitudes of change, the unit's features, elements or key qualities have low susceptibility and/or value.	N/A
Minor	SLIA: The project would introduce features that may have noticeable low to medium levels of visual prominence within the geographic area of an ocean/ seascape/ landscape character unit. The project features may introduce a visual character that is somewhat inconsistent with the character of the unit, It may have minor to medium negative effects to the unit's features, elements, or key qualities, but the unit's features, elements, or key qualities have low susceptibility or value.	N/A
Negligible	SLIA: Very little or no effect on seascape/landscape unit character, features, elements, or key qualities because unit lacks distinctive character, features, elements, or key qualities; values for these are low; and/or Project visibility is minimal.	N/A

Impact Level	Definition of Potential Adverse Impact Levels	Definition of Potential Beneficial Impact Levels
VIA		
Major	VIA: The visibility of the project would introduce a major level of character change to the view; would attract, hold, and dominate the viewer's attention; and have a moderate to major effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to high. If the magnitude of change to the view's character is medium, but the susceptibility or value at the KOP is high, and, then evaluate the nature of the sensitivity to determine if elevating the impact to major is justified. If the susceptibility and value at the KOP is low in an area where the magnitude of change is large, then evaluate the nature of the sensitivity to determine if lowering the impact to moderate is justified.	N/A
Moderate	VIA: The visibility of the project would introduce a moderate to large level of change to the view's character; may have a moderate to large levels of visual prominence that attracts and holds but may or may not dominate the viewer's attention; and has a moderate effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to low. Moderate impacts are typically associated with medium viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has medium levels of change; or low viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has large changes to the character. If the value, susceptibility, and viewer concern for change is high, then evaluate the nature of the sensitivity to determine if elevating the impact to the next level is justified.	N/A
Minor	VIA: The visibility of the project would introduce a small but noticeable to medium level of change to the view's character; have a low to medium level of visual prominence that attracts but may or may not hold the viewer's attention; and have a small to medium effect on the viewer's experience. The viewer receptor sensitivity/susceptibility/value is low. If the value, susceptibility, and viewer concern for change is medium or high, then evaluate the nature of the sensitivity to determine if elevating the impact to the next level is justified. For instance, a KOP with a low magnitude of change, but has a high level of viewer concern (combination of susceptibility/value) may justify adjusting to a moderate level of impact.	N/A
Negligible	VIA: Very little or no effect on viewers' visual experience because view value is low, viewers are relatively insensitive to view changes, or Project visibility is minimal.	N/A

3.22.3 Impacts of Alternative A – No Action on Visual Resources

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

3.22.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for scenic and visual resources described in Section 3.22.1, *Affected Environment*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Onshore development and construction activities and offshore vessel traffic are ongoing activities in the GAA that could have impacts on scenic and visual resources. They would potentially contribute to impacts on scenic and visual resources through new structures, traffic congestion, and nighttime lighting. Impacts associated with non-offshore ongoing activities could be short-term or permanent in nature.

Ongoing offshore wind activities within the GAA that contribute to impacts on scenic and visual resources include:

- Continued O&M of the Block Island project (5 WTGs) installed in State waters.
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of the Block Island project and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect scenic and visual resources through the primary IPFs of presence of structures, nighttime lighting, and traffic congestion. Ongoing offshore wind activities would have the same type of impacts from land disturbance, port utilization, accidental releases, traffic, lighting, and presence of structures that are described in detail below for planned offshore wind activities, but the impacts would be of lower intensity.

3.22.3.2 Cumulative Impacts of the No Action Alternative

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

Planned offshore activities, excluding offshore wind, within the GAA that contribute to seascape, open ocean, landscape, and viewers include activities related to undersea transmission lines, gas pipelines, submarine cables, tidal energy projects, marine minerals use and ocean-dredged material disposal, military use, marine transportation, fisheries use and management, global climate change and oil and gas activities (see Appendix E for further description of planned activities in the GAA). These planned activities could potentially impact seascape character, ocean character, landscape character, and viewer experience through the presence of new or additional structures, light, land disturbance, vessel and vehicle traffic, air emissions, and accidental releases to the landscape or seascape.

The sections below summarize the potential impacts of planned offshore wind activities on scenic and visual resources during construction, O&M, and decommissioning of the projects. BOEM anticipates future offshore wind activities to affect scenic and visual resources through the following primary IPFs.

Presence of structures: Without the Proposed Action, future offshore wind development would result in the addition of structures, including but not limited to WTGs, OCS-DC, and onshore development of interconnecting facilities. Under this alternative, proposed or anticipated future wind facility projects would consist of up to 942 WTGs, associated OSS, and associated onshore structures in the visual GAA. The presence of the WTGs and OCS-DC from 10 planned offshore wind projects would contribute to adverse impacts to scenic and visual resources. The impact on visual components of onshore structures would be dependent upon their location, including the existing development and zoning of the area. Impacts would be limited if onshore structures were constructed in areas that are already industrial in nature and used for commercial or industrial purposes. The degree of visual significance of these in-water structures would depend upon the perceivable contrast, dominance, and scale of structures along the ocean horizon and the distance of the viewer. Future offshore wind activities would result in adverse impacts to visual and scenic resources, as the presence of WTGs and OCS-DC would influence the seascape character, ocean character, landscape character, and viewer experience. Projects located within 12 miles (19.3 km) of viewing areas would have the most significant visual impacts, and those located further away from viewing areas would have less significant impacts. A recent study undertaken by NYSERDA suggest that wind energy projects of a typical magnitude, which for this study was considered to be 100 8-MW WTGs, would have minimal visual effects beyond a distance of 20 mi (32.2 km) and negligible effects beyond 25 mi (40.2 km) (EDR 2017). Theses distances assume open views with ideal viewing conditions for atmospheric haze, cloud cover, and human visual acuity. The changes in visual and scenic characteristics would result in long-term, adverse impacts to scenic and visual resources.

Light: Under the No Action Alternative, anticipated construction would involve seven offshore wind farm projects in the visual GAA. Construction activities associated with these developments would result in lighting from construction vessels and equipment. Lighting could be used in nighttime, dusk, and early morning construction activities and could be visual from onshore and offshore locations. Under the maximum-case scenario, seven offshore wind projects (without the Proposed Action) could have nighttime lighting associated with construction activities in the visual GAA. These impacts would be short-term, periodic, and localized. Nighttime lighting of vessels could also occur during O&M of future offshore wind developments. This could have long-term, periodic minor to major adverse impacts on visual and scenic resources, as the seascape character, ocean character, nighttime viewer experience, and valued scenery would be influenced.

Future offshore wind development would require permanent lighting from aviation warning lighting on the in-water structures. Depending upon location of the viewer, distance from the structure, angle of the structure, and atmospheric conditions, the impacts from warning lighting would range from long-term minor to long-term major adverse impacts. Lighting would be visible from beaches and coastlines within the visual GAA. Up to 961 structures would be equipped with FAA hazard lighting systems during O&M activities.

An important factor that influences the impacts from lighting is whether the future offshore developments would implement an ADLS to activate the hazard lighting system in response to the presence of nearby aircraft. If ADLS is implemented, lighting would be activated for shorter periods of time and would be anticipated to result in shorter duration of adverse impacts to visual and scenic resources. A recent study was completed to understand the duration of timing that ADLS lighting would be activated if implemented (Atlantic Shores 2021). Results found that if implemented, ADLS lighting would occur for less than 11 hours per year for 880- or 890-foot-tall (268 m or 271 m) WTGs, compared to standard, continuous FAA hazard lighting. If implemented, it is anticipated that the reduced timing of lighting would result in less than 1 percent of the normal operating time that would occur if ADLS is not implemented. ADLS is implemented when aircraft enter the light activation volume, which is defined as a three-dimensional volume of airspace or coverage area, around the obstructions within a 3 nautical mile perimeter around the edge of the Project, and a minimum of 1,000 ft (304.8 m) above the highest part of the obstructions in the Project, however actual light activation volume would vary depending on the ADLS (Atlantic Shores 2021).

Traffic (vessel): Future offshore wind projects would result in increased vessel traffic, predominantly during construction and decommissioning activities, but increased traffic would also be present to a lesser extent during O&M activities. Activities would be concentrated along routes from the future offshore wind construction areas and ports used to support the construction, O&M, and decommissioning activities. The exact vessel traffic associated with each future project is not known but would be expected to be similar to that of the Proposed Action, which is projected to use up to 69 different vessels over the course of the project, but not all vessels would be operating simultaneously (COP Section 4.8.1.2; Sunrise Wind 2023). During construction activities of future offshore wind development, increased vessel traffic could affect visual and scenic resources by changing the daytime and nighttime seascape and ocean character to an active waterway with an increased presence of stationary and moving vessels. Vessel activity and impacts to visual and scenic resources during decommissioning would be anticipated to be similar to those described for construction.

O&M activities for future offshore wind development would result in impacts to visual and scenic resources from vessel activity being visible from both onshore and offshore viewing areas. During O&M of future offshore wind projects, vessel traffic would result in long-term, periodic contrasts in the viewer experience of valued scenery and to seascape and ocean character.

Land disturbance: Future projects would require onshore infrastructure to be installed, including onshore export cables, onshore substations, and transmission infrastructure. The installation of these facilities would result in localized, short-term, visual impacts near construction sites. Construction activities would affect visual and scenic resources because of land disturbance, potential vegetation clearing, grading, or trenching, construction staging, and construction laydown areas. These impacts would be minor and short-term, as they would last through construction activities and when measures are taken to restore sites. Project O&M may require some land disturbance to occur. The significance of impacts to visual and scenic resources from land disturbance would be dependent upon the location, scenic features, and expected viewer experience. It would be anticipated that proposed offshore wind projects would have short-term, localized impacts to scenic and visual resources during construction, O&M, and decommissioning activities.

