Ocean Wind 1 Offshore Wind Farm Essential Fish Habitat Assessment

For National Marine Fisheries Service

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

BOEM
Bureau of Ocean Energy Management

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ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
ALARP	As Low As Reasonably Practicable
APM	applicant-proposed measure
aRPD	apparent redox potential discontinuity
BOEM	Bureau of Ocean Energy Management
BRUV	baited remote underwater video
CFE	controlled-flow excavation
CFR	Code of Federal Regulations
CHIRP	compressed high intensity radiated pulses
cm	centimeter
CMECS	Coastal and Marine Ecological Classification Standard
COP	Construction and Operations Plan
dB	decibels
DO	dissolved oxygen
eDNA	environmental DNA
EFH	essential fish habitat
EMF	electromagnetic field
EPM	environmental protection measure
ESA	Endangered Species Act
F/V	fishing vessel
FLiDAR	Floating Light Detecting and Ranging
FMP	fishery management plan
FRMP	Fisheries Research Monitoring Plan
HAPC	habitat area of particular concern
HDD	horizontal directional drilling
HRG	high-resolution geophysical
Hz	hertz
IECRC	Inshore Export Cable Route Corridor
kJ	kilojoule
km	kilometer
km^2	square kilometer
kV	kilovolt
$L_{E,24h}$	cumulative injury distance
L_{pk}	peak sound pressure level
MAFMC	Mid-Atlantic Fishery Management Council
MBES	multibeam echosounder
MEC	munitions and explosives of concern
mG	milligauss
mg/L	milligrams per liter
MLLW	mean lower low water

Abbreviation	Definition
mm	millimeters
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
mV/m	millivolts per meter
NEFMC	New England Fishery Management Council
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
nm	nautical miles
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWI	National Wetlands Inventory
O&M	operations and maintenance
Ocean Wind	Ocean Wind, LLC, an affiliate of Ørsted Wind Power North America LLC
OCS	Outer Continental Shelf
OECRC	Offshore Export Cable Route Corridor
OSS	offshore substation
PAM	passive acoustic monitoring
ppt	parts per thousand
Project	Ocean Wind Offshore Wind Farm; *also* Proposed Action
Proposed Action	Ocean Wind Offshore Wind Farm; *also* Project
PSU	practical salinity units
R/V	research vessel
RARMS	Risk Assessment with Risk Mitigation Strategy
ROV	remotely operated vehicle
SAV	submerged aquatic vegetation
SPI/PV	sediment profile imaging/plan view
SPL	sound pressure level
SPL_{RMS}	root-mean-square sound pressure level
TJB	transition junction bay
TSS	total suspended sediment
TTS	temporary threshold shift
USACE	U.S. Army Corps of Engineers
USC	United States Code
UXO	unexploded ordinance
WFA	Wind Farm Area
WTG	wind turbine generator

1. Introduction

The Energy Policy Act of 2005, Public Law No. 109-58, added Section 8(p)(1)(C) to the Outer Continental Shelf Lands Act, which grants the Secretary of the Interior the authority to issue leases, easements, or rights-of-way on the Outer Continental Shelf (OCS) for the purpose of renewable energy development (43 United States Code [USC] § 1337(p)(1)(C)). The Secretary delegated this authority to the former Minerals Management Service, now the Bureau of Ocean Energy Management (BOEM). On April 22, 2009, BOEM (formerly the Bureau of Ocean Energy Management, Regulation, and Enforcement) promulgated final regulations implementing this authority at 30 Code of Federal Regulations (CFR) § 585.

This essential fish habitat (EFH) assessment has been prepared pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), as amended by the Sustainable Fisheries Act of 2007 (16 USC 1801-1884) to evaluate the potential effects of the Ocean Wind Offshore Wind Farm (Project or Proposed Action) described herein on EFH and EFH species under the jurisdiction of the National Marine Fisheries Service (NMFS). The MSFCMA requires a federal agency to consult with NMFS on activities it authorizes, funds, or undertakes that may adversely affect EFH and EFH species.

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 USC § 1802(10). NMFS further clarified the terms associated with EFH (50 CFR 600.05-600.930 and 600.910) by the following definitions:

- Waters – Aquatic areas and their associated physical, chemical, and biological properties that are used by fish and, where appropriate, may include aquatic areas historically used by fish;
- Substrate – Sediments, hard bottoms, structures underlying the waters, and associated biological communities;
- Necessary – The habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and
- Adverse effects – may include direct or indirect physical, chemical, or biological alterations of the waters or substrate, as well as the loss of and/or injury to benthic organisms, prey species, their habitat, and other ecosystem components. Adverse effects may be site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

BOEM completed an environmental assessment and EFH consultation on the issuance of leases for wind resource data collection on the OCS offshore within the New Jersey, Delaware, Maryland, and Virginia Wind Energy Areas in 2012 and on associated site characterization and site assessment activities that could occur on those lease areas, including the Lease Area for the Project. The New Jersey Wind Energy Area comprises 43 whole and 26 partial lease blocks (Figure 1-1). A site assessment plan was submitted by Ocean Wind LLC for site assessment studies of the Lease Area. BOEM transmitted its determinations regarding impacts to essential fish habitat to the NMFS on October 17, 2017. On October 19, 2017, NMFS concurred with BOEM that activities proposed in the site assessment plan were within the scope of the effects considered in the EFH consultation for the 2012 Environmental Assessment. Given that no sensitive habitats were affected, and the Project effects were short-term and localized, impacts to EFH were expected to be minimal. As a result, NMFS did not provide any additional EFH conservation recommendations for the site assessment plan, and none were required.

Ocean Wind, LLC, an affiliate of Ørsted Wind Power North America LLC, (Ocean Wind) submitted the Construction and Operation Plan (COP) for the Project, including the Wind Farm Area (WFA), Offshore Export Cable Route Corridor (OECRC), and Inshore Export Cable Route Corridor (IECRC), to BOEM for review and approval. The most recent submittal is dated June 2022 and is consistent with the requirements of 30 CFR 585.620 to 585.638. COP submittal occurs after BOEM grants a lease for the Project and Ocean Wind completes all studies and surveys defined in their site assessment plan. This EFH assessment relies on the most current information available for the Project.

BOEM has responsibility as the lead federal agency to initiate an EFH consultation in compliance with the MSFCMA prior to approval, approval with conditions, or disapproval of the COP for the Project. This report describes the Project and presents an assessment of the potential for the proposed construction, operation and maintenance, and conceptual decommissioning of the Project to adversely affect EFH and managed species.

BOEM is consulting on the proposed COP for the Project, as well as other permits and approvals from other agencies that are associated with the approval of the COP. BOEM is the lead federal agency for purposes of the EFH consultation. Other co-action agencies include the Bureau of Safety and Environmental Enforcement, and the U.S. Army Corps of Engineers (USACE). The USACE will adopt this EFH assessment for impacts resulting from the Proposed Action that are relevant to USACE permitting actions under Section 10 of the Rivers and Harbors Act of 1899 (33 USC § 403) and Section 404 of the Clean Water Act (33 USC § 1344),

This EFH assessment provides a comprehensive description of the Proposed Action, defines the Project Area, describes EFH and EFH species potentially affected by the Proposed Action, and provides an analysis and determination of how the Proposed Action may affect EFH and EFH species. The activities being considered include approving the COP for the construction, operation, maintenance, and conceptual decommissioning of the proposed Project, which is an offshore wind energy facility on the OCS offshore of New Jersey. A separate EFH consultation will be conducted for Project decommissioning.

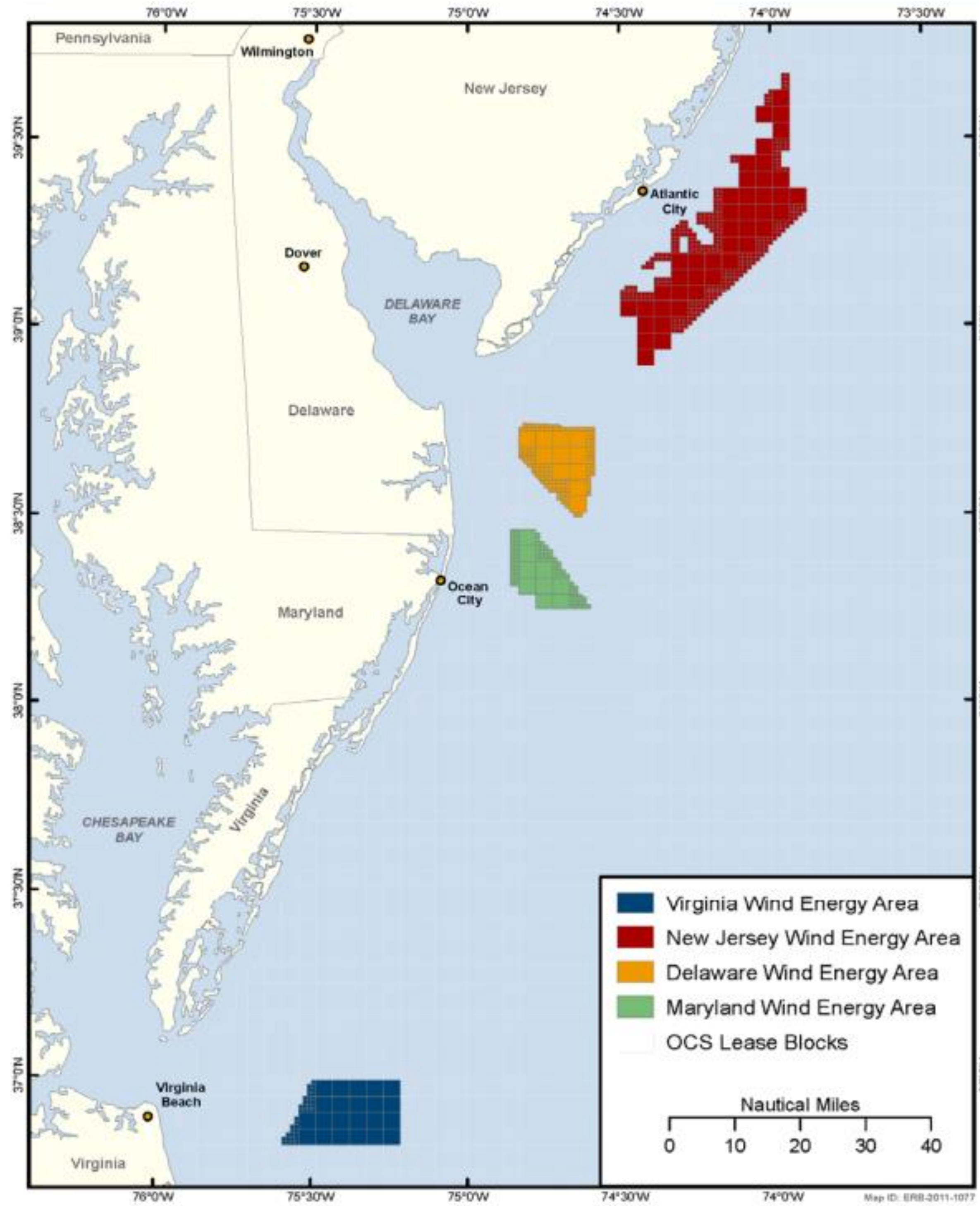

Figure 1-1 New Jersey, Delaware, Maryland, and Virginia Refined Wind Energy Areas

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2. Description of the Proposed Action

BOEM is evaluating the potential environmental effects of approval of the COP for the Project by Ocean Wind. The Proposed Action would allow Ocean Wind to construct, operate, maintain, and eventually decommission a wind energy facility approximately 1,100 megawatts in scale on the OCS offshore New Jersey (Ocean Wind 2022a). The Project would include up to 98 wind turbine generators (WTGs), up to three offshore substations (OSSs), inter-array cables linking the individual wind turbines and OSS, offshore export cable routes, onshore cable landfall sites, onshore cable routes, and two onshore substation locations. The onshore substation would connect to the existing electrical grid in New Jersey at BL England and Oyster Creek. Construction of an onshore operations and maintenance (O&M) facility is considered a separate action and is undergoing permitting through the USACE, Philadelphia District.