Port utilization: Future offshore wind projects would require ports to be utilized for staging and construction activities, O&M activities, and decommissioning activities. The vast majority of regional ports that are suitable for activities related to construction of offshore wind projects are industrial in nature. Additional activity occurring at the ports could influence visual and scenic resources. However, activities would be occurring in current, marine industrial areas at existing ports, and would therefore, not significantly change scenic and visual resources (BOEM 2016). Overall, port utilization of future offshore wind projects would not be expected to have adverse impacts on visual and scenic resources.

Accidental releases: During construction, O&M, and decommissioning activities associated with future offshore wind projects, accidental releases are possible. Accidental releases could influence nearby seascape character, ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Visual and scenic resources could be impacted if accidental releases result in the short-term closure of beaches or other recreational areas that would limit viewer experiences. Accidental releases would be more likely to occur during construction and decommissioning activities but would be short-term impacts. Potential impacts from accidental releases during O&M would be continuous, but less likely to occur.

3.22.3.3 Conclusions

Impacts of the No Action Alternative

Under the No Action Alternative scenic and visual resources would continue to be affected by current regional trends and would change in response to other ongoing activities. Ongoing activities would continue to have both short-term and long-term impacts on seascape character, ocean character, landscape character, and viewer experience through the presence of structures, lighting, vessel traffic, land disturbance, and accidental releases. Ongoing O&M of the Block Island project and construction of the Vineyard Wind 1 project and South Fork project would have impacts on a viewer's experience, as they change the expected environment and contrasts to the previous seascape, landscape, and open ocean environments. The No Action Alternative would result in **moderate** adverse impacts on scenic and visual resources.

Cumulative Impacts of the No Action Alternative

Under the No Action Alternative, existing environmental trends and ongoing activities would continue and scenic and visual resources would continue to be affected by the relevant IPFs. Planned activities would contribute to impacts on scenic and visual resources due to short-term and long-term impacts on seascape character, ocean character, landscape character and viewer experience. The development of future offshore wind projects under the No Action Alternative would anticipate the installation of seven current and future offshore wind projects within the visual GAA. This would result in changes to the surrounding marine environment as the undeveloped ocean character is changed to an industrial wind farm environment. Impacts to seascape, open ocean, landscape, and viewer experience would be short-term and long-term. IPFs that would contribute to these impacts include the presence of structures, lighting, vessel traffic, accidental releases, and land disturbance.

The planned activities evaluated under the cumulative impacts of the No Action Alternative would result in up to 942 WTGs would be present, changing the visual character of the ocean character, which could have adverse impacts on the viewer experience. Activities related to construction, O&M, and decommissioning of future offshore wind projects could have impacts on a viewer's experience, as they would result in changes in the expected environment and contrasts to the previous seascape, landscape, and open ocean environments that did not have the IPFs from future offshore wind development present.

The cumulative impacts of the No Action Alternative would result in **major** adverse impacts on visual and scenic resources within the GAA due to the presence of new structures, nighttime lighting, land disturbance, and increased traffic.

3.22.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The Project layout, including the number, size, and placement of the WTGs and OSS;
- The design of lighting systems for structures including the implementation of ADLS lighting systems;
- The number and type of vessels involved in construction, O&M, and decommissioning;
- The time of day and time of year that construction, O&M, and decommissioning occur;
- The onshore cable export route options; and
- The size and location of onshore substations.

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

- The number, size, location, and lighting of the WTGs. The visual impacts from onshore KOPs would increase with the presence of more WTGs and larger turbine size. The design and type of WTG lighting would affect nighttime visibility of WTGs from onshore and offshore viewing locations. Implementation of ADLS technology would reduce visual impacts.
- The time of day that construction, O&M, and decommissioning activities occur. Activities are anticipated to occur outside of the busy summer tourist season.
- The location and size of onshore Project components could have varying impacts depending on the current land use and zoning of the Project facilities. If Project facilities are located in closer proximity to sensitive receptors, then they would have greater impacts.

3.22.5 Impacts of Alternative B - Proposed Action on Visual Resources

This section addresses the impacts associated with the construction, O&M, and conceptual decommissioning of the Proposed Action on seascape character, open ocean character, landscape character, and viewer experience in the visual GAA. The impact level is considered in with the context to the sensitivity of the view receptor and the magnitude of the impact. The magnitude of the impact considers the noticeable features; distance and field of view (FOV) effects; view framing and intervening foregrounds; and the form, line, color, and texture contrasts, scale of change, and prominence in the characteristic seascape, open ocean, and landscape. The impact from the presence of structures can vary due to the variability in visual contrast from changing sun angles, atmospheric conditions, orientation of viewers within the KOPs and the orientation of the KOP to the project.

The degree of adverse effects is determined by the following criteria:

- The Proposed Action’s susceptibility to change of baseline seascape, open ocean, and landscape characters;
- The characteristics, contrasts, scale of change, prominence, and spatial interaction with the special qualities;
- The duration/reversibility of the change to scenic and visual resources;
- The sensitivities and locations of viewers;
- The primary use and use level of the resource; and
- The intervisibility between viewer locations and the Proposed Action’s features.

Viewers or visual receptors within the Proposed Action’s zone of theoretical visibility include:

- Residents living in coastal communities or individual residences;
- Tourists visiting, staying in, or traveling through the area;
- Recreational users of the seascape, including those using ocean beaches and tidal areas;
- Recreational users of the open ocean, including those involved in yachting, fishing, boating, and passage on ships;
- Recreational users of the landscape, including those using landward beaches, nature preserves, parks, cycle routes, and footpaths;
- Tourists, workers, visitors, or local people using transport routes; and
- People working in the marine environment, such as those on fishing vessels and crews of ships.

The seascape, open ocean, and landscape character units, and potential level of impact would be affected by sensitivity of the seascape, open ocean, and landscape and noticeable elements, distances, and contrasting elements of the proposed Project.

Table 3.22-12 considers the potential level of impact of the proposed Project by seascape character unit, open ocean character unit, and landscape character unit.

Table 3.22-12. Proposed Action Impact on Seascape Character, Open Ocean Character, Landscape Character (SLIA)

Level of Impact	Character Units	Characteristics
Major	OCA	Open Ocean Areas
	SCA	Ocean shoreline areas; seascapes with national, state or local designations; beaches, seaward boardwalks, jetties, and piers
	LCA	Ocean shoreline areas; beaches, seaward boardwalks, jetties, and piers
Moderate	SCA	Beachfront and Jetty/Seawall, Boardwalk Coastal Dune, and Island Community
	LCA	Beachfront and Jetty/Seawall, Boardwalk Coastal Dune, and Island Community
Minor	LCA	Bays, sounds, and adjoining estuaries and shores
Negligible	LCA	Inland areas beyond the viewsheds of the Project's offshore and onshore facilities

Source: EDR 2022c

Notes: LCA = landscape character area; OCA = ocean character area; SCA = seascape character area

KOPs 1 through 40 (Table 3.22-9) are representative of sensitive receptors and their vicinities in the shoreward seascape and landscape parts of the visual GAA. Visual simulations of the No Action Alternative and Proposed Action alternative are provided in the COP Appendix Q1 (EDR 2022b) and Appendix I, Attachment I-3 of this EIS. Table 3.22-13 provides a summary of the potential viewer experience based on assessment of the KOP visualizations.

For each KOP, various sensitivity and magnitude factors were considered in evaluating the potential visual impact of the WTGs based on assessment of the KOP visualizations (Attachment I-3) according to BOEM's methodology provided in "*Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Developments on the Outer Continental Shelf of the United States* (BOEM 2021). Sensitivity Factors considered included: susceptibility and sensitivity of the landscape to change (i.e., distinctiveness, development patterns, landform, ocean view), and perceived value and user sensitivity associated with the KOP (i.e., anticipated visitor expectations, viewer elevation, duration of viewing experience, scenic resource value and use level). Magnitude Factors considered included: size and scale (i.e., distance to the nearest turbine, extent the WTG was viewable, and visibility threshold), geographic extent (i.e., vertical and horizontal scale of the WTGs in relation to the viewscape), and duration/reversibility (i.e., long-term permanence of the WTG structures and ability to reverse or remove feature). Attachment I-4, Table I-4.3 provides a summary of the VIA KOP assessment parameters and considerations for the Sensitivity Factors and Magnitude Factors.

These evaluations were then collectively considered and assessed via BOEM's matrices for combining sensitivity components, magnitude components, and for identifying impact levels (BOEM 2021). Section 1.3 provides the results of this assessment and Attachment 1-4.1 provides summaries of key characteristics of the KOPs (location, view types, VSRs, KOP location landscape similarity zone), and Table I-4.2 provides a summary of additional KOP features, including distance from viewing location to nearest WTG, extent that WTG is visible (full tower, platform or partial), horizontal and vertical field of view, and rating factors (sensitivity, magnitude and visibility) for each KOP. Appendix I provides additional information regarding the methodology and assessment of potential effects on seascape, open ocean, landscape character areas, and the representative KOPs and viewers of offshore wind development considering the No Action and the Proposed Action alternatives.

Table 3.22-13. Proposed Action Summary of Potential Impact on Viewer Experience (VIA)

Level of Impact	KOP Information Appendix I, Attachment I-3 Page No. of KOP Cover Sheet	Key Observation Point ID and Name	Description of Key Contributing Factors for Impact Level Characterization
Major	41	MV05 Moshup Beach	The visibility of the project would introduce a major level of character change to the view; would attract, hold, and dominate the viewer's attention; and have a moderate to major effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to high. Panoramic ocean views, scenic resource value, high resident/visitor use area, high viewer sensitivity, high visibility threshold range, high susceptibility to change, backlighting increases visibility particularly at sunrise/sunset conditions.
	46	MV07-SS Aquinnah Overlook - sunset	
	46	MV07 Aquinnah Overlook -day	
	46	MV07-NI Aquinnah Overlook -night	
	58	MV09-SS Gay Head Lighthouse - sunset	
	119	BI04-SR Southeast Lighthouse - sunrise	
Moderate	9	CI01 Cuttyhunk Island	The visibility of the project would introduce a moderate to large level of change to the view's character; may have a moderate to large levels of visual prominence that attracts and holds but may or may not dominate the viewer's attention; and has a moderate effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to low. Panoramic ocean views, moderate residential/visitor use, high to medium viewer sensitivity, moderate visibility threshold range, area of natural or cultural significance, backlighting increases visibility particularly at sunrise/sunset conditions, nighttime lighting increases visibility.
	28	MV02 Philbin Beach	
	35	MV03 Lucy Vincent Beach	
	35	MV03-SS Lucy Vincent Beach-sunset	
	58	MV09 Gay Head Lighthouse	
	70	MV12 Peaked Hill Reservation	
	70	MV12-SS Peaked Hill-sunset	
	76	MV13 Edwin D Vanderhoop	
	83	NL01 Nomans Land Island - sunset	
	119	BI04 Southeast Lighthouse - day	
	119	BI04-NI Southeast Lighthouse-night	
	125	BI06 New Shoreham Beach	
	131	BI12 Clayhead Trail	

Level of Impact	KOP Information Appendix I, Attachment I-3 Page No. of KOP Cover Sheet	Key Observation Point ID and Name	Description of Key Contributing Factors for Impact Level Characterization
	136	BI16 Mohegan Bluffs	
	150	RI03 Point Judith Lighthouse	
Minor	4	LI04 Montauk Point State Park	The visibility of the project would introduce a small but noticeable to medium level of change to the view's character; have a low to medium level of visual prominence that attracts but may or may not hold the viewer's attention; and have a small to medium effect on the viewer's experience. The viewer receptor sensitivity/susceptibility/value is low. Ocean views, residential/visitor use, high to medium viewer sensitivity, lower magnitude and visibility threshold, backlighting/lighting may increase visibility particularly at sunrise/sunset, nighttime lighting increases visibility.
	4	LI04-N Montauk Point State Park - night	
	14	MM01 Gooseberry Island	
	64	MV10 South Beach State Park	
	67	MV11 Wasque Point	
	86	AI01-NI Brenton Point State Park - night	
	93	AI03 Newport Cliff Walk	
	98	AI05 Sachuest Point National Wildlife Refuge	
	128	BI08 Fred Benson Beach	
	155	RI04 South Shore Beach	
	163	RI08 Scarborough Beach	
	173	RI11 Matunuck Beach	
Negligible	1	LI01 Camp Hero State Park Overlook	Very little or no effect on viewers' visual experience because view value is low, viewers are relatively insensitive to view changes, or Project visibility is minimal. Medium viewer sensitivity, low magnitude and visibility threshold.
	19	MM04 Nobska Lighthouse	
	22	MM06 Demarest Lloyd State Park	
	46	MM07 Fort Taber District	
	79	NI10 Madaket Beach	
	79	NI10-CL Madaket Beach-clear	
	86	AI01 Brenton Point State Park	
	103	AI06 Sachuest Beach (Second)	
	108	AI07 Hanging Rock	
	113	AI09 Easton's Beach	
	116	BI02 Great Salt Pond	
	139	C01 Beavertail Lighthouse	
	144	RI01 Watch Hill Lighthouse	

Level of Impact	KOP Information Appendix I, Attachment I-3 Page No. of KOP Cover Sheet	Key Observation Point ID and Name	Description of Key Contributing Factors for Impact Level Characterization
	147	RI02 Weekapaug Breachway	
	160	RI06 Trustom Pond NWR	
	168	RI09 Narragansett Beach	
	176	RI12 Ninigret National Wildlife Refuge	

Visual simulations associated with the SRWF were assessed to illustrate potential cumulative visual impacts associated with other planned offshore wind Projects in the GAA (EDR 2021), as summarized Appendix I. With the Proposed Action, cumulative visual simulations were evaluated considering 1,073 WTG structures present in the GAA, which would result in changes to the surrounding marine environment and the change of an undeveloped ocean character to an industrial wind farm environment. Reasonably foreseeable impacts an occur from individually minor but collectively significant actions that take place over time. Due to this, planned activities, described in Appendix E, have the potential to contribute to reasonably foreseeable impacts when combined with the Proposed Action and other alternatives over the specified spatial and temporal scales. Impacts to seascape, open ocean, landscape, and viewer experience would be short-term and long-term. This would result in major cumulative impacts on visual and scenic resources within the GAA due to the presence of new structures, nighttime lighting, land disturbance, and increased vessel traffic. Appendix I, Attachment I-5 provides selected Key Observation Points cumulative assessment visual simulations (EDR 2021).

3.22.5.1 Construction and Installation

3.22.5.1.1 Onshore Activities and Facilities

Presence of structures: Onshore construction activities for the Proposed Action has a landfall location at Smith Point County Park in Brookhaven, New York. Construction at the landing site would lead to short-term disturbances to neighboring land uses and have structures present during construction activities. Onshore construction and installation would result in the incremental additions of an O&M facility, an interconnection facility, and distribution cable. There would be visual impacts to users sensitive to changes in the view from construction impacts, including in the adjacent Otis Pike Wilderness Area and the Fire Island Wilderness Center, and areas where the user would anticipate seeing undisturbed visual resources. Although construction activities would not occur directly in these areas, activities would influence the scenic and visual character during construction. The landfall construction area would change the scenic viewpoints of the Smith Point County Park Beach during construction activities, impacting users in this area and in adjacent areas where landfall construction activities are visible. Onshore construction activities would impact scenic and visual resources at the TWA Flight 800 International Memorial, located within Smith Point County Park, due to alterations to the visual characteristics of the space during the construction phase. Impacts would be moderate and short-term. Along the onshore cable route, scenic and visual resources would be impacted at Southaven County

Park, Wertheim National Refuge, the Brookhaven Fairgrounds, and the Long Island Baptist Church. Construction activities would not directly impact the space, but would alter the visual characteristics of the area during construction activities. The effects to onshore visual resources would be limited to the window in which the construction activities are occurring and visible to those recreating in the vicinity of the viewshed. Effects would be expected to be limited and short-term.

During onshore construction activities of the SRWF Project facilities, the main visible elements would be related to site preparation, duct bank installation, cable installation, cable jointing, final testing, and site restoration. To help minimize impacts, sites would be mainly screened by existing vegetation and structure. Therefore, it is expected that impacts would be short-term and moderate to scenic and visual resources during onshore construction activities.

Lighting: Onshore construction activities would have general yard lighting present, which would affect the visual and scenic resources of the visual GAA. Lighting would be minimal at night. Construction activities are planned to occur primarily in daytime hours, however, if nighttime construction needed to occur, there would be additional lighting uses. Lighting for construction activities at dawn, dusk, and during the nighttime would have impacts to dark skies in the undeveloped Otis Pike Wilderness Area, adjacent to the proposed landfall site. Lighting for construction activities would also impact community cultural spaces during construction activities, including the TWA Flight 800 International Memorial, Fire Island Wilderness Visitor Center, Smith Point County Park, Wertheim National Wildlife Refuge, Southaven County Park, Brookhaven Fair Grounds, and Long Island Baptist Church. Users located in this area would experience artificial lighting that could negatively influence their viewer experience. Sunrise Wind would follow state and local requirements for lighting otherwise and follow the five principles for responsible outdoor lighting (useful, targeted, low level, controlled and warm-colored) recommended by Illuminating Engineering Society and International Dark-Sky Association to limit visual impact (COP Section 3.3.1; Sunrise Wind 2023; NPS 2022). Impacts to scenic and visual resources from lighting during onshore construction activities should be short-term and minor to negligible.

Land disturbance: Onshore construction activities would connect the SRWEC to onshore facilities at Smith Point County Park on Fire Island in the Town of Brookhaven, New York. The SRWEC would land at the landfall location via HDD methodology and would have minimal visual impact on Smith Point County Park (COP Section 3.3.3.3; Sunrise Wind 2023). Sunrise Wind proposes to implement the APM that construction activities, to the extent possible, would occur during the period when fewer recreational use occurs at Smith Point County Park (November 12 to March 31), which would help reduce the potential magnitude of visual resource impacts. However, visitors utilize the Fire Island National Seashore and Otis Pike Wilderness Area year-round, resulting in those who are in the area during the offseason of recreation activities experiencing changes in the scenic resources in the area. Once construction activities are completed, short-term laydown areas would be restored to their previous condition.

The onshore transmission cable route would be sited, to the extent possible, within existing disturbed ROWs and would be located underground. Construction activities would involve site preparation, trench excavation, duct bank and vault installation, cable jointing, final testing, and restoration, resulting in temporary impacts. Impacts would be short-term and negligible to moderate to scenic and visual resources.

3.22.5.1.2 Offshore Activities and Facilities

Presence of structures: During construction activities, construction vessels would be present in the visual GAA. Additionally, in varying stages of construction, the WTGs and OCS-DC would be visible in the viewshed. The presence of these structures would result in short-term, limited, adverse impacts on visual resources in the visual GAA.

Lighting: If construction activities occur during nighttime, evening, or early morning hours, visual resources would be impacted from nighttime vessel and barge lighting. The impact from vessel lighting would be dependent upon the quantity of vessels, distance from the viewpoint, and intensity of lighting being utilized. Lighting would be visible from some onshore viewpoints and could result in skyglow from a previously dark seascape. Lighting for construction and installation activities have the potential to impact community cultural spaces, including the TWA Flight 800 International Memorial, Fire Island Wilderness Visitor Center, Smith Point County Park, Wertheim National Wildlife Refuge, Southaven County Park, Brookhaven Fair Grounds, and Long Island Baptist Church. Users located in these areas may experience artificial lighting that could negatively influence their viewer experience. Sunrise Wind would follow state and local requirements for lighting and follow the five principles for responsible outdoor lighting recommended by Illuminating Engineering Society and International Dark-Sky Association to limit nighttime visual impacts on humans, wildlife, and the cultural resources/historic properties sense of place and feel. Impacts from vessel lighting during construction activities would be adverse but would be short-term, localized and negligible to minor.