2.1 Project Area

The proposed Project area is located in and off of the southern tip of New Jersey 15 miles (13 nautical miles [nm], 24.1 kilometers [km]) southeast of Atlantic City, New Jersey, within BOEM Renewable Energy Lease Area OCS-A 0498 (Lease Area) (Figure 2-1). The Project area comprises the WFA, OECRC, and IECRC, which would be constructed in ocean habitats in the New Jersey Wind Energy Area on the Atlantic Ocean OCS offshore of New Jersey, adjacent state waters, and tidal wetlands and coastal inshore habitats of Barnegat Bay and Great Egg Harbor Bay in southern New Jersey. The proposed offshore Project elements would be located on the OCS, as defined in the Outer Continental Shelf Lands Act, with the exception of a portion of the export cables within state waters (Figure 2-1).

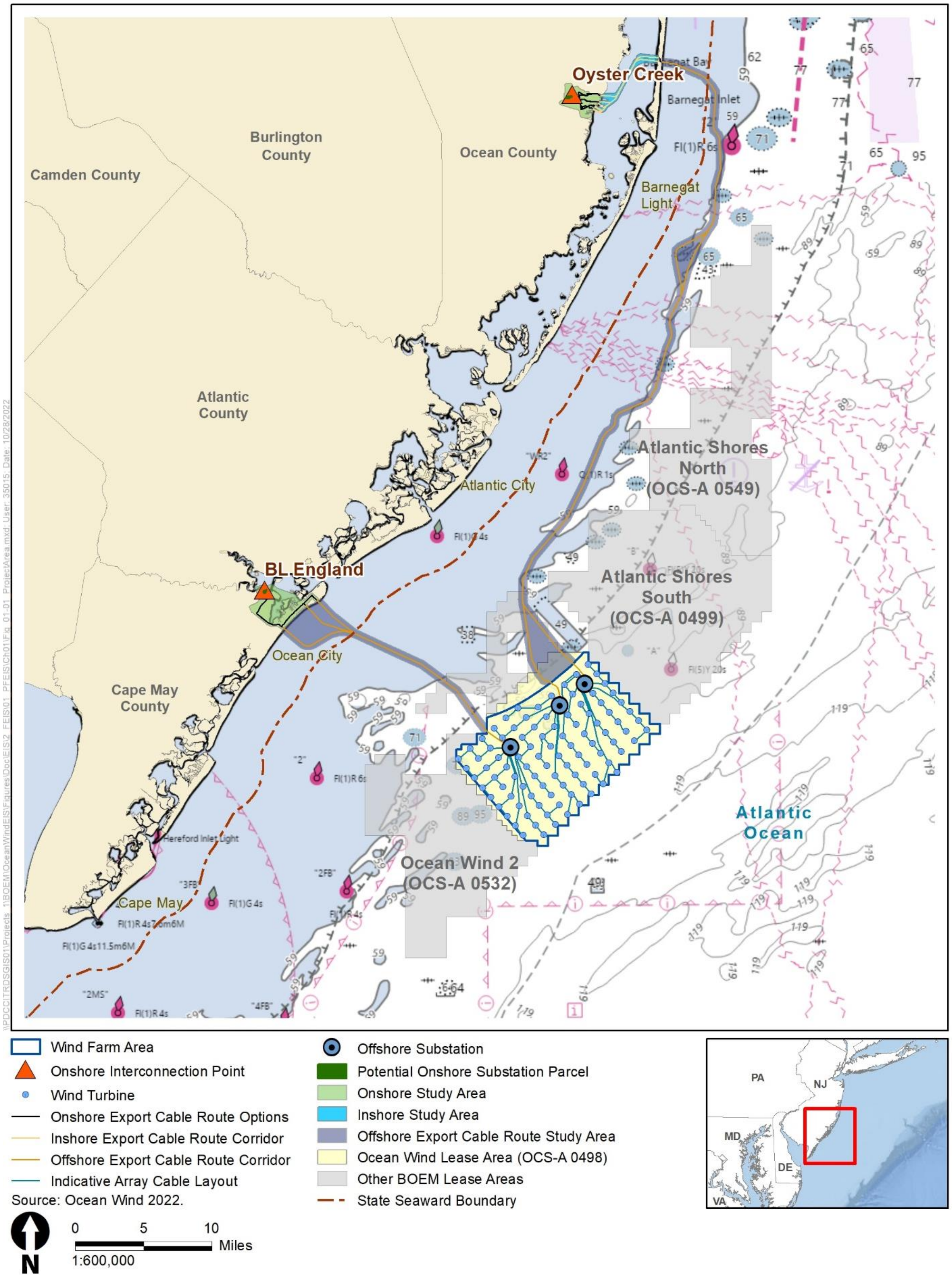


Figure 2-1 Ocean Wind Project Area

2.2 Construction and Installation

The Proposed Action would be the construction and installation of up to 98 WTGs and their foundations, up to three OSSs and their foundations, scour protection for foundations, inter-array and substation interconnection cables, and offshore export cables (these elements collectively compose the Offshore Project area). Discussion of all proposed alternative layouts are included in Section 6.2 as alternative Project designs that could avoid or minimize impacts.

The Project would involve temporary construction laydown areas and ports utilized by construction vessels; however, the primary ports that are expected to be used during construction have independent utility and are not solely dedicated to the Project. Project specific construction is not anticipated at any of these locations. The O&M facility would be located be in Atlantic City, New Jersey and serve multiple Ørsted Wind Power North America LLC, projects in the Mid-Atlantic, and is not considered part of the Project action.

Construction and installation activities required for the Project are discussed in this Section. Dredging activities would be required for the Project and are discussed in Section 2.2.2.2 Seabed Preparation, 5.1.2.3 Trenching/Cable Installation, and Section 5.2.2.4 Clam Surveys. Material from the Ocean Wind 1 dredging of the federal channel in Barnegat Bay would be transferred to an upland disposal facility via a pipeline system, barge, or scow and disposed of in conformance with U.S. Environmental Protection Agency guidelines, USACE Guidelines New Jersey Administrative Code (NJAC) 7:7 Appendix G for the Management and Regulation of Dredging Activities and Dredged Material in New Jersey's Tidal Waters and applicable State Surface Water Quality Standards at NJAC 7:9B and permit conditions. Dewatering methods would be determined after contractor and equipment selection is complete.

The Project's export cables would include offshore (OECRC), inshore (IECRC), and onshore segments, Figure 2-1. The OECRC would be located in federal waters and consists of two OECRCs proposed by Ocean Wind in the COP: Oyster Creek and BL England (Ocean Wind 2022a). The IECRC would be located within Barnegat Bay (New Jersey state territorial waters); upon entering Barnegat Bay from Island Beach State Park, the IECRC route would cross Barnegat Bay southwest to make landfall in either Lacey or Ocean Township. Entering and exiting the bay would be accomplished with open cut trenching or horizontal directional drilling (HDD). Dredging may be required in shallow areas in Barnegat Bay to facilitate vessel access for cable installation. Up to three offshore export cables would be buried under the seabed floor within the Oyster Creek OECRC/IECRC and BL England OECRC to connect the proposed wind energy facility to the onshore electrical grid, up to two cables in the Oyster Creek route, and one cable in the BL England route. Installing the cables would be by simultaneous lay and burial (plow/jetting/cutting) or surface lay and burial by a cable burial vessel (jetting/cutting/control flow excavation). The export cables have a target burial depth of 4 to 6 feet (1.2 to 1.8 meters) below the stable seabed. Each offshore export cable would consist of three-core 275 kV alternating current cables. Site preparation activities (i.e., boulder relocation, sandwave clearance, and unexploded ordinance [UXO] mitigation) for cable laying are discussed in Section 2.2.2.2. Trenching and cable installation methodologies for the OECRC and IECRC are discussed in Section 2.2.2.3. Installation of cable protection, as required, is discussed in Section 2.2.2.4.

There are two proposed onshore routes, which would terminate at the Oyster Creek and BL England substation sites. The Oyster Creek IECRC would make landfall on the mainland and then the onshore cable segment would extend to an existing interconnection point at the Oyster Creek substation in Lacey Township, Ocean County, New Jersey. The BL England cable landfall would be located in Ocean City, New Jersey, and the onshore cable segment would extend from the landfall connection across Great Egg Harbor Bay to an interconnection at the BL England substation in Upper Township, Cape May County, New Jersey.

The Project action includes two major components, the turbines and the export cables. These components are differentiated in the Project description and effects analysis where appropriate to clarify the potential impacts of the action on EFH. Preliminary layout is available; however, the final design of these components is currently in development and is being evaluated as part of the Environmental Impact Statement (EIS). Table 2-1 outlines the details for each project component and any options being considered for the design, construction, and installation of that component.