Traffic (vessel): Construction activities associated with the Proposed Action would result in increased vessel traffic. The impacts would occur primarily along routes between ports and the construction area of the Proposed Action. Marine vessel traffic is common along coastal shores of the Atlantic Ocean and increased traffic from construction activities would not be expected to result in a significant increase in the number of vessels using waterways and commercial shipping lanes in the vicinity of the Proposed Action. It would be anticipated that the majority of the vessels used would be similar in size to existing commercial vessels, resulting in minimal visual impacts from vessel traffic. Some larger vessels, such as barges, would result in greater visual impacts as they may draw additional viewer attention. Increased vessel traffic would result in short-term, localized, minor adverse impacts to visual resources.

Land disturbance: Construction of the Proposed Action would require the installation of onshore export cables, onshore substations, and transmission infrastructure to connect to the electrical grid. Visual resources would have short-term, localized impacts where land disturbance would occur due to construction activities, including trenching, clearing, site grading, vegetation clearing, and construction staging activities. After the completion of construction activities, land would be restored to the extent possible. This would result in short-term, negligible impacts to visual resources.

Accidental releases: Under the Proposed Action, accidental releases could occur during offshore construction activities. Accidental releases could influence nearby seascape character, ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Visual and scenic resources could be impacted if accidental releases result in the short-term closure of beaches or other recreational areas that would limit viewer experiences. Impacts from accidental releases during construction activities would be short-term, localized, and minor.

3.22.5.2 Operations and Maintenance

3.22.5.2.1 Onshore Activities and Facilities

Presence of structures: Impacts to scenic and visual resources from the O&M activities of the Proposed Action from the presence of structure would be dependent upon the character of the surrounding landscape and area. The OnCS-DC would be located within the vicinity of other similar uses, including an existing substation. Onshore infrastructure would be in areas where the existing character is commercial and industrialized. Therefore, the presence of structure during O&M activities should have negligible adverse impacts to visual and scenic resources.

Lighting: Facility lighting would be required for the safe and secure operation of the OnCS-DC during routine O&M activities. The proposed location of the OnCS-DC is in a developed site that is currently occupied by various commercial industries and existing light sources, highway traffic, and visual distractions (COP, Section 4.5.1.2; Sunrise Wind 2023). Lighting for operations and maintenance activities have the potential to impact community cultural spaces, including the TWA Flight 800 International Memorial, Fire Island Wilderness Visitor Center, Smith Point County Park, Wertheim National Wildlife Refuge, Southaven County Park, Brookhaven Fair Grounds, and Long Island Baptist Church. Users located in these areas may experience artificial lighting that could negatively influence their viewer experience. Sunrise Wind would follow state and local requirements for lighting and follow the five principles for responsible outdoor lighting recommended by Illuminating Engineering Society and International Dark-Sky Association to limit nighttime visual impacts on humans, wildlife, and the cultural resources/historic properties sense of place and feel. Impacts from this lighting to visual resources would be expected to be localized and negligible, as it would not change the character of the area due to the current developed nature of the area. It would be expected that visual effects from facility lighting of onshore structures during O&M would be minimal.

Land disturbance: Under the Proposed Action, O&M activities would not significantly change the existing landscape character. Project facilities, to the extent possible, would be sited within existing disturbed ROW. The onshore transmission cable route would be located underground. Other facilities would be located in areas that are currently used for commercial and industrial uses. Therefore, impacts from land disturbance associated with O&M of onshore facilities of the Proposed Action would be negligible.

3.22.5.2.2 Offshore Activities and Facilities

Presence of structures: The Proposed Action would result in the installation of 94 11-MW WTGs within 102 potential positions extending up to 787 ft (240 m) AMSL and one OCS-DC with up to 295 ft (110 m) total structure height from lowest astronomical tide, including lighting protection and ancillary structures within the Lease Area. As an APM, Sunrise Wind proposes to paint the WTGs a light grey (RAL 7035) to pure white (RAL 9010). By using these colors, the WTGs would not require daytime lighting or further turbine marking for daytime conspicuity, helping to minimize impacts to scenic and visual resources.

The presence of offshore structures in the visual GAA would affect the character of the seascape, open ocean, landscape character, and viewer experience. The magnitude of impact is defined by the noticeable features; distance and FOV effects; view framing and intervening foregrounds; and the form, line, color, and texture contrasts, scale of change, and prominence in the characteristic seascape, open ocean and landscape. Appendix Q1 in the COP V2 April 2022 (EDR 2022b) presents visual simulations from each of the 40 KOPs considered in this analysis. The effects analyses involved consideration of susceptibility/sensitivity to change, value/user sensitivity, magnitude factor, geographic extent, duration/reversibility. These analyses included consideration of different atmospheric conditions, different times of day, variability of viewer location within the KOP vicinity, and nighttime visibility.

Appendix I in this Final EIS provides additional analyses of the Proposed Action from the KOPs and provides an assessment of the Proposed Action's noticeable elements, distance effects, FOV effects, foreground elements and influence, and contrast rating effects by seashore character unit, landscape character unit, and offshore and onshore KOPs.

The presence of WTGs and the OSC-DC would affect the visual and scenic resources during O&M due to its noticeable elements changing the seascape character units, ocean character unit, landscape character units, and viewer experiences. These impacts at specific locations would be dependent upon the character of the viewer location, applicable distance, open view versus intervening foregrounds, and form, line, color, and texture contrasts in the characteristic seascape, open ocean, and landscape. Higher impacts occur at locations where viewers expect to experience an undisturbed landscape, sensitivity of location, sensitivity of viewer, distance from the structures, and meteorological conditions. Table 3.22-12 considers all of these factors for the totality of the Proposed Action's level of impact by seascape character unit, ocean character unit, landscape character unit, and offshore and onshore KOPs.

O&M activities of the Proposed Action would result in result in the installation of 94 11-MW WTGs within 102 potential wind turbine positions and one OCS-DC present that would alter the seascape character, ocean character, landscape character, and viewer experience. These changes would be long-term and would result in minor to major impacts to scenic and visual resources.

Lighting: O&M activities from the Proposed Action could result in nighttime vessel lighting if activities are undertaken during nighttime, evening, or early morning hours. Dependent upon the quantity of vessels, intensity of lighting, and distance from the viewer, lighting could be visible from some areas of shore. Lighting for operations and maintenance activities have the potential to impact community cultural spaces, including the TWA Flight 800 International Memorial, Fire Island Wilderness Visitor Center, Smith Point County Park, Wertheim National Wildlife Refuge, Southaven County Park, Brookhaven Fair Grounds, and Long Island Baptist Church. Users located in these areas may experience artificial lighting that could negatively influence their viewer experience. Sunrise Wind would follow state and local requirements for lighting and follow the five principles for responsible outdoor lighting recommended by Illuminating Engineering Society and International Dark-Sky Association to limit nighttime visual impacts on humans, wildlife, and the cultural resources/historic properties sense of place and feel. Impacts to visual resources from vessel lighting would be intermittent and long-term during O&M activities.

The Proposed Action would result in the installation of up to 94 11-MW WTGs within 102 potential wind turbine positions and one OCS-DC within the Lease Area. The WTGs would be painted a light grey (RAL 7035) to pure white (RAL 9010) to eliminate the need for daytime lighting (COP Section 4.5.1.2; Sunrise Wind 2023). Nighttime lighting would be necessary on these structures. Under the Proposed Action, as an APM, Sunrise Wind would install ADLS or related means on WTGs to limit visual impacts pursuant to approval by FAA and BOEM (COP Section 4.5.1.2; Sunrise Wind 2023). The installation of ADLS would result in shorter duration impacts from lighting to visual resources, as lighting would only be activated in response to detection of the presence of nearby aircraft. This would lessen impacts to the sea scape, open ocean, landscape, and viewers in comparison to other nighttime lighting alternatives because it would result in the lights being turned on for shorter periods of time. When the lights are on, it would result in a major impact within the range of the viewer, but when the lights are off there would be no impact from them. The impacts from lighting would also be dependent on the viewer location, the atmospheric conditions, and distance from the lighting source. Impacts to visual resources from lighting would be short-term and intermittent in nature but could result in some onshore resources experiencing visual impacts when lighting is in use. The impact to visual resources would be dependent upon the distance from the SRWF, presence of existing onshore and offshore light sources, meteorological conditions, and angle of view. Impacts from lighting would range from negligible to major long-term effects to visual resources.

Traffic (vessel): O&M activities associated with the Proposed Action would result in increases in vessel traffic that could contribute to adverse impacts to visual resources within the visual GAA. Marine traffic associated with O&M of the Proposed Action would be expected to be less frequent than during construction activities. Within the SRWF ZVI, there are relatively frequent trips undertaken by vessels (COP Section 4.5.1.2; Sunrise Wind 2023). Impacts to visual resources from vessel traffic would be long-term but would be minor.

Accidental releases: Under the Proposed Action, accidental releases could occur during O&M activities. Accidental releases could influence nearby seascape character, ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Visual and scenic resources could be impacted if accidental releases result in the temporary closure of beaches or other recreational areas that would limit viewer experiences. Impacts from accidental releases during O&M activities would be short-term, localized, and minor.

3.22.5.3 Conceptual Decommissioning

3.22.5.3.1 Onshore Activities and Facilities

Conceptual decommissioning activities to onshore facilities would have similar minor to moderate adverse impacts to scenic and visual resources as described under construction activities.