Table 2-1 Summary of Ocean Wind 1 WFA, OECRC, and IECRC Construction and O&M Effect Mechanisms by Project Component

Project Component	Design Element	Effect Mechanism	Measurement Parameter	Component	Effect Measurement	Options (if applicable
WFA construction	Turbine selection/ spacing	Installation disturbance area	WTG size	-	37 ft (11 m)	-
			Number of turbines	-	Up to 98	-
			Rotor hub height above mean lower low water	-	512 ft (156 m)	-
			Spacing	-	1.15 linear miles by 0.92 linear miles (1.85 km by 1.48 km, 1 nautical mile [nm] by 0.8 nm)	-
			Array area	-	68,450 acres (27,700.73 hectares)	-
	Foundation installation	Habitat alteration, physical disturbance	Number of piles	37-foot (11-meter) WTG monopiles;	Up to 98 (1 per WTG)	-
				OSS	Up to 3	Monopiles, 3 per OSS = 9 Jacketed pile, 16 per OSS, total = 48
			Footprint area total (with scour protection)	37-foot (11-meter) monopile	0.60 acres (0.24 hectares) per monopile	-
			Installation method	37-foot (11-meter monopile)	5,000 kJ impact hammer normal: 50 strikes/minute 4 hours total per foundation	-
				Jacketed pile	2,500-kJ hammer, 4 hrs per foundation	-
			Underwater noise (approximate)	All	250 dB_{peak} re: 1 µPa2/Hz/m @ 10 meters, 30-60 Hz frequency band	-
	Inter-array cable construction	Physical disturbance, turbidity, entrainment	Total length	All	190 linear miles (305.77 km, 165.10 nm)[1]	-
			Installation method	All	Cable trenching/burial 4- to 6-feet (1.2- to 1.8-meter) depth	-
			Short-term disturbance	All	1,410.67 acres (570.88 hectares)[2]	-
			Long-term habitat conversion (exposed cable protection)	All	24 acres (9.71 hectares)[3]	-
	Construction vessels	Physical disturbance, noise	Number of vessels	All	Up to 61 simultaneous wind turbine vessels during turbine foundation installation Up to 38 simultaneous wind turbine vessels during structure installation Up to 17 vessels for each substation installation Up to 18 simultaneous vessels during array cable installation	-
			Vessel noise	All	SPL 150 to 180 dB re 1 µPa for dynamically positioned vessels (BOEM 2014), SPL 177 to 188 dB re 1 µPa for large shipping vessels (McKenna et al. 2012), duration of construction	-
WFA operation	-	Operational electromagnetic field (EMF) (Inter-array cable)	Transmission voltage	-	170 kV maximum voltage	-
			Magnetic field	All	Buried cable at seabed, 0.2 milligauss (mG) at 515 Ampere (A) Exposed cable at seabed, 12.2 mG at 515 A	-

[1] Maximum estimated total length of inter-array cables (Ocean Wind 2022a).
[2] Inter-array cable installation and seabed preparation calculated using an 82.02-foot (25-meter) width (Inspire 2022a).
[3] Inter-array cable protection calculated using a 9.81-foot (2.99-meter) total width (Inspire 2022a).

Project Component	Design Element	Effect Mechanism	Measurement Parameter	Component	Effect Measurement	Options (if applicable
OECRC and IECRC	Export cable construction	Installation disturbance area	Total length	Oyster Creek route (OECRC)	OSS A to IBSP (1 cable) (55.5 linear miles [89.32 km, 48.23 nm]) OSS B to IBSP (1 cable) (56.4 linear miles [90.77 km, 49.01 nm]) Substation interconnector cable (2 cables) (19 linear miles [30.58 km, 16.51 nm])	-
				Oyster Creek route (IECRC)	See effect measurement by option.	• The Farm/Holtec to Base Case (2 cables) (11.40 linear miles [18.35 km, 9.91 nm]) • The Farm/Holtec to Prior Channel (2 cables) (11.64 linear miles [18.74 km, 10.12 nm]) • Bay Parkway One Shot to Base Case (1 cable) (5.82 linear miles [9.36 km, 5.05 nm]) • Bay Parkway One Shot to Prior Channel (1 cable) (5.93 linear miles [9.55 km, 5.16 nm]) • Bay Parkway to Base Case (2 cables) (12.23 linear miles [19.69 km, 10.63 nm]) • Bay Parkway to Prior Channel (2 cables) (12.46 linear miles [20.05 km, 10.83 nm]) • Nautilus Road to Base Case (1 cable) (6.42 linear miles [10.33 km, 5.58 nm]) • Nautilus Road to Prior Channel (1 cable) (6.54 linear miles [10.52 km, 5.68 nm]) • Lighthouse Drive to Base Case (1 cable) (6.46 linear miles [10.39 km, 5.72 nm]) • Lighthouse Drive to Prior Channel (1 cable) (6.58 linear miles [10.59 km, 5.72 nm]) • Marina to Base Case (2 cables) (13.17 linear miles [21.20 km, 11.45 nm]) • Marina to Prior Channel (2 cables) (13.41 linear miles [21.58 km, 11.65 nm])
				BL England route (OECRC)	See effect measurement by option.	• OSS C to 5th Street (1 cable) (18.15 linear miles [29.21 km, 15.77 nm]) • OSS C to 13th Street (1 cable) (18.71 linear miles [30.11 km, 16.26 nm]) • OSS C to 35th Street (1 cable) (20.48 linear miles [32.96 km, 17.80 nm])
			Installation method	All	Cable trenching/burial, 4- to 6-foot (1.2- to 1.8-meter) target depth	-

Project Component	Design Element	Effect Mechanism	Measurement Parameter	Component	Effect Measurement	Options (if applicable
			Short-term disturbance area (cable installation, seafloor preparation, and anchoring)	Oyster Creek route (OECRC)	1,115.53 acres (451.44 hectares)	-
				Oyster Creek route (IECRC)	See effect measurement by option.	• The Farm/Holtec to Base Case (2 cables) (113.06 acres [45.75 hectares]) • The Farm/Holtec to Prior Channel (2 cables) (101.11 acres [40.92 hectares]) • Bay Parkway One Shot to Base Case (1 cable) (57.45 acres [23.25 hectares]) • Bay Parkway One Shot to Prior Channel (1 cable) (51.60 acres [20.88 hectares]) • Bay Parkway to Base Case (2 cables) (120.75 acres [48.87 hectares]) • Bay Parkway to Prior Channel (2 cables) (108.80 acres [44.03 hectares]) • Nautilus Road to Base Case (1 cable) (63.44 acres [25.67 hectares]) • Nautilus Road to Prior Channel (1 cable) (57.59 acres [23.3 hectares]) • Lighthouse Drive to Base Case (1 cable) (63.82 acres [25.83 hectares]) • Lighthouse Drive to Prior Channel (1 cable) (58.29 acres [23.59 hectares]) • Marina to Base Case (2 cables) (130.18 acres [52.68 hectares]) • Marina to Prior Channel (2 cables) (118.23 acres [47.85 hectares])
				BL England route (OECRC)	See effect measurement by option.	• OSS C to 5th Street (1 cable) (178.82 acres [72.37 hectares]) • OSS C to 13th Street (1 cable) (183.53 acres [74.27 hectares]) • OSS C to 35th Street (1 cable) (200.36 acres [81.08 hectares])
			Area exposed to sedimentation > 4mm	All	Up to 328 feet (100 meters) from cable trench	-
			Long-term habitat alteration	Oyster Creek route (OECRC)	133.46 acres (54.01 hectares) of potential impact anticipated from cable protection	-
				Oyster Creek route (IECRC)	See effect measurement by option for potential impact anticipated from cable protection	The Farm/Holtec to Base Case (2 cables) (13.51 acres [5.47 hectares]) The Farm/Holtec to Prior Channel (2 cables) (12.11 acres [4.90 hectares]) Bay Parkway One Shot to Base Case (1 cable) (6.87 acres [2.78 hectares]) Bay Parkway One Shot to Prior Channel (1 cable) (6.14 acres [2.48 hectares]) Bay Parkway to Base Case (2 cables) (14.44 acres [5.84 hectares]) Bay Parkway to Prior Channel (2 cables) (13.05 acres [5.28 hectares]) Nautilus Road to Base Case (1 cable) (7.59 acres [3.07 hectares]) Nautilus Road to Prior Channel (1 cable) (6.85 acres [2.77 hectares]) Lighthouse Drive to Base Case (1 cable) (7.63 acres [3.09 hectares]) Lighthouse Drive to Prior Channel (1 cable) (6.97 acres [2.82 hectares]) Marina to Base Case (2 cables) (15.57 acres [6.3 hectares]) Marina to Prior Channel (2 cables) (14.17 acres [5.73 hectares])

Project Component	Design Element	Effect Mechanism	Measurement Parameter	Component	Effect Measurement	Options (if applicable
				BL England route (OECRC)	See effect measurement by option for potential impact anticipated from cable protection	OSS C to 5th Street (1 cable) (21.38 acres [8.65 hectares]) OSS C to 13th Street (1 cable) (21.95 acres [8.88 hectares]) OSS C to 35th Street (1 cable) (23.96 acres [9.70 hectares])
		Federal channel dredging	Short-term disturbance area	Oyster Creek route (IECRC)	3.7 acres (1.50 hectares)	Hydraulic cutterhead dredge Closed-clamshell dredge
		Vessel traffic	Number of vessels	All	26 vessels	-
			Vessel noise	All	SPL 150 to 180 dB re 1 µPa for dynamically positioned vessels (BOEM 2014), SPL 177 to 188 dB re 1 µPa for large shipping vessels (McKenna et al. 2012), duration of construction	-
	Sea-to-shore transition construction	Cofferdam installation/ removal or sheet piling for temporary shoring	Cofferdam footprint	Oyster Creek route (OECRC)	27.76 acre (11.23 hectares) of short-term disturbance for the Oyster Creek route at the IBSP transition	-
				Oyster Creek route (IECRC)	See effect measurement by option for short-term disturbance for the Oyster Creek route at the IBSP transition	The Farm/Holtec to Base Case (2 cables) (25.80 acres [10.44 hectares]) Bay Parkway One Shot to Base Case (1 cable) (49.04 acres [19.84 hectares]) Bay Parkway One Shot to Prior Channel (1 cable) (23.23 acres [9.4 hectares]) Bay Parkway to Base Case (2 cables) (52.86 acres [21.39 hectares]) Bay Parkway to Prior Channel (2 cables) (27.06 acres [10.95 hectares]) Nautilus Road to Base Case (1 cable) (49.03 acres [19.84 hectares]) Nautilus Road to Prior Channel (1 cable) (23.23 acres [9.4 hectares]) Lighthouse Drive to Base Case (1 cable) (49.03 acres [19.84 hectares]) Lighthouse Drive to Prior Channel (1 cable) (23.22 acres [9.4 hectares]) Marina to Base Case (2 cables) (54.36 acres [22.0 hectares]) Marina to Prior Channel (2 cables) (28.56 acres [11.56 hectares])
				BL England route (OECRC)	See effect measurement by option for short-term disturbance for the BL England route	OSS C to 5th Street (1 cable) (23.20 acres [9.39 hectares]) OSS C to 13th Street (1 cable) (23.20 acres [9.39 hectares]) OSS C to 35th Street (1 cable) (23.20 acres [9.39 hectares])
	Onshore Cable Corridor	Installation Disturbance Area	Tidal Wetlands Short-term Disturbance	Oyster Creek	7.35 acres (NWI Estuarine and Marine Wetland)	-
				BL England	0.49 acres (NWI Estuarine and Marine Wetland)	-
			Tidal Wetlands Permanent Habitat Alteration	Oyster Creek	0 acres	-
				BL England	0 acres	-
	Operation and maintenance	Operational EMF	Transmission voltage	-	275 kV maximum voltage	-
			EMF generation	All	Buried cable at seabed, 10 mG at 1,032 A Exposed cable at seabed, 137 mG at 1,032 A	-

Onshore export cables would be buried and housed within a single duct bank buried along the onshore export cable route. The duct bank would include six conduits for the power cables, two conduits for fiber optic communications cables, and two conduits for ground continuity conductors. Installation of onshore export cable would require up to a 50-foot- (15-meter-) wide construction corridor and up to a 30-foot- (9-meter-) wide permanent easement for the Oyster Creek and BL England cable corridors, excluding landfall locations and cable splice locations.

The Proposed Action would include the construction and installation of both onshore and offshore facilities. For the purposes of this EFH assessment, distinct areas of the proposed Project include the WFA, OECRC, IECRC, and onshore cable route, including the waters of the Atlantic Ocean, Barnegat Bay and Great Egg Harbor Bay, and vegetated wetlands. Components included in these areas are the WTGs (including foundations and scour protection), OSSs (including foundations and scour protection), inter-array cables (including scour protection), OSS cables, offshore export cables (including scour protection), cable landing sites, and onshore export cables. Construction and installation would begin in 2023 and be completed in 2025. Ocean Wind anticipates beginning land-based construction before the offshore components. An approximate Project schedule is shown in Table 2-2.

Table 2-2 Project Schedule

Event	Schedule
Onshore Export Cables and Onshore Substations	• Q3 of 2023 to Q1 of 2025
Landfall Cable Installation	• Q4 of 2023 to Q4 of 2024
Offshore Export Cable Installation	• Q2 of 2024 to Q4 of 2024
Offshore Foundations (WTG and Offshore Substation)	• Q2 of 2024 to Q4 of 2024
Inter-array Cable Installation	• Q3 of 2024 to Q2 of 2025
WTG and Offshore Substation Installation and Commissioning	• Q3 of 2024 to Q4 of 2025
Federal Channel Dredging	• Q4 of 2023

WTG = wind turbine generator

2.2.1 Installation of WTG/OSS Structures and Foundations

Proposed offshore Project components include WTGs and their foundations, OSSs and their foundations, scour protection for foundations, inter-array cables, and offshore export cables (these elements collectively compose the Offshore Project area). The proposed offshore Project elements are on the OCS as defined in the Outer Continental Shelf Lands Act, with the exception of a portion of the export cables within state waters (Figure 2-1).

Ocean Wind proposes the installation of up to 98 WTGs extending up to 906 feet (276 meters) above mean lower low water (MLLW). Turbines are oriented in a southeast-northwest direction within the 68,450-acre (277 square kilometers [km^2]) WFA with 10 open corridors in between of varying width. Corridor width between turbines (southwest-northeast orientation) varies depending on location within the array from 1.15 to 1.31 miles (1 to 1.13 nm, 1.9 to 2.1 km between WTGs. Southeast-northwest spacing between the turbines is 0.9 miles (0.8 nm) throughout the WFA. Ocean Wind would mount the WTGs on monopile foundations. The WTG foundations would have a maximum seabed penetration of 164 feet (50 meters). The tapered monopiles for WTG foundations would be 11 meters (37 feet) in diameter at the seabed and 8 meters (26 feet) in diameter at the sea surface (Ocean Wind 2022a); however, since publication of the COP, Project development has carried forward a monopile with a maximum outer diameter of 11 meters (37 feet; Ocean Wind 2022c). A monopile foundation typically consists of a single steel tubular section, consisting of sections of rolled steel plate welded together. A transition piece is fitted over the monopile and secured via bolts or grout. OSSs would be placed on either monopile or piled jacket foundations. Piled jacket foundations are formed of a steel lattice construction, composed of tubular steel members and welded joints, and secured to the seabed by hollow steel pin piles attached to each of the jacket feet. Where required, scour protection would be placed around foundations to stabilize the seabed near the foundations as well as the foundations themselves. Each WTG would contain up to 1,585 gallons (6,000 liters) of transformer oil and 146 gallons (553 liters) of general oil (for hydraulics and gearboxes). Use of other chemicals would include diesel fuel (793 gallons), coolants/refrigerants (405 gallons), grease (187 gallons), and sulfur hexafluoride (243 pounds). OSSs would hold up to 79,252 gallons of transformer oil and 52,834 gallons of diesel fuel, 4,950 pounds of sulfur hexafluoride and 317 gallons of hydraulic oil.

2.2.1.1 Vessel Activity

The construction and installation phase of the proposed Project would make use of both construction and support vessels to complete tasks in the WFA. During installation of array and substation interconnection cables, Ocean Wind anticipates a maximum of 20 vessels operating during a typical workday in the WFA. Many vessels would remain in the WFA and along the export cable route for days to weeks at a time, potentially only making infrequent trips to port for bunkering and provisioning as needed. Construction vessels would travel between the WFA and the following ports that are expected to be used during construction: Atlantic City, New Jersey as a construction management base; Paulsboro New Jersey or from Europe directly for foundation fabrication and load out; Norfolk, Virginia or Hope Creek New Jersey for WTG pre-assembly and load out; and Port Elizabeth, New Jersey or Charleston, South Carolina, or directly from Europe for cable staging. Construction activities would result in increased vessel traffic. Global industry practices, such as temporary laydown areas and construction safety zones, would be followed during construction within the WFA.

Ocean Wind would install foundations and WTGs using up to two jack-up vessels, as well as necessary support vessels and barges. Where installation vessels are not used to transport the turbines to the installation site, dedicated transport, feeder barges, or jack-ups would be used for transport. In addition, support vessels may be used including crew boats, hotel vessels, tugs, and other miscellaneous support vessels if needed (e.g., security vessels). Where turbine installation and commissioning are occurring in the same area, up to eight vessels may be working simultaneously in 1.9 square miles (4.9 km^2) (Ocean Wind 2022a).

Each substation is expected to require two primary installation vessels. Primary vessels may include self-propelled jack-up vessels, jack-up barges (towed by tugs), sheerleg barges (either self-propelled or towed by tugs), or heavy-lift vessels. Up to 12 support vessels may be required, including up to six tugboats, one dedicated leveling/dredging vessel, up to two crew boats, and up to two guard boats. In addition, transport vessels may be required. Alternatively, foundations and topsides could be transported on the installation vessel (Ocean Wind 2022a).

Impacts during construction could include the following:

- Although the WFA is within low vessel traffic areas, some vessels may need to alter routes when navigating near construction zones within WFA.
- Construction would require vessel traffic to coastal areas, corridors between land and WFA and within WFA.
- During construction, vessels would require anchoring and spudding which could impact benthic environments. The Benthic Monitoring Plan, as discussed in Section 2.5.3, was developed in accordance with guidelines outlined by BOEM (2013) and identifies sensitive habitats, hard-bottom habitat, and soft sediments. During construction, anchoring within sensitive habitats would be avoided or minimized to prevent significant impacts, as discussed in Section 6.

2.2.1.2 Pile Driving

Each WTG would require one monopile and each OSS would require 3 monopiles or 16 vertical pin piles (vertical pin pile installation method discussed below). Pile driving of monopiles would use an IHC-4000 or IHC S-2500 kilojoule (kJ) hammer until the target embedment depth is met. The tapered monopiles for WTG foundations would be 11 meters (37 feet) in diameter at the seabed and 8 meters (26 feet) in diameter at the sea surface (Ocean Wind 2022a). Installation of monopiles is expected to take up to 4 hours per pile, and a maximum of two piles may be installed per day. Pile driving operations would occur during the daytime but could extend to nighttime hours if pile driving was started during daylight. After the seabed has been prepared for foundations, Ocean Wind would begin pile driving until the target embedment depth is met. Installation of monopile and piled jacket foundations are similar, although piled jacket foundations would require more seabed preparation for each of the jacket feet.

OSSs are generally installed in two phases: first, the foundation substructure would be installed in a similar method to that described above, then the topside structure would be installed on the foundation structure. Ocean Wind would construct up to three OSSs to collect the electricity generated by the offshore turbines. OSSs would consist of a topside structure with one or more decks on either a monopile or piled jacket foundation. Three additional monopiles the same size as the WTG monopiles, or a jacket foundation composed of 16 2.44-meter diameter vertical pin piles (48 total for the three OSSs), could be installed for OSS foundations. Installation of OSS monopiles would be consistent with the WTG monopiles described above. Jacket foundation pin piles would be installed using an IHC S-2500 kJ hammer, or similar. A maximum of three pin piles would be installed per day and it is expected that pin piles would take up to 4 hours each to install. The installation of all pin piles would take up to six days. The final OSS foundation will be selected and associated design specifications will be determined by the final engineering design process, informed by factors including seabed conditions, wave and tidal conditions, Project economics, and procurement approach. Detailed information on the foundation selected will be included in the facility design report/fabrication and installation report, to be reviewed by the Certified Verification Agent and submitted to BOEM prior to construction.

OSSs help stabilize and maximize the voltage of power generated offshore, reduce potential electrical losses, and transmit energy to shore. Array cables would transfer electrical energy generated by the WTGs to the OSS. OSSs would include step-up transformers and other electrical equipment needed to connect the 66-kilovolt (kV) inter-array cables to the 275 kV or 220 kV offshore export cables. Substations would be connected to one another via substation interconnector cables. Up to two interconnector cables with a maximum voltage of 275 kV would be buried beneath the seabed floor.

Pile installation for WTG and OSS foundations would occur intermittently from May through December depending on protected species time-of-year restrictions, weather, and other potential delays and logistical constraints, and is anticipated to be completed within a one-year period. Pile installation for WTGs and OSSs would not occur from January 1 through April 30 to avoid disturbance to North Atlantic right whales. Pile installation would occur intermittently during the daily work periods, with durations of minutes to hours at a time. It is anticipated that monopile installation would occur within a 52- to 116-day period, dependent upon efficiency of foundation installation.