3.22.5.3.2 Offshore Activities and Facilities

Conceptual decommissioning activities to offshore facilities would have similar minor to major adverse impacts to scenic and visual resources as described under construction activities.

3.22.5.4 Cumulative Impacts of the Proposed Action

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

Presence of structures: The Proposed Action would contribute 94 11-MW WTGs of 1,073 WTGs, associated OSSs, and other associated structures that would be installed in the GAA by 2030. The total number of WTGs that would be visible from any single KOP would be substantially fewer than the 1,073

WTGs considered under the planned and future activities scenario in combination with the Proposed Action. For example, a total of 382 WTGs would be theoretically visible from Aquidneck Island. Attachment I-5 of Appendix I provides selected KOPs cumulative visual simulations of the Proposed Action, in combination with other offshore wind projects that would be theoretically visible within the same viewshed as the Project, including South Fork, Vineyard Wind, Revolution Wind, New England Wind Phase 1, New England Wind Phase 2, Mayflower Wind, Liberty Wind, Beacon Wind, and Bay State Wind. The presence of structures associated with offshore wind development in combination with the Proposed Action would have major impacts on the seascape character, open ocean character, landscape character, and viewer experience. The impacts would be dependent upon the Project's features, applicable distances, horizontal and vertical FOV extents, view framing, form, line, color, texture and contrasts, scale of change, and prominence.

Lighting: Construction of offshore wind developments in conjunction with the Proposed Action would result in lighting from construction vessels and equipment. Lighting could be used in nighttime, dusk, and early morning construction activities and could be visible from both onshore and offshore locations. Proposed projects could have nighttime lighting associated with construction activities in the visual GAA, that would result in short-term, periodic and localized impacts. Nighttime lighting could also occur during O&M of offshore wind projects, including the Proposed Action. This could have long-term, periodic minor to major adverse impacts on visual and scenic resources, as the seascape character, ocean character, nighttime viewer experience, and scenery would be influenced.

Lighting for construction, operations and maintenance activities both onshore and offshore would be mitigated by following state and local requirements for lighting and follow the five principles for responsible outdoor lighting recommended by Illuminating Engineering Society and International Dark-Sky Association to limit nighttime visual impacts on humans, wildlife, and the cultural resources/historic properties sense of place and feel.

Future offshore wind development, including the Proposed Action, would require permanent lighting from aviation and warning lighting on the in-water structures. Up to 1,073 structures would be equipped with FAA hazard lighting systems during O&M activities in the GAA. This lighting would be visible from onshore and offshore locations, dependent upon location of the viewer, distance from the structure, angle of the structure, and atmospheric conditions. The extent to which other offshore wind projects is unknown. If ADLS is implemented, lighting would be activated for shorter periods of time and would be anticipated to result in shorter duration of adverse impacts to visual and scenic resources. A recent study was completed to understand the duration of timing that ADLS lighting would be activated if implemented (Atlantic Shores 2021). Results found that if implemented, ADLS lighting would occur for less than 11 hours per year for 880- or 890-foot-tall (268 m or 271 m) WTGs, compared to standard, continuous FAA hazard lighting. If implemented, it is anticipated that the reduced timing of lighting would result in less than 1 percent of the normal operating time that would occur if ADLS is not implemented. ADLS is implemented when aircraft enter the light activation volume, which is defined as a three-dimensional volume of airspace or coverage area, around the obstructions within a 3 nautical mile perimeter around the edge of the Project, and a minimum of 1,000 ft (304.8 m) above the highest part of the obstructions in the Project, however actual light activation volume would vary depending on the ADLS (Atlantic Shores 2021).

Traffic (vessel): The Proposed Action would contribute a noticeable increment to the combined vessel traffic impacts on scenic and visual resources from ongoing and planned activities including offshore wind, which would be moderate to major. Activities would be concentrated along routes from future offshore wind construction areas and ports used to support construction, O&M, and decommissioning activities. Offshore wind activities would increase vessel traffic in the GAA beyond what the Proposed Action would generate in isolation.

Land disturbance: The Proposed Action would contribute a noticeable increment to the combined land disturbance impacts on scenic and visual resources from ongoing and planned activities including offshore wind, which would be minor to moderate. The exact extent of the impacts would depend on the locations of project infrastructure for other offshore wind energy projects.

Port utilization: The Proposed Action would contribute a noticeable increment in the use of ports for staging and construction activities, O&M activities, and decommissioning activities. The exact extent to which the pots would be used for the Proposed Action and future offshore wind projects would depend on the location of the project and the port used, and would not be expected to have adverse impacts on visual and scenic resources.

Accidental releases: The Proposed Action would contribute to the combined impacts on scenic and visual resources from ongoing and planned activities that could contribute to accidental releases. The impacts of this would be moderate to major. Accidental releases have the highest potential to occur during construction and decommissioning of offshore wind projects, but potential impacts during O&M would be continuous, but less likely to occur.

The impacts would be dependent upon the Project's features, applicable distances, horizontal and vertical FOV extents, view framing, form, line, color, texture and contrasts, scale of change, and prominence. The cumulative impacts on scenic and visual resources would be negligible to major adverse. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a detectable increment to the presence of structures, lighting, traffic, land disturbance, increased vessel traffic, port utilization, and accidental releases.

3.22.5.5 Conclusions

Impacts of the Proposed Action

Under the Proposed Action, the seascape character units, ocean character unit, landscape character units, and viewer experience would be impacted from construction, O&M, and decommissioning activities. These impacts would be dependent upon the Project's features, applicable distances, horizontal and vertical FOV extents, view framing, form, line, color, texture and contrasts, scale of change, and prominence. These assessments are further documented in Appendix I. The Proposed Action would have major adverse impacts on scenic and visual resources on the ocean character unit. These impacts would result from the presence of WTGs and the OCS-DC and from associated nighttime lighting changing the character of the open ocean landscape. The presence of offshore WTGs and OCS-DC would result in major adverse impacts to the seascape character and landscape character. Onshore scenic and visual resources would have short-term minor to moderate adverse impacts during construction and decommissioning activities that would result in changes to the resources. Onshore structures would be located either underground or in previously developed areas, which would result in negligible impacts during O&M activities. Under the Proposed Action, impacts of the SRWF to scenic and visual resources would be **major** adverse.

Cumulative Impacts of the Proposed Action

BOEM anticipates that the cumulative impacts on scenic and visual resources in the GAA would be **major** adverse. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a detectable increment to the presence of structures, lighting, traffic, land disturbance, port utilization, and accidental releases. The Proposed Action would contribute to the cumulative impacts through changes in seascape character units, ocean character units, landscape character units, and viewer experience.

3.22.6 Alternative C-1 - Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions

Alternative C-1 was developed to potentially reduce impacts to fisheries habitat within the Lease Area by removing 8 WTGs from Priority Areas 1, 2, 3, and/or 4. Under Alternative C, the 11-MW WTGs and OCS-DC would occur within the range of design parameters outlined in the COP.

3.22.6.1 Construction and Installation

3.22.6.1.1 Onshore Activities and Facilities

Impacts of Alternative C-1 to scenic and visual resources during construction activities would be similar to those described under the Proposed Action.

3.22.6.1.2 Offshore Activities and Facilities

Impacts of Alternative C-1 to scenic and visual resources during construction activities would be similar to those described under the Proposed Action.

3.22.6.2 Operations and Maintenance

Impacts of Alternative C-1 to scenic and visual resources from vessel traffic, accidental releases, and land disturbance would be anticipated to be similar to those described under the Proposed Action. However, there are anticipated differences in impacts from presence of structures and lighting. These impacts are discussed below.

3.22.6.2.1 Onshore Activities and Facilities

Impacts of Alternative C-1 to scenic and visual resources from O&M activities of onshore facilities would be similar to those described under the Proposed Action.

3.22.6.2.2 Offshore Activities and Facilities

Under Alternative C-1, 8 11-MW WTG positions would be removed from Priority Areas 1, 2, 3, and/or 4. Under Alternative C-1, the same number of WTGs, 94 11-MW WTGs would be installed, the same as under the Proposed Action. The different locations of the WTGs and associated lighting could have increased visibility from different KOPs. Viewers located closer to the eastern side of the Lease Area would have slightly greater impacts to visual and scenic resources, as WTGs would be closer to those coastal communities. These negligible changes in distance would be unnoticeable to the casual viewer at this distance, and would not have noticeable differences in form, line, color, or texture contrasts to seascape unit character, open ocean unit character, landscape unit character, or onshore or offshore viewer experience as compared to the Proposed Action.

3.22.6.3 Conceptual Decommissioning

3.22.6.3.1 Onshore Activities and Facilities

Impacts of Alternative C-1 to scenic and visual during decommissioning activities would be similar to those described under the Proposed Action.

3.22.6.3.2 Offshore Activities and Facilities

Impacts of Alternative C-1 to scenic and visual during decommissioning activities would be similar to those described under the Proposed Action.

3.22.6.4 Cumulative Impacts of Alternative C-1

The cumulative impacts on scenic and visual resources would be negligible to major adverse because the seascape character unit, ocean character unit, landscape character unit, and viewer experience would be impacted through the primary IPFs of lighting, presence of structures, traffic, land disturbance, port utilization, and accidental releases. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-1 to the cumulative impacts would be similar to those described under the Proposed Action.

3.22.6.5 Conclusions

Impacts of Alternative C-1

Under Alternative C-1, the seascape character units, ocean character unit, landscape character units, and viewer experience would have similar **major** adverse impacts to those of the Proposed Action. The negligible changes in distance of the WTGs relocation would be unnoticeable to the casual viewer and impacts to scenic and visual resources would be similar.

Cumulative Impacts of Alternative C-1

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-1 to the cumulative impacts on scenic and visual resources would be detectable. However, the differences in impacts among the Proposed Action and Alternative C-1 would be negligible. BOEM anticipates that the cumulative impacts of Alternative C-1 would be **major** adverse.