2.2.1.3 Seabed Preparation/Boulder Relocation

Seabed preparation and boulder relocation activities are discussed in Section 2.2.2.2.

2.2.1.4 Installation of Scour Protection

Scour protection is used to protect the offshore foundations from erosion of the seabed. Where required, scour protection would be placed around foundations to stabilize the seabed near the foundations, as well as the foundations themselves. The scour protection would be a maximum of 8.2 feet (2.5 meters) in height, would extend away from the foundation as far as 73.5 feet (22.4 meters), and would have a volume of 7,764 cubic yards (6,619 cubic meters) per monopile.

Several types of scour protection for monopiles exist, including rock placement, mattress protection, sand bags, and stone bags; rock placement is the most frequently used solution. Scour protection for may be placed pre- and/or post-installation of the foundations. Methods of installation may include side stone dumping, fall pipe, or crane placement. Rock placement scour protection may comprise a rock armor layer resting on a filter layer. The filter layer can either be installed before the foundation is installed (preinstalled) or afterward (post-installed). Alternatively, by using heavier rock material with a wider gradation, it is possible to avoid using a filter layer and pre- or post-install a single layer of scour protection. The need for and amount of scour protection required would vary for the different foundation types being considered and based on the local site conditions.

2.2.2 Inter-Array and Offshore/Inshore Cable Installation

The Project includes two OECRCs: Oyster Creek and BL England. Installation of the approximately 618 km (384 miles) of in-water transmission cables would be installed in two phases: a simultaneous lay and bury phase at a speed of 1.9 miles (3 km) per day (125 meters per hour [410 feet per hour]) and a post-lay burial phase at a speed of 9.6 km (6.0 miles) per day (400 meters per hour [1,312 feet per hour]), weather depending. The simultaneous lay and bury phase speed is less than the post-lay burial speed due to the requirement for the vessel to stop and perform anchor resets. Total installation of in-water cables is anticipated to occur over 386 days. Up to two offshore export cables would be buried under the seabed within the Oyster Creek OECRC to make landfall and deliver electrical power to the Oyster Creek substation. The OECRC to Oyster Creek would begin within the WFA and proceed northwest to the Atlantic Ocean side of Island Beach State Park with a maximum total length of 143 miles (230 km). It is anticipated that approximately 0.8 miles (1.3 km) of cable would be installed per day over a total of 179 days for the Oyster Creek offshore export cable. The IECRC to Oyster Creek would exit west into the bay side of Island Beach State Park before entering Barnegat Bay. Upon entering Barnegat Bay, the export cable route would run west within a previously dredged channel. A second route corridor option would extend directly across Island Beach State Park. Both options would cross Barnegat Bay southwest to make landfall near Oyster Creek in either Lacey or Ocean Township. One offshore export cable would be buried under the seabed within the BL England OECRC to make landfall and deliver electrical power to the BL England substation. The BL England OECRC would begin within the WFA and proceed west to make landfall in Ocean City, New Jersey (Figure 2-1) with a total length ranging from 18.2 miles (29.2 km) to 20.5 miles (33.0 km), depending on the landfall option (Table 2-1). Each offshore export cable would consist of three-core 275 kV alternating current cables. It is anticipated that approximately 1.2 miles (2.0 km) of cable would be installed per day over a total of 26 days for the BL England offshore export cable.

Ocean Wind has proposed several cable installation methods for the array and substation interconnector cables. Array cables may reach a maximum total length of 190 miles (306 km), while cables associated with linking OSSs may reach a maximum cable length of 19 miles (31 km). It is anticipated that approximately 1.7 miles (2.7 km) of array cable would be installed per day over a total of 112 days. It is further anticipated that approximately 1.5 miles (2.4 km) of OSS inter-link cable would be installed per day over a total of 13 days. Site preparation activities for cable laying would include boulder and sandwave clearance and pre-lay grapnel runs. A combination of displacement plow, subsea grab or a backhoe dredger may be used to clear boulders. For dense boulder fields, a displacement plow would most likely be used. A displacement plow is a Y-shaped tool composed of a boulder board attached to a plow. The plow is pulled along the seabed and scrapes the seabed surface pushing boulders out of the cable corridor. The plow is lightly ballasted to clear the corridor of boulders, but not create a deep depression in the seabed. A displacement plow cannot be used in areas where slopes are steep. Multiple passes may be required dependent on the burial tool selected and seabed conditions. Where there are steep slopes, large obstructions occur, or boulder density is low, a subsea grab may be used. In shallower waters, a backhoe dredger may be used. Following boulder clearance, a series of grapnels would be towed along the final cable route to locate and clear remaining obstructions, such as abandoned cables, fishing gear, and marine debris, prior to cable installation (i.e., a pre-lay grapnel run). A pre-lay grapnel run would be undertaken usually no more than two weeks before installation of the cable along a particular route length.

Cables may be laid and buried post-lay using a jetting tool if seabed conditions allow. In this option, cables may remain unburied on the seabed within the WFA for up to 2 weeks. Alternatively, the array cables may be simultaneously laid and buried. In this option, array cables can be installed by using a tool towed behind the installation vessel to simultaneously open the seabed and lay the cable, or by laying the cable and following with a tool to embed the cable. Possible installation methods for these options include jetting, vertical injection, control flow excavation, trenching, and plowing. The array and substation interconnector cables have a target burial depth of 4 to 6 feet (1.2 to 1.8 meters) below the stable seabed, although final burial depth is dependent on a cable burial risk assessment and coordination with agencies. Offshore export cables would typically be buried below the seabed, similarly to the array cables. The installation vessel would transit to and take position at the landfall location and the cable end would be pulled into the preinstalled duct ending in the transition junction bay (TJB). The installation vessel would transit the route toward the OSS, installing the cable by simultaneous lay and burial (plow/jetting/cutting) or surface lay and burial by a cable burial vessel (jetting/cutting/control flow excavation).

Cable landfall where the submarine offshore cable transitions to an onshore cable would be connected to onshore cables at underground TJBs located onshore. Offshore export cables would be installed up to the TJB using open cut (i.e., trenching) or trenchless methods (bore or HDD). The final method to be used, which may vary over the extent of the installation, would be determined during the design and engineering phase, and would be based on an assessment of topography, bathymetry, accessibility, tidal conditions, geotechnical situation, environmental constraints, and other parameters. Sheet piling would be temporarily installed to support open cut trenches and as intertidal cofferdams for HDD exit pits. Open cut installation would entail excavation of up to a 10-foot wide trench that would extend up to approximately 300 feet waterward from the shoreline using a land-based or barge-mounted excavator, positioning and securing the cable, burial and backfill to restore pre-construction contours, and revegetation. Open cut trenching is being considered for landfalls not under the USACE beach nourishment program, including the west side of Island Beach State Park (Prior Channel Route) and the west side of Barnegat Bay at the Farm/Holtec landfall due to elevated risks of inadvertent returns of drilling mud occurring during HDD. Ocean Wind has conducted a hydrofracture evaluation and determined that the required drilling fluid pressure is estimated to be greater than the theoretical strength of the overlying soils for most of the HDD installation, which would suggest high risk of prolonged and repeated drilling fluid losses to surrounding environment.

HDD installation involves excavation of an exit pit, drilling and pumping drilling fluid to create a bore and then pulling conduit into the bore. The export cable is then pulled through the installed conduit. The installation process is supported by a marine work platform and support vessels. Ocean Wind has stated that the design of an HDD’s geometry, including length and depth, is determined through a site-specific analysis that considers thermal load requirements and site-specific conditions (surface and subsurface). Hole stability challenges during HDD construction and potential for inadvertent returns generally increase at shallower depths of cover. As crossing length increases, the annular pressure required to excavate material and circulate drilling fluid back to the designated endpoints also increase. Since cable thermal load requirements limit the depth at which the HDD paths can be configured, increased depth cannot be used to offset increased annular pressure associated with greater length, so the length is also limited to that which allows for an acceptable (i.e., reduced) risk of inadvertent returns between the endpoints (Ocean Wind 2022a).

Post-cable installation restoration activities would include backfill and grading to restore the pre-construction shoreline contours. The recontoured area would be replanted with native wetland vegetation and would be monitored for a minimum of 5 years of post-construction to confirm shoreline stabilization and adequate vegetative cover. In the event that shoreline vegetation does not become re-established or the shoreline is not considered stable, Ocean Wind will evaluate alternative wave attenuation and shoreline protection measures such as temporary booms, geotextiles or other “soft” shoreline stabilization measures and continue monitoring and adaptive management, as needed, until the shoreline is effectively stabilized and vegetation restored (Ocean Wind 2022a).

Dredging may be required in shallow areas in Barnegat Bay to facilitate vessel access for cable installation, including west of Island Beach State Park and near the landfall at Lacey or Ocean Township. Ocean Wind also proposes to dredge Barnegat Inlet and the Oyster Creek Channel within the authorized width and depth, if necessary to allow for safe and reliable passage of construction vessels into Barnegat Bay. The Oyster Creek Federal Channel in Barnegat Bay is part of the Barnegat Inlet Federal Navigation Project, operated and maintained by USACE. Ocean Wind has coordinated with the USACE Philadelphia District regarding current channel conditions and planned maintenance dredging, as USACE maintains the authorized depths within Barnegat Inlet and the Oyster Creek Channel through regular maintenance dredging. Dredging of approximately 18,000 cubic yards within an 3.7-acrea area would be conducted over approximately 4 weeks using a hydraulic cutterhead or closed-clamshell dredge, and dredged material would be transferred to an upland disposal facility via a pipeline system, barge, or scow and disposed of in accordance with EPA Guidelines, USACE Guidelines, N.J.A.C. 7:7 Appendix G for the Management and Regulation of Dredging Activities and Dredged Material in New Jersey’s Tidal Waters, and applicable State Surface Water Quality Standards at N.J.A.C. 7:9B and permit conditions. Ocean Wind currently has an agreement with an upland disposal facility (Clean Earth) and is continuing to evaluate the use of permitted and available confined disposal locations and upload facilities.

The Oyster Creek Channel is 200 feet wide by 8 feet deep (MLLW). The western portion of the channel shoals frequently and is typically dredged every three years depending on funding appropriations (USACE 2020). USACE previously completed maintenance dredging of the Oyster Creek Channel in December 2020 and Spring 2016 (USACE 2016, 2021). Recent surveys indicate some continued shoaling and shifting of the channel (USACE 2022). Maintenance dredging by USACE is currently planned for November 2022 and November 2023 (Monica Chasten, personal communication, October 14, 2022). If USACE does not conduct the regular maintenance dredging as planned or if the Oyster Creek Federal Channel conditions do not provide for the safe and reliable passage of construction vessels into Barnegat Bay, Ocean Wind would dredge those areas of the Oyster Creek Federal Channel within the federally authorized limits of the regularly performed USACE maintenance dredging. Authorization/permission for maintenance dredging of Barnegat Inlet and the Oyster Creek Channel was requested from USACE by Ocean Wind on April 27, 2022, as part of the permit application submitted for the Ocean Wind 1 project; no additional permit for Ocean Wind would be required.

2.2.2.1 Vessel Activity

For offshore export cable installation (OECRC and IECRC), Ocean Wind anticipates a maximum of 26 vessels operating during a typical workday. During construction, installation vessels for array and export cable installation include main laying vessels and burial vessels in addition to support vessels. Main laying and burial vessels could include barges or dynamic positioning, each with three associated anchor handling tugs. Anchoring would occur every 1,640 feet (500 meters), also known as the anchor position spacing. Each main vessel would have up to eight anchors spaced 984 to 1,640 feet (300 to 500 meters) from the vessel. Support vessels would be required, including crew boats, service vessels for pre-rigging foundations with cable, and vessels for divers, pre-lay grapnel run, and post-lay inspection (Ocean Wind 2022a).

For the potential maintenance dredging of the Oyster Creek Federal Channel for vessel access for cable installation, a barge or scow may be used to transport dredge materials, as described above.

2.2.2.2 Seabed Preparation/Boulder Relocation

2.2.2.2.1 Boulder Relocation

There is a potential to encounter boulders during construction and installation of the offshore infrastructure. Boulders pose the following risks:

- Exposed or shallow buried cables that may require post-lay cable protection such as armoring with rock or concrete mattresses;
- Obstruction of cable installation equipment that may lead to failure to reach cable burial depth, equipment damage, and/or delayed cable installation due to multiple installation passes; and
- Risk of damage to cable assets.

The results of high-resolution geophysical (HRG) surveys would be used to determine where boulders occur and to inform decisions regarding micrositing to avoid boulders or which clearance methods would be used. Boulder clearance would take place prior to construction to clear the cable corridor in preparation for trenching and burial operations. A combination of displacement plow, subsea grab or in shallower waters a backhoe dredger may be used to clear boulders and undertake route clearance activities. For dense boulder fields, a displacement plow would most likely be used to clear boulders. A displacement plow is a Y-shaped tool composed of a boulder board attached to a plow. The plow is pulled along the seabed and scrapes the seabed surface pushing boulders out of the cable corridor. The plow is lightly ballasted to clear the corridor of boulders, but not create a deep depression in the seabed. A displacement plow cannot be used in areas where slopes are steep. A displacement plow is not practical where it may encounter large obstacles (force greater than 80 metric tons) that may shift or rotate the tool, causing reduced clearance effectiveness or damage to the tool. Multiple passes may be required dependent on the burial tool selected and seabed conditions (Ocean Wind 2022a).

Where there are steep slopes, large obstructions occur, or boulder density is low, a subsea grab may be used. The subsea grab is an effective way to relocate individual boulders with limited interaction with and disturbance of the seabed. The subsea grab is equipped with a survey and remotely operated vehicle (ROV) spread to assist in subsea positioning of the grab onto a boulder and to record the boulder’s new position. The presence, position, and nature of the boulders would be visually confirmed through ROV inspection. In shallower waters, a backhoe dredger may be used. A backhoe dredger is a type of mechanical excavator mounted on a vessel, pontoon or amphibious vehicle. Backhoe dredgers are widely used in shallow waterways and shores to remove vegetation and undertake targeted route clearance. Results of the geophysical surveys would be used to determine where boulder clearing would be required and to plan which clearing tool to use (Ocean Wind 2022a).

2.2.2.2.2 Sandwave Clearance

Sandwaves are sediment features on the seabed that resemble sand dunes. Cables must be buried at a depth beneath the level where natural sandwave movement would uncover them. In addition, the natural slope of the sandwaves can pose a hazard for installation tools that require a relatively level surface to operate effectively. In some cases, it is necessary to remove the mobile sediments prior to cable installation. Sandwave clearance would be completed as needed within the WFA and along the offshore cable export corridor in advance of cable installation. Sandwave clearance volumes were estimated based on the sandwave height, anticipated cable burial depth, likely installation technique, and required clearance area. Sandwave clearance may be undertaken where cable exposure is predicted over the lifetime of the Project due to seabed mobility. This facilitates cable burial below the reference seabed. Alternatively, sandwave clearance may be undertaken where slopes become greater than approximately 10 degrees (17.6%), which could cause instability to the burial tool. The work could be undertaken by traditional dredging methods such as a trailing suction hopper. Alternatively, controlled-flow excavation (CFE) or a sandwave removal plow could be used. Multiple passes may be required. The method of sandwave clearance would be chosen based on the results from the site investigation surveys and cable design (Ocean Wind 2022a).

2.2.2.2.3 UXO Mitigation

HRG surveys and data analysis are still underway, and the exact number and type of UXOs in the Project area are not yet known. As a conservative approach however, it is currently assumed that up to 10 UXOs may have to be detonated in place. If necessary, these detonations would occur on up to 10 different days (i.e., one detonation would occur per day). A UXO/munitions and explosives of concern (MEC) risk assessment with risk mitigation strategy was conducted for the Project (Ordtek 2020). Likelihood of encounter for various MEC types was analyzed for the Ocean Wind Project area and assigned one of five possibility rankings: very unlikely, unlikely, possible, likely, and very likely. Presence of MEC was determined to be very unlikely for most MEC types but recorded as possible for small projectiles (<6 inches) both nearshore and offshore, meaning that evidence suggests that this type of explosive ordinance could be encountered within the Project boundary. The primary munitions with potential for occurrence in the dump area close to the Project pose a limited risk and are of low net explosive quantity. Depth charges and torpedoes were given a possibility ranking of unlikely in the offshore Project area, meaning that some evidence of this type of explosive ordinance in the wider region exists but it would be unusual for it to be encountered. In situ disposal of MEC/UXO would be done with low order (deflagration) or high order (detonation) methods or by cutting the MEC/UXO to extract the explosive components. The UXO/MEC might also be relocated through a “Lift and Shift” operation, in which case the relocation would be to another suitable location on the seabed within the Area of Potential Effects or previous designated disposal areas for either wet storage or disposal through low or high noise order methods as described for in situ disposal. UXO detonations would begin as early as June 2023 and may occur up to ten times throughout the duration of construction activities. Potential locations of UXO within the Project area have not been released at the time of this assessment.

2.2.2.3 Trenching/Cable Installation

Installation of inter-array cables and substation interconnection cables would typically be laid, and post-lay burial would be performed using a jetting tool, if seabed conditions allow. The maximum total installed array cable length is 190 miles (300 km). Alternatively, the array cables may be simultaneously laid and buried. Array cables could be installed using a tool towed behind the installation vessel to simultaneously open the seabed and lay the cable, or by laying the cable and following with a tool to imbed the cable. Possible installation methods for these options include jetting, vertical injection, control flow excavation, trenching, and plowing.

Offshore export cables would typically be buried below the seabed. The offshore export cable installation area would be prepared, and cables would be installed in a similar manner described for the array and substation interconnection cables. The maximum total cable length is 143 miles (230 km) for the Oyster Creek portion of the OECRC and 32 miles (51 km) for the BL England portion of the OECRC. Site preparation activities would take place prior to the placement and burial of the cable along the OECRC, similar to those described for the array cables. The installation vessel would transit the route toward the OSS, installing the cable by simultaneous lay and burial (plow/jetting/cutting) or surface lay and burial by a cable burial vessel (jetting/cutting/control flow excavation). It is anticipated that approximately 1 to 3 miles (1.61 to 4.83 km) of cable would be installed per day during active installation. Where offshore joints or termination at an OSS occur, up to 328 yards of cable may remain on the seabed until the foundation is installed or the next cable section is available for installation or jointing. In the case that the cable installation sequence does not allow for immediate jointing, and a significant increase of time is expected between laydown and jointing, then exposed cable ends would be temporarily buried and later recovered prior to jointing process. Where OSS foundations are not ready, the cable would remain on the seabed until the substation foundation is ready for a second end pull in.

As described above, export cables would be installed up to the TJB using open cut trenching or trenchless methods (bore or HDD). Sheet piling would be temporarily installed to support open cut trenches and as intertidal cofferdams for HDD exit pits. Open cut trenching is being considered for landfalls not under the USACE beach nourishment program, including the west side of Island Beach State Park (Prior Channel Route) and the west side of Barnegat Bay at the Farm/Holtec landfall.

For installation of the IECRC (the portion of the Oyster Creek cable route that crosses Barnegat Bay), work would begin in December 2023 and run intermittently through the middle of April; work is not anticipated to continue on a full-time basis. The current construction schedule includes an approximately two-week period starting in January 2024 to install the first cable, followed by installation of the second cable during a second approximately two-week period in late February/early March 2024, with vessel transit back to port between the installation of the two cables. Following the second cable installation, targeted cable burial activities would take place for approximately 2 to 4 weeks at the in-water transition of the cable landfall directly west of Island Beach State Park and near the HDD exit pit on the west side of Barnegat Bay, utilizing jetting technologies (controlled-flow excavator or diver jetting) and mechanical dredging to backfill these areas, as necessary.

2.2.2.4 Cable Protection

In the event that cables cannot achieve proper burial depths or where the proposed offshore export cables would cross existing infrastructure, Ocean Wind proposes the following protection methods: (1) rock placement, (2) concrete mattress placement, (3) front mattress placement, (4) rock bags, or (5) seabed spacers. When the cable has been installed, post-cable-lay surveys and depth-of-burial surveys would be conducted to determine if the cable has reached the desired depth. The remedial protection measures described above may be required in places where the target burial depth cannot be met.

Approximately 10% of the cable route may require cable protection (Ocean Wind 2022a). Installation of cable protection would cause long-term and localized habitat conversion and short-term and localized sediment suspension which would adversely affect EFH and EFH-designated species.

2.2.2.4.1 Rock Placement

Rocks of different grade sizes are placed from a fall pipe vessel over the cable. Initially smaller stones are placed over the cable as a covering layer to protect the cable from larger rocks, followed by larger rocks. The rocks generally form a trapezoid, up to 4.9 feet (1.5 meters) above the seabed with a 2:1 gradient. This may vary depending on expected scour. The trapezoid shape is designed to protect against anchor drag as well as anchor drop. The length of the protection depends on the length of cable that is not buried or has not achieved target depth. Where rock placement is used for crossing another cable or utility, a separation layer may be laid on the seabed before rock placement.