3.22.7 Alternative C-2 - Reduced Layout from Priority Areas via Exclusion of up to 8 WTG Positions and Relocation of up to 12 WTG Positions to the Eastern Side of the Lease Area

Alternative C-2 was developed to potentially reduce impacts to fisheries habitat within the Lease Area by removing up to 8 WTGs from Priority Areas 1, 2, 3, and/or 4 and relocating up to an additional 12 WTGs to currently unoccupied positions along the eastern side of the Lease Area. Under Alternative C-2, the 11-MW WTGs and OCS-DC would occur within the range of design parameters outlined in the COP.

3.22.7.1 Construction and Installation

3.22.7.1.1 Onshore Activities and Facilities

Impacts of Alternative C-2 to scenic and visual resources during construction activities would be similar to those described under the Proposed Action.

3.22.7.1.2 Offshore Activities and Facilities

Impacts of Alternative C-2 to scenic and visual resources from vessel traffic, accidental releases, and land disturbance would be anticipated to be similar to those described under the Proposed Action. However, there are anticipated differences in impacts from presence of structures and lighting. These impacts are discussed below.

3.22.7.2 Operations and Maintenance

3.22.7.2.1 Onshore Activities and Facilities

Impacts of Alternative C-2 to scenic and visual resources from O&M activities of onshore facilities would be similar to those described under the Proposed Action.

3.22.7.2.2 Offshore Activities and Facilities

Under Alternative C-2, up to 20 11-MW WTGs would be removed from Priority Areas 1, 2, 3, and/or 4 (up to 8 removed and 12 relocated). Up to 12 WTGs would be relocated to currently unoccupied positions along the eastern side of the Lease Area. Under Alternative C-2, the same number of WTGs, 94 11-MW WTGs would be installed, the same as under the Proposed Action. The different locations of the WTGs and associated lighting could have increased visibility from different KOPs. Viewers located closer to the eastern side of the Lease Area would have slightly greater impacts to visual and scenic resources, as WTGs would be closer to those coastal communities. For those shoreline viewers northeast of the Lease Area, the distance to the nearest WTG would decrease under Alternative C-2 when compared to the Proposed Action. Coastal communities located north, and northwest of the Lease Area could have slightly less impacts to scenic and visual resources, as the WTGs would be located farther away from those coastal communities. These negligible changes in distance would be unnoticeable to the casual viewer at this distance, and would not have noticeable differences in form, line, color, or texture contrasts to seascape unit character, open ocean unit character, landscape unit character, or onshore or offshore viewer experience as compared to the Proposed Action.

3.22.7.3 Conceptual Decommissioning

3.22.7.3.1 Onshore Activities and Facilities

Impacts of Alternative C-2 to scenic and visual during decommissioning activities would be similar to those described under the Proposed Action.

3.22.7.3.2 Offshore Activities and Facilities

Under Alternative C-2, the seascape character units, open ocean character unit, landscape character units, and viewer experience would have similar negligible to major adverse impacts to those of the Proposed Action. The negligible chances in distance of the WTGs would be unnoticeable to the casual viewer at the distance and impacts to scenic and visual resources would be similar.

3.22.7.4 Cumulative Impacts of Alternative C-2

The cumulative impacts on scenic and visual resources would be negligible to major adverse because the seascape character unit, ocean character unit, landscape character unit, and viewer experience would be impacted through the primary IPFs of lighting, presence of structures, traffic, land disturbance, port utilization, and accidental releases. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-2 to the cumulative impacts would be similar to those described under the Proposed Action.

3.22.7.5 Conclusions

Impacts of Alternative C-2

Under Alternative C-2, the seascape character units, ocean character unit, landscape character units, and viewer experience would have similar **major** adverse impacts to those of the Proposed Action. The negligible changes in distance of the WTGs relocation would be unnoticeable to the casual viewer and impacts to scenic and visual resources would be similar.

Cumulative Impacts of Alternative C-2

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-2 to the cumulative impacts on scenic and visual resources would be detectable. However, the differences in impacts among the Proposed Action and Alternative C-2 would be negligible. BOEM anticipates that the cumulative impacts of Alternative C-2 would be **major** adverse.

3.22.8 Alternative C-3 - Reduced Layout from Priority Areas Considering Feasibility Due to Glauconite Sands

Under the Fisheries Habitat Impact Minimization Alternative C-3, the construction, O&M, and eventual decommissioning of the 11-MW WTGs and an OCS within the proposed Project Area and associated inter-array and export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, Alternative C-3 was developed to address concerns regarding pile refusal due to glauconite sands in the southeastern portion of the Lease Area while still minimizing impacts to benthic and fisheries resources. Alternative C-3a, C-3b, and C-3c described in Section 3.7.8, *Benthic Resources*, consider different WTG configurations to avoid sensitive habitats and engineering constraints while still meeting the NYSERDA OREC. This alternative only considered removal of WTGs from Priority Area 1 based on consultation with NMFS. Areas with high density of boulder, complex habitat, and data suggesting Atlantic cod aggregation and spawning was considered when determining which WTGs to remove.

3.22.8.1 Construction and Installation

3.22.8.1.1 Onshore Activities and Facilities

Impacts of Alternative C-3a, C-3b, and C-3c to scenic and visual resources during construction activities would be similar to those described under the Proposed Action.

3.22.8.1.2 Offshore Activities and Facilities

Impacts of Alternative C-3a, C-3b, and C-3c to scenic and visual resources from vessel traffic, accidental releases, and land disturbance would be anticipated to be similar to those described under the Proposed Action. However, there are anticipated differences in impacts from presence of structures and lighting. These impacts are discussed in Section 3.22.8.2.2.

3.22.8.2 Operations and Maintenance

3.22.8.2.1 Onshore Activities and Facilities

Impacts of Alternative C-3a, C-3b, and C-3c to scenic and visual resources from O&M activities of onshore facilities would be similar to those described under the Proposed Action.

3.22.8.2.2 Offshore Activities and Facilities

Under Alternative C-3a, up to 87 11-MW WTGs would be installed in the 87 potential positions. The lower eastern portion of the Lease Area would not be developed due to presence of glauconite sands which may result in pile refusal. Alternative C-3a would consider development of the northeastern portion of the Lease Area and WTG No. 154. There would be fewer WTGs installed than considered under the Proposed Action (7 less WTGs), which could result in overall slightly reduced impacts to scenic and visual resources, as compared to the Proposed Action. These changes would be negligible to the casual viewer, and would not have noticeable differences in line, form, color, or texture contrasts to seascape unit character, open unit ocean character, landscape unit character, or onshore or offshore viewer experience as compared to the Proposed Action.

Under Alternative C-3b, up to 84 WTGs would be installed in the 87 potential positions. The lower eastern portion of the Lease Area would not be developed due to the presence of glauconite sands. This alternative considers development in the northeastern portion of the Lease Area and WTG No. 154, which is not considered under the Proposed Action. There would be fewer WTGs installed than considered under the Proposed Action (10 less WTGs), which could result in slightly reduced impacts to scenic and visual resources, but the overall change in impact would be negligible. These changes would be negligible to the casual viewer at this distance, and would not have noticeable differences in line, form, color, or texture contrasts to seascape unit character, open unit ocean character, landscape unit character, or onshore or offshore viewer experience as compared to the Proposed Action.

Under Alternative C-3c, 80 WTGs would be installed in the 87 potential positions. The lower eastern portion of the Lease Area would not be developed due to presence of glauconite sands. This alternative considers development of the northeastern portion of the Lease Area and WTG No. 154, which is not considered under the Proposed Action. There would be fewer WTGs installed than considered under the Proposed Action (14 less 11-MW WTGs), which could result in slightly reduced impacts to scenic and visual resources, but the overall change in impact would be negligible. These changes would be negligible to the casual viewer at this distance, and would not have noticeable differences in line, form, color, or texture contrasts to seascape unit character, open unit ocean character, landscape unit character, or onshore or offshore viewer experience as compared to the Proposed Action.

3.22.8.3 Conceptual Decommissioning

3.22.8.3.1 Onshore Activities and Facilities

Impacts of Alternative C-3a, C-3b, and C-3c to scenic and visual during decommissioning activities would be similar to those described under the Proposed Action.

3.22.8.3.2 Offshore Activities and Facilities

Under Alternative C-3a,C-3b, and C-3c , the seascape character units, open ocean character unit, landscape character units, and viewer experience would have similar negligible to major adverse impacts to those of the Proposed Action. The negligible chances in distance of the WTGs would be unnoticeable to the casual viewer at the distance and impacts to scenic and visual resources would be similar.

3.22.8.4 Cumulative Impacts of Alternative C-2

The cumulative impacts on scenic and visual resources would be negligible to major adverse because the seascape character unit, ocean character unit, landscape character unit, and viewer experience would be impacted through the primary IPFs of lighting, presence of structures, traffic, land disturbance, port utilization, and accidental releases. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-3a, C-3b, and C-3c to the cumulative impacts would be similar to those described under the Proposed Action.

3.22.8.5 Conclusions

Impacts of Alternative C-3a, C-3b, and C-3c

Under Alternative C-3a, C-3b, and C-3c, the seascape character units, ocean character unit, landscape character units, and viewer experience would have similar **major** adverse impacts to those of the Proposed Action. The negligible changes in distance of the WTGs relocation and reduction of total WTGs installed would be unnoticeable to the casual viewer and impacts to scenic and visual resources would be similar.

Cumulative Impacts of Alternative C-3a, C-3b, and C-3c

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-3a, C-3b, and C-3c to the cumulative impacts on scenic and visual resources would be detectable. However, the differences in impacts among the Proposed Action and Alternative C-3a, C-3b, and C-3c would be negligible. BOEM anticipates that the cumulative impacts of Alternative C-3a, C-3b, C-3c would be **major** adverse.