2.2.2.4.2 Mattress Placement

Mattresses generally have dimensions of 19.7 feet by 9.8 feet by 1 foot (6 by 3 by 0.3 meters). They are formed by interweaving a number of concrete blocks with rope and wire. They are lowered to the seabed on a frame. Once positioning over the cable has been confirmed, the frame release mechanism is triggered, and the mattress is deployed. The mattress placement process is repeated over the length of cable that requires additional protection. Mattresses provide protection from anchor drop, but are less effective at protecting against anchor drag. Where mattresses are used for crossing another cable or utility, a separation layer must be laid on the seabed before mattress placement.

2.2.2.4.3 Frond Mattress Placement

Frond mattresses are designed to mimic natural seagrass and promote the formation of protective, localized sand berms. Buoyant fronds are built into the mattress and when deployed they float in the water column trapping sand. Frond mattresses are installed following the same procedure as general mattress placement. The fronds floating in the water column can impede the correct placement of additional mattresses.

2.2.2.4.4 Rock Bags

Rock bags consist of various sized rocks constrained within a rope or wire netting containment. They are placed using a crane and deployed to the seabed in the correct position. Rock bags are more appropriate for cable stability or trench scour related issues.

2.2.2.4.5 Seabed Spacers

Seabed spacers consist of plastic or metal half shell sections that are bolted together to form a circular protection barrier around the cable as the cable is installed. Because they must be installed during installation, they are only used at areas where it is known burial would not be achieved, such as crossings or rock areas. Rock may be placed on top to provide additional protection from anchors or fishing gear.

2.3 Operations and Maintenance

2.3.1 Overview

The proposed Project is anticipated to have an operating period of 35 years.[4] Ocean Wind would use an onshore O&M facility in Atlantic City, New Jersey sited at the location of a retired marine terminal. Ørsted plans to rehabilitate this former marina facility near Absecon Inlet to create a port facility located off the Mid-Atlantic coast that can service potential wind turbine farms. Ørsted's rehabilitation of the former marina facility (including office and warehouse construction) and the City of Atlantic City's marina upgrades are being separately reviewed and authorized by the USACE (USACE Public Notice NAP-2021-00187-39 and NAP-2021-00573-95, respectively) and state and local agencies. The improvements are not dependent on the proposed action being analyzed in this EFH assessment.

The proposed Project would include a comprehensive maintenance program, including preventative maintenance based on statutory requirements, original equipment manufacturers' guidelines, and industry best practices. Ocean Wind would inspect WTGs, OSS, foundations, offshore export cables, inter-array

[4] For analysis purposes, BOEM assumes in this EFH assessment that the proposed Project would have an operating period of 35 years. Ocean Wind's lease with BOEM (Lease OCS-A 0498) has an operations term of 25 years that commences on the date of COP approval. (See https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/NJ/NJ-SIGNED-LEASE-OCS-A-0498.pdf; see also 30 CFR § 585.235(a)(3).) Ocean Wind would need to request and be granted an extension of its operations term from BOEM under the regulations at 30 CFR 585.425 et seq. in order to operate the proposed Project for 35 years. While Ocean Wind has not made such a request, this EFH assessment uses the longer period in order to avoid possibly underestimating any potential effect.

cables, onshore export cables, and other parts of the proposed Project using methods appropriate for the location and element.

2.3.2 Offshore Activities and Facilities

Routine maintenance is expected for WTGs, foundations, and OSS. Ocean Wind would conduct annual maintenance of WTGs, including safety surveys, blade maintenance, and painting as needed. OSS would be routinely maintained for preventative maintenance up to 12 times per year. The offshore export cables, inter-array cables, and OSS interconnector cables typically have no maintenance requirements unless a failure occurs.

Ocean Wind would need to use vessels and vehicles during O&M activities described above. The Project would use a variety of vessels to support O&M including crew transfer vessels, service operation vessels, jack-up vessels, and supply vessels. In a year, the Proposed Action would generate a maximum of 908 crew vessel trips, 102 jack-up vessel trips, and 104 supply vessel trips and a maximum of 2,278 crew transfer vessel trips or service operations vessel trips. Project O&M would involve approximately 115,150 vessel trips over the lifetime of the Project, originating from the Atlantic City O&M facility (Ocean Wind 2022a). As discussed in Section 2.2.1.1, vessels anchoring for maintenance would avoid sensitive habitats to avoid significant impacts.

Painting would be required at each foundation to protect against corrosion. Offshore turbine foundations may be fully painted every 10 years and may require touch-up paint every 3 years. Substation foundations would require one full paint job during the life of the Project. Routine service, safety surveys and checks, oil and high-voltage maintenance, and blade maintenance, as well as painting, cleaning, and ladder replacement would be done annually. Major overhauls are expected every 5 to 7 years (COP Volume I; Ocean Wind 2022a).

The offshore export cables, inter-array cables, and OSS interconnector cables typically have no maintenance requirements unless a fault or failure occurs. Cable failures are mainly anticipated as a result of damage from external influences, such as anchors and fishing gear. To evaluate the integrity of the cables, Ocean Wind intends to conduct a multibeam echosounder (MBES) bathymetry survey along the entirety of the cable routes immediately following installation, and at 1 year after commissioning, 2 to 3 years after commissioning, and 5 to 8 years after commissioning. Survey frequency thereafter would depend on the findings of the initial surveys (e.g., site seabed dynamics and soil conditions). Additional surveys may be conducted as needed, such as after a major storm event (i.e., a greater than 10-year event). Surveys of the cables may be conducted in coordination with scour surveys at the foundations. Vessels would be used to transport crew and materials. Sonar, ROVs and related equipment, drones, and divers may be required. Jack-up vessels may be required for cable recovery/repairs within 656 feet (200 meters) of the OSSs and WTGs. Portions of the cables are expected to become exposed due to natural sediment transport processes and are expected to require scour protection replenishment or reburial. In addition, seabed disturbance would be required associated with repair of cable faults. Where a fault is detected, cable would be exposed and repaired or replaced. A new section of cable would be jointed aboard the cable handling vessel. Upon completion of the repair, the cable would be lowered onto the seabed and assessed to determine whether it is on or as close as practicable to the original cable/trench location. Reburial by a jetting tool is expected (COP Volume I, Section 6.1.3.4; Ocean Wind 2022a).

2.4 Decommissioning

2.4.1 Overview

Under 30 CFR Part 585 and commercial Renewable Energy Lease OCS-A 0498, Ocean 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 proposed Project. A separate EFH consultation would be conducted for the decommissioning phase of the Project. All facilities would need to be removed 15 feet (4.6 meters) below the mudline (30 CFR 585.910(a)). Absent permission from BOEM, Ocean Wind would have to achieve complete decommissioning within 2 years of termination of the lease and either reuse, recycle, or responsibly dispose of all materials removed. Ocean Wind has submitted a conceptual decommissioning plan as part of the COP, and the final decommissioning application would outline Ocean Wind's process for managing waste and recycling proposed Project components (Volume I, Section 6.3; Ocean Wind 2022a). Although the proposed Project is anticipated to have an operation life of 35 years, it is possible that some installations and components may remain fit for continued service after this time. Ocean Wind would have to apply for and be granted an extension if it wanted to operate the proposed Project for more than the 25-year operations term stated in their lease.

BOEM would require Ocean 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, or 90 days after cancellation, relinquishment, or other termination of the lease (see 30 CFR 585.905). A separate EFH consultation would be conducted for the decommissioning phase of the Project. Upon completion of the technical and environmental reviews, BOEM may approve, approve with conditions, or disapprove the lessee's decommissioning application. This process would include an opportunity for public comment and consultation with municipal, state, and federal management agencies. Ocean Wind would need to obtain separate and subsequent approval from BOEM to retire in place any portion of the proposed Project. Approval of such activities would require compliance under the National Environmental Policy Act and other federal statutes and implementing regulations.

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

2.4.2 Offshore Activities and Facilities

For both WTGs and OSSs, decommissioning would be a "reverse installation" process, with turbine components or the OSS topside structure removed prior to foundation removal. Ocean Wind would remove monopile foundations by cutting 15 feet (4.57 meters) below the seabed level in accordance with standard practices and seabed conditions at the time of demolition. Although Ocean Wind proposes to leave scour protection placed around the base of the monopile, if used, in place; BOEM would most likely require that the scour protection be removed in accordance with 30 CFR 585.902(a). It is anticipated that the export and array cables would be removed using CFE or a grapnel to lift the cables from the seabed as practicable to recover and recycle valuable metals. Cable segments that cannot be easily recovered would be left buried below the seabed or rock armoring.

2.5 Monitoring Surveys

2.5.1 Protected Species Mitigation and Monitoring Plan

2.5.1.1 Passive Acoustic Monitoring

Monitoring during construction activities would include passive acoustic monitoring (PAM) as a mitigation technique. PAM data would be used to characterize the presence of protected species, specifically marine mammals, through passive detection of vocalizations, record ambient noise and marine mammal vocalizations in the lease area before, during, and after construction to monitor Project impacts in the Project area and to support the Vessel Strike Avoidance Plan. Mobile and hybrid PAM systems utilizing autonomous surface vehicles and radio-linked autonomous acoustic recorders would be considered when they can meet monitoring and mitigation requirements in a cost-effective manner. If practicable, the PAM system would be deployed outside the shutdown zone. The total number of PAM stations and array configuration would depend on the size of the zone to be monitored, the amount of noise expected in the area, and the characteristics of the signals being monitored. The optimal system would depend on Project phase, cost considerations, the target species, the length of deployment desired, and a variety of other factors. A software system (Mysticetus or similar) would be employed for data collection and dissemination to other vessels or protected species observers/PAM operators on the Project.

2.5.2 Fisheries Monitoring Plan

The proposed Fisheries Monitoring Plan submitted October 27, 2021, includes six different components to assess fisheries status in the Project area and a nearby control site throughout the pre-, during, and post-construction phases. Survey types include trawl surveys, environmental DNA (eDNA) surveys, structure-associated fishes surveys, clam surveys, pelagic fish surveys, and acoustic telemetry monitoring. 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.