3.22.9 Comparison of Alternatives

Construction, O&M, and decommissioning of Alternatives B, C-1, C-2, and C-3 would have the same overall negligible to major adverse impacts on scenic and visual resources. Table 3.22-14 provides an overall summary of alternative impacts.

Table 3.22-14. Comparison of Impacts on Scenic and Visual Resources

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
No Action Alternative: Under the No Action Alternative scenic and visual resources would continue to be affected by current regional trends and would change in response to other ongoing activities. The No Action Alternative would result in **moderate** adverse impacts on scenic and visual resources. *Cumulative Impacts of the No Action Alternative:* BOEM anticipates that the cumulative impacts of the No Action Alternative would result in **major** adverse impacts on visual and scenic resources within the GAA due to the presence of new structures, nighttime lighting, land disturbance, and increased traffic.	*Proposed Action:* Under the Proposed Action, impacts of the SRWF to scenic and visual resources would be **major** adverse. The presence of offshore WTGs and OCS-DC would result in moderate to major adverse impacts to the seascape character and landscape character. Onshore structures would be located either underground or in previously developed areas, which would result in negligible impacts during O&M activities. *Cumulative Impacts of the Proposed Action:* BOEM anticipates that the cumulative impacts on scenic and visual resources in the GAA would be **major** adverse. In context of reasonably foreseeable environmental trends, the Proposed	*Alternative C-1:* Under Alternative C-1, the seascape character units, ocean character unit, landscape character units, and viewer experience would have similar **major** adverse impacts to those of the Proposed Action. The negligible changes in distance of the WTGs would be unnoticeable to the casual viewer at the distance and impacts to scenic and visual resources would be similar. *Cumulative Impacts of Alternative C-1:* In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-1 to the cumulative impacts on scenic and visual resources would be detectable. However, the differences in impacts among the	*Alternative C-2:* Under Alternative C-2, the seascape character units, ocean character unit, landscape character units, and viewer experience would have similar **major** adverse impacts to those of the Proposed Action. The negligible changes in distance of the WTGs would be unnoticeable to the casual viewer at the distance and impacts to scenic and visual resources would be similar. *Cumulative Impacts of Alternative C-2:* In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-2 to the cumulative impacts on scenic and visual resources would be detectable. However, the differences in impacts among the	*Alternative C-3:* Under Alternative C-3, the seascape character units, open ocean character unit, landscape character units, and viewer experience would have similar **major** adverse impacts to those of the Proposed Action. The negligible changes in distance of the WTGs and total number of WTGs installed would be unnoticeable to the casual viewer at the distance and impacts to scenic and visual resources would be similar. *Cumulative Impacts of Alternative C-3:* In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-3 to the cumulative impacts on scenic and visual resources would be detectable. However, the differences in the

No Action Alternative (Alternative A)	Proposed Action (Alternative B)	Fisheries Habitat Minimization (Alternative C-1)	Fisheries Habitat Minimization (Alternative C-2)	Fisheries Habitat Minimization Considering Feasibility due to Glauconite Sands (Alternative C-3)
	Action would contribute a detectable increment to the presence of structures, lighting, traffic, land disturbance, port utilization, and accidental releases. The Proposed Action would contribute to the cumulative impacts through changes in seascape character units, ocean character units, landscape character units, and viewer experience.	Proposed Action and Alternative C-1 would be negligible. BOEM anticipates that the cumulative impacts of Alternative C-1 would be **major** adverse.	Proposed Action and Alternative C-2 would be negligible. BOEM anticipates that the cumulative impacts of Alternative C-2 would be **major** adverse.	impacts among the Proposed Action and Alternative C-3 would be negligible. BOEM anticipates that the cumulative impacts of Alternative C-3 would be **major** adverse.

3.22.10 Summary of Impacts of the Preferred Alternative

BOEM has identified Alternative C-3b as the Preferred Alternative as depicted in Figure 2.1-10. Alternative C-3b would include installation of up to 84 WTGs, which is 10 fewer WTGs than the maximum WTGs proposed under the PDE of the Proposed Action. The installation of WTGs and other facilities associated with the SRWF would result in changes to the existing seascape character. The seascape character units, open ocean character unit, landscape character units, and viewer experience would have negligible to major adverse impacts.

3.22.11 Proposed Mitigation Measures

The mitigation measures listed in Table 3.22-15 are recommended for inclusion in the Preferred Alternative.

Table 3.22-15. Proposed Mitigation Measures: Scenic and Visual Resources

Measure	Description	Effect
Monitoring	In coordination with BOEM, Sunrise Wind is to prepare and implement a scenic and visual resource monitoring plan that monitors and compares the visual effects of the wind farm during construction and operations/maintenance (daytime and nighttime) to the findings in the COP Visual Impact Assessment and verifies the accuracy of the visual simulations (photo and video). The monitoring plan should include monitoring and documenting meteorological influences on actual wind turbine visibility over a duration of time from selected onshore key observation points, as determined by BOEM and the developer. In addition, the developer needs to include monitoring the operation of ADLS in the monitoring plan. The developer needs to monitor the frequency that the ADLS is operative documenting when (dates and times) the aviation warning lights are in the on position and the duration of each event. Details for monitoring and reporting procedures are to be included in the plan.	This measure would not modify the impact determination for scenic and visual resources but would provide the information necessary to ensure these effects do not exceed the levels analyzed herein.
Onshore Transmission	Sunrise Wind shall consider selecting a transmission tower type that has the least amount of visual contrast within the predominate setting where the transmission line is routed.	This measure would minimize the visual contrast between the project components and the setting where the transmission line would be routed.
Tower Visual Contrast Mitigation	Monopoles typically have a less visual contrast within built environments whereas lattice towers typically have less visual contrast in more natural settings. Consider color-treating the transmission tower to reduce visual contrast darker grays (chemically treated galvanized finishes), or powder-coated with Bureau of Land Management	This measure would help minimize the visual contrast of the transmission tower with it surroundings.

Measure	Description	Effect
	Environmental Color Covert Green or Shadow Gray, or other if these colors do not accomplish the purpose. Bureau of Land Management color samples may be acquired by email to blm_oc_pmds@blm.gov	
Onshore Overhead Transmission Conductors Visual Contrast Mitigation	Consider using non-specular conductors for overhead transmission powerlines to avoid glare commonly associated with untreated conductors.	This measure would help minimize glare.
Onshore Overhead Transmission Line Insulator Visual Contrast Mitigation	Consider using polymer insulators to minimize glare commonly associated glass insulators. Use polymer insulators that are a color that minimizes visual contrast with the surrounding setting. Consider using Bureau of Land Management Environmental Color Covert Green or Shadow Gray, or Sudan Brown, or other options if these colors do not accomplish the purpose.	This measure would help minimize the visual contrast of the onshore overhead transmission line insulator with the surrounding setting.
Onshore Facility Security Fencing Visual Contrast Mitigation	When using galvanized and other types of security fencing, consider treating the fencing to eliminate glare and minimize visual contrast with the surrounding setting. Methods include vinyl-coating, powder-coating, and oxidizing treatments. Colors should be dark grays, black, or dark brown (oxidizing treatments only).	This measure would minimize the visual contrast of the security fencing with the surrounding setting.
Onshore Facility Lighting	Consider incorporating night lighting principles and best management practices that avoid light pollution from artificial light needed for nighttime operations and security at onshore facilities (e.g., operational and maintenance facilities, substations), as described in the Bureau of Land Management's Technical Note 457 at https://www.blm.gov/sites/default/files/docs/2023-05/IB2023-038_att1.pdf.	This measure would reduce light pollution.
Onshore Substation visual contrast mitigation	Sunrise Wind shall consider treating all substation facilities with the same color and select a color that minimizes visual contrast within the surrounding setting and as viewed from outside of the site. Consider using Bureau of Land Management Environmental Color Covert Green or Shadow Gray, or other options if these colors do not accomplish the purpose. Bureau of Land Management color samples may be acquired by email to blm_oc_pmds@blm.gov	This measure would help minimize the visual contrast of the substation facilities with the surrounding setting.

3.22.11.1 Effect of Measures Incorporated into the Preferred Alternative

The mitigation measures listed in Table 3.22-15 are recommended for inclusion in the Preferred Alternative. The proposed mitigation measures would help minimize the visual contrast between the proposed Project facilities and actions included in the Preferred Alternative and the surrounding environment. These measures, if adopted, would have the effect of reducing the impacts as compared to the Proposed Action; however, the anticipated range of impact levels would remain from negligible to major overall for the Preferred Alternative.

Chapter 4

Other Required Impact Analyses

4.0 OTHER REQUIRED IMPACT ANALYSES

4.1 Unavoidable Adverse Impacts of the Proposed Action

Table 4.1-1 summarizes unavoidable adverse impacts for each analyzed resource, subject to applicable EPMs (refer to Appendix H). However, it does not include potential additional mitigation measures that could avoid or further minimize or mitigate Project impacts. Please see the individual resource discussions in Chapter 3 for detailed analyses.

Table 4.1-1. Potential Unavoidable Adverse Impacts of the Proposed Action

Resource Area	Potential, Unavoidable Adverse Impact of the Proposed Action
Air quality	Impacts from emissions from engines associated with vessel traffic, construction activities, and equipment operation.
Water quality	Increase in erosion, turbidity and sediment resuspension, and inadvertent spills during construction and installation, O&M, and decommissioning.
Bats	Displacement and avoidance behavior due to habitat loss and alteration, equipment noise, and vessel traffic. Individual mortality due to collisions with operating WTGs.
Benthic resources	Habitat quality impacts including reduction in habitat as a result of seafloor surface alterations. Conversion of soft-bottom habitat to new hard-bottom habitat.
Birds	Displacement and avoidance behavior due to habitat loss and alteration, equipment noise, and vessel traffic. Individual mortality due to collisions with operating WTGs.
Coastal habitats and fauna	Displacement and avoidance behavior from habitat loss and alteration and from equipment noise. Individual mortality from collisions with vehicles or construction equipment. Short-term habitat alteration and increased invasive species risk.
Finfish, invertebrates, and Essential Fish Habitat	Increase in suspended sediments and resulting effects due to seafloor disturbance. Displacement, disturbance, and avoidance behavior due to habitat loss and alteration, equipment noise, vessel traffic, increased turbidity, sediment deposition, and electromagnetic fields. Individual mortality due to construction and installation, O&M, and conceptual decommissioning.
Marine mammals	Displacement, disturbance, and avoidance behavior due to habitat loss and alteration, equipment noise, vessel traffic, increased turbidity, and sediment deposition during construction and installation and O&M. Short-term loss of acoustic habitat and increased potential for vessel strikes.
Sea turtles	Disturbance, displacement, and avoidance behavior due to habitat loss and alteration, equipment noise, vessel traffic, increased turbidity, sediment deposition, and EMFs.

Resource Area	Potential, Unavoidable Adverse Impact of the Proposed Action
Wetlands and other WOTUS	Increase in soil erosion, sedimentation, and discharges and releases from land disturbance during construction and installation, O&M, and decommissioning.
Commercial fisheries and for-hire recreation fishing	Disruption to access or short-term restriction in port access or harvesting activities due to construction of offshore Project elements. Disruption to harvesting activities during operations of offshore wind facility. Changes in vessel transit and fishing operation patterns. Changes in risk of gear entanglement or target species.
Cultural resources	Impacts to unidentified or undefined submerged marine resources from Project construction and installation, O&M, and decommissioning. Impacts to terrestrial cultural resources and to the viewshed from Project construction, installation, and O&M. Visual impacts to onshore cultural resources.
Demographics, employment, and economics	Disruption of commercial fishing, for-hire recreational fishing, and marine recreational business during offshore construction and cable installation. Hindrances to ocean economy sectors due to the presence of the offshore wind facility, including commercial fishing, recreational fishing, sailing, sightseeing, and supporting businesses
Environmental justice	Changes to air quality, water quality, land use and coastal infrastructure, and commercial fisheries and for-hire recreational fishing that are disproportionately borne by minority or low-income populations from Project construction and installation, O&M, and decommissioning.
Land use and coastal infrastructure	Land use disturbance due to construction as well as effects due to noise, vibration, and travel delays.
Navigation and vessel traffic	Changes in vessel transit patterns. Increased navigational complexity and allision risk within the offshore wind farm area.
Other marine uses	Changes in access to marine mineral resources, and cable placement. Disruption of scientific surveys, radar systems, military, and aviation traffic.
Recreation and tourism	Disruption of coastal recreation activities during onshore construction. Viewshed effects from the WTGs altering enjoyment of marine and coastal recreation and tourism activities. Disruption to access or short-term restriction of in-water recreational activities from construction of offshore Project elements. Hindrances to some types of recreational fishing from the WTGs during operation.
Scenic and visual resources	Change in scenic quality of landscape and seascape.

4.2 Irreversible and Irretrievable Commitment of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time, such as the short-term loss of timber productivity in forested areas that are kept clear for a power line or a road. Table 4.2-1 summarizes irreversible or irretrievable effects for each analyzed resource, subject to applicable EPMs. Table 4.2-1 does not include potential additional mitigation measures that could avoid or further minimize or mitigate Project impacts. Chapter 3 provides a detailed discussion of effects associated with the Project.

Table 4.2-1. **Irreversible and Irretrievable Commitment of Resources by Resource Area**

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Air quality	No	No	BOEM expects air emissions to be compliant with permits regulating air quality standards, and emissions would be short-term during construction activities. If the Proposed Action displaces fossil-fuel energy generation, overall improvement of air quality would be expected.
Water quality	No	No	BOEM does not expect activities to cause loss of major impacts on existing inland waterbodies or wetlands. Turbidity and other water quality impacts in the marine and coastal environment would be short-term, with the rare exception of a major spill.
Bats	No	No	Irreversible impacts on bats could occur if one or more individuals were injured or killed; however, implementation of mitigation measures developed in consultation with the U.S. Fish and Wildlife Service (USFWS) would reduce or eliminate the potential for such impacts. Decommissioning of the Project would reverse the impacts of bat displacement from foraging habitat.
Benthic resources	No	No	Although local mortality of benthic fauna and habitat alteration could occur, BOEM does not anticipate population-level impacts. The Project could alter habitat during construction and operations but could restore the habitat after decommissioning.
Birds	No	No	Irreversible impacts on birds could occur if one or more individuals were injured or killed; however, implementation of mitigation measures developed in consultation with the USFWS would reduce or eliminate the potential for such impacts. Decommissioning of the Project would reverse the impacts of bird displacement from foraging habitat.
Coastal habitat and fauna	No	No	Although local mortality could occur, BOEM does not anticipate population-level impacts on other coastal habitats or fauna. The Project could alter habitat during construction and operations but could restore the habitat after decommissioning.
Finfish, invertebrates, and essential fish habitat	No	No	Although local mortality of finfish and invertebrates could occur, and habitat alteration could occur, BOEM does not anticipate population-level impacts. It is expected that the aquatic habitat for finfish and invertebrates would recover or be restored following decommissioning activities.
Marine mammals	No	Yes	Irreversible impacts on marine mammals could occur if one or more individuals of species listed under the ESA were injured or killed; however, mitigation measures would reduce or eliminate the potential for such impacts on listed species. Irretrievable impacts could occur if individuals or populations grow more slowly as a result of displacement from the Lease Area.
Sea turtles	No	Yes	Irreversible impacts on sea turtles could occur if one or more individuals of species listed under the ESA were injured or killed; however, mitigation measures would reduce or eliminate the potential for impacts on listed species. Irretrievable impacts

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
			could occur if individuals or populations grown more slowly as a result of displacement from the Lease Area.
Wetlands and other waters of the United States (WOTUS)	No	No	BOEM does not expect activities to cause loss of or major impacts on existing wetlands or other WOTUS.
Commercial fisheries and for-hire recreation fishing	No	Yes	Based on the anticipated duration of construction, installation, and O&M, BOEM does not anticipate impacts on commercial fisheries to result in irreversible impacts. The Project could alter habitat during construction and operations, limit access to fishing areas during construction, or reduce vessel maneuverability during operations. However, decommissioning of the Project would reverse those impacts. Irretrievable impacts (lost revenue) could occur due to the loss of use of fishing areas at an individual level.
Cultural resources	Yes	Yes	Although unlikely, unanticipated removal or disturbance of previously unidentified cultural resources onshore and offshore could result in irreversible or irretrievable impacts.
Demographics, employment, and economics	No	No	Based on the anticipated duration of construction, installation, and O&M, BOEM does not anticipate that contractor needs, housing needs, and supply requirements would lead to an irretrievable loss of workers for other projects or increase housing and supply costs.
Environmental justice	No	No	Potential EJ impacts, if any, would be short-term and localized.
Land use and coastal infrastructure	Yes	Yes	Land use required for construction and operation activities could result in a minor irreversible impact. Construction activities could result in a minor irretrievable impact due to the short-term loss of use of the land for otherwise typical activities. Onshore facilities may or may not be decommissioned.
Navigation and vessel traffic	No	Yes	Based on the anticipated duration of construction, installation, and O&M, BOEM does not anticipate impacts on vessel traffic to result in irreversible impacts. Irretrievable impacts could occur due to changes in transit routes, which could be less efficient during the life of the Project.
Other marine uses	No	No	BOEM does not anticipate the potential impacts to be irreversible; however, disruption of offshore scientific research and surveys would occur during proposed Project construction, operations, and decommissioning activities.
Recreation and tourism	No	No	Construction activities near the shore could result in a minor to moderate, short-term loss of use of the land for recreation and tourism purposes, but these impacts would not be irreversible or irretrievable.
Scenic and visual resources	No	Yes	Viewshed changes would persist for the life of the Project, until decommissioning is complete.

4.3 Relationship between the Short-term Use of Man's Environment and the Maintenance and Enhancement of Long-term Productivity

CEQ's NEPA implementing regulations (40 CFR 1502.16) require that an EIS address the relationship between short-term use of the environment and the potential impacts of such use on the maintenance and enhancement of long-term productivity. Such impacts could occur as a result of a reduction in the flexibility to pursue other options in the future, or assignment of a specific area (land or marine) or resource to a certain use that would not allow other uses, particularly beneficial uses, to occur at a later date. An important consideration when analyzing such effects is whether the short-term environmental effects of the action would result in detrimental effects to long-term productivity of the affected areas or resources.

As assessed in Chapter 3, BOEM anticipates that most of the potential adverse effects associated with the Proposed Action would occur during construction activities and would be short-term and minor to moderate in severity/intensity. Table 4.1-1 and Table 4.2-1 identify unavoidable, irretrievable, or irreversible impacts that would be associated with the Project. However, BOEM expects most of the marine and onshore environments to return to normal long-term productivity levels after Project decommissioning. Based on the findings, BOEM anticipates that the Proposed Action would not result in impacts that would significantly narrow the range of future uses of the environment.

Additionally, the Project would provide several long-term benefits:

- Promotion of clean and safe development of domestic energy sources and clean energy job creation;
- Promotion of renewable energy to help ensure geopolitical security; combat climate change; and provide electricity that is affordable, reliable, safe, secure, and clean;
- Delivery of power to the New York grid, to contribute to the state's renewable energy requirements; and
- Increased habitat for certain fish species.

U.S. Department of the Interior (USDOI)

The DOI protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors the Nation’s trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

Bureau of Ocean Energy Management (BOEM)

BOEM’s mission is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.

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