2.5.2.1 Trawl Survey

The trawl surveys would be conducted using the fishing vessel (F/V) Darana R, a 90-foot commercial dragger and occur once per season, or four times per year. The net would be a 400 by 12 centimeter (cm), three bridle four-seam bottom trawl with Thyboron, Type IV 168 cm (66-inch) doors and a 2.5 cm (1-inch) knotless cod end. It is expected the trawl surveys would occur 2 years prior to construction, during the 2 years of construction and installation, as well as for a minimum of 2 years after construction. The planned schedule totals 24 separate survey events over the 6-year span. During a trawl survey event, 20 tows would be conducted in the Project area and 20 tows in the control site. A total of 160 tows per year would be conducted for the trawl survey and 960 tows over a 6-year period. All tows would be conducted during daylight hours, at a speed of 2.9 to 3.3 knots, and last for 20 minutes. Transits for the F/V Darana R from its homeport in Wanchese, North Carolina to the Project area would be approximately 428 nm round trip for each seasonal survey. The eDNA survey would occur concurrently with the trawl survey, aboard the F/V Darana R. Mitigation measures for species protected under the Endangered Species Act (ESA) listed 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 would commence as soon as possible once the vessel arrives on station, and during haul back codend would be opened as quickly and carefully as possible to avoid damaging any protected species that may have been incidentally captured.

2.5.2.2 eDNA Survey

Ocean Wind is partnering with researchers from Monmouth University and St. Anselm's College to carry out a comprehensive eDNA survey at the Lease Area. The eDNA sampling would occur synoptically with the trawl survey, enabling for a more holistic understanding of the relative abundance and composition of the species assemblage at the WFA site. eDNA sampling is non-invasive and can be conducted without causing damage to the benthic habitat.

Two years of sampling (e.g., eight seasonal surveys) are planned prior the commencement of offshore construction. The eDNA survey would continue during the construction phase, and a minimum of 2 years of eDNA monitoring would be completed following offshore construction. eDNA sampling would be competed concurrently with trawl sampling. At each trawl survey sampling location in the Lease Area and the control area, an eDNA sample would also be collected. Therefore, during each seasonal sampling event, 40 samples would be targeted for collection in the Ocean Wind Offshore Windfarm Project impact area and the trawl survey control area.

2.5.2.3 Multi-Method Survey for Structure-Associated

The multi-method survey for structure-associated fish would also be conducted concurrently with the trawl survey (four surveys per year and a total of 24 separate survey events), however it would occur aboard the F/V Dana Christine II. Methods employed in the multi-method survey include chevron traps, rod-and-reel fishing, and baited remote underwater video (BRUVs). Target sampling dates would occur in January, April, July, and late September or early October. It is anticipated that 12 to 15 locations would be sampled over three days using each of the three methods. Locations would be located inside the Project area as well as at a nearby control site. At each location, chevron traps would be baited and placed in a group of six traps spaced 200 meters apart and soak for 90 minutes. Each chevron trap would have a vertical buoy line. The BRUV method would occur concurrently at the same location as the chevron traps after the vessel anchors. The equipment used for BRUVs would include a weighted line attached to surface and subsurface buoys that would hold a stereo-camera system in the water column and a system at the seafloor. The BRUVs would be deployed for 60 minutes at each site. Simultaneously with the BRUV sampling, rod-and-reel sampling would be conducted from the stern using four to five rods with terminal tackle with baited hooks. Each angler would complete four to five 3-minute timed fishing "drops" at each sampling location, for a total of 16 to 25 drops at each location. Transits for the F/V Dana Christine II from its homeport in Barnegat Light, New Jersey to the Project area would be approximately one 90 nm round trip for each seasonal survey. Mitigation measures for ESA-listed species that would be enacted during the structure-associated fishes surveys include a limited soak duration for chevron traps of <90 minutes, vessel would remain on site during equipment deployment, lines used in the multi-method survey would have a breaking strength of <1,700 pounds and weak links to reduce potential for moderate or significant right whale entanglement risk, labeled buoys with scientific permit numbers, immediate reports of any missing lines, and deployment would not occur if any ESA-listed species were to be observed.

2.5.2.4 Clam Surveys

The clam survey would occur once yearly in the Project area and two control sites in August over at least 6 years: two surveys before construction, two during construction, and at least 2 years post-construction. A towed modified sampling dredge would be pulled by the F/V Joey D at ten stations within the Project area and five stations at each of the two control sites. An unspecified amount of additional sampling would occur each year if time permits. Tows would be conducted for two minutes at a speed of 3 knots. It is anticipated that 40 minutes of dredging would occur for each survey trip, 20 minutes in the Project area and 10 minutes at each of the control sites. Target tow duration may be modified following the first sampling trip, dependent upon the volume of catch and performance of the dredge. The clam survey would occur over a two-day cruise. Transits for the F/V Joey D from its homeport in Atlantic City, New Jersey would be approximately one 44 nm round trip for each yearly survey.

2.5.2.5 Pelagic Fish Survey

The pelagic fish survey would employ two methods, towed BRUVs and autonomous gliders. One glider deployment would be conducted during each of the three Project phases: pre-construction, during construction, and post-construction. Glider deployment would occur in October, coinciding with one of the other vessel-based surveys, and span three to four weeks. The second survey method in the pelagic fish survey would occur during all survey vessels of opportunity (e.g., trawl survey vessel, clam survey vessel, glider deployment vessel, structure-associated habitat survey vessel) while underway. This survey would not result in additional vessel traffic.

2.5.2.6 Acoustic Telemetry

The acoustic telemetry survey would cover the Ocean Wind lease area and adjacent inshore areas. Tagging efforts would not increase vessel transits as they would occur aboard the trawl, trap, or hook and line sampling vessels. The sole increase to vessel traffic for this survey component would be the towing of the omni-directional hydrophone during the four trips per year by the 25-foot research vessel (R/V) Resilience. Transits for the R/V Resilience are unclear, as it is able to be driven on a trailer to a nearby boat ramp. This EFH assessment assumes a nearby boat ramp from Ocean City or Atlantic City would be chosen resulting in an approximately 48- to 53-mile (42 to 46 nm, 78 to 85 km) round trip transit per survey event.

2.5.3 Benthic Surveys

The benthic monitoring plan was developed in accordance with recommendations set forth in "Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf" (BOEM 2013). Benthic monitoring activities would evaluate novel hard-bottom habitat and soft sediments with the Project area through various methodologies

The hard-bottom monitoring would include an examination of three types of novel surfaces: WTG foundations (including associated scour protection layers), export cable protection layers, and the OSS foundations. The primary objective of the novel hard-bottom survey is to measure changes over time and with depth of the nature and extent of macrobiotic cover of hard bottom associated with the Ocean Wind Project. Macrofaunal percent cover, identification of species (to the lowest possible taxonomic unit), and the relative abundance of native and non-native organisms would be documented using a ROV and video surveying approach. High-resolution video imagery via ROV would be utilized to monitor hard-bottom habitat. A stratified random design, with benthic habitat types as strata, would be used to select the novel hard-bottom structures that would be monitored. As described above, benthic habitat mapping results documented two predominant benthic habitat types in the WFA: (1) Sand and Muddy Sand – Mobile, and (2) Coarse Sediment – Mobile (Figure 2 in Ocean Wind 2022b). Along the export cables, three benthic habitat types, all with similar biological community characteristics, were documented: (1) Sand and Muddy Sand, (2) Mud and Sandy Mud, and (3) Coarse Sediment. The survey design would include randomly selected WTGs and cable protection areas within each of these habitat type strata. Within each habitat type strata three WTG locations and three cable protection areas would be randomly selected for monitoring. One of the three OSS foundations would also be selected for benthic monitoring. Following the completion of the foundation and cable installation, an ROV would be used to collect reference video imagery of the underwater surfaces (i.e., turbine foundations down to the scour protection layer, cable protection area). Continuous video imagery would be collected down the length of the selected foundations to provide general context on the community composition and how and where dominant species shift with depth. Then, high-resolution still imagery would be collected (or subsampled from the continuous video imagery) at discrete randomly placed and replicated quadrats (four replicates per depth stratum) within pre-defined depth intervals as informed by the continuous video footage. These depth intervals would be dependent on the community composition shifts with depth as gleaned from the continuous video footage. The novel hard-bottom monitoring survey would be repeated at annual intervals coinciding with the soft-bottom sediment profile imaging/plan view (SPI/PV) survey planned at the base of the foundation structures. Monitoring the novel habitats would begin after construction is complete (i.e., after all infrastructure has been installed) during late summer or early fall, and sampling would be repeated annually at time intervals of one (Y1), two (Y2), three (Y3), and five (Y5) years after construction.

The soft-bottom monitoring would include three distinct studies (1) an examination of two offshore wind components: WTG/OSS foundation-associated and export cable-associated soft-bottom habitats. The overall objectives of the soft-bottom benthic monitoring surveys are to measure potential changes in the benthic function of soft-bottom habitats over time, and to assess whether benthic function changes with distance from the base of the novel foundations or export cable centerline; (2) an examination effects of installation and operation on soft-bottom habitat along the Ocean Wind export cables. This component of the benthic monitoring would include focused surveys along the export cable corridors across each observed benthic habitat type; and (3) an examination within the WFA along the inter-array cable, specifically where sand ridges exist in the northeast portion of the WFA. The objective for these soft-bottom benthic surveys within this portion of the WFA is to examine the effects of installation and operation of the inter-array cables on the benthic habitat over time and along a spatial gradient with distance from the cable centerlines. All three soft-bottom monitoring studies would use SPI/PV as the monitoring approach for the soft sediment habitat surveys. The following descriptions detail each soft-bottom survey:

- Structure-associated Organic Enrichment: At the wind farm, a single benthic survey would be conducted in late summer or early fall (August to October) prior to the start of seafloor preparation for construction to document benthic habitats prior to disturbance. Subsequent surveys would be conducted in the same seasonal time frame at time intervals of one (Y1), two (Y2), three (Y3), and five (Y5) years after construction. The same wind structure foundations selected for the novel hard-bottom monitoring survey (Inspire 2022b) would be selected for this soft sediment survey (triplicate WTGs randomly selected within each pre-defined habitat type stratum). Data on the mean currents near the WFA would be used to establish up current and down current transects extending from each selected WTG foundation. Two belt transects (25 meters wide) of SPI/PV stations would be established, one up current and the other down current of the selected turbine/OSS locations (Figure 5 in Ocean Wind 2022b). Pre-construction transects would begin at the center point of the planned foundation with two stations at equal intervals up to the maximum planned extent of the scour protection area and then at intervals of 0 to 10 meters, 15 to 25 meters, 40 to 50 meters, 90 to 100 meters, 190 to 200 meters, and 900 meters extending outward from the edge of the scour protection area (i.e., a single station at each of eight distance intervals in two directions from each turbine/OSS sampled; Figure 5 in Ocean Wind 2022b). Post-construction transects would repeat this design at the same turbines/OSS and the same sampling distance intervals.
- Cable-associated Physical Disturbance: This soft-bottom survey sample design would focus on sampling at representative sections of the export cables based on mapped habitat types as informed by the habitat mapping report (Inspire 2022a). Based on benthic habitat mapping results, there are two predominant benthic habitat types along the route offshore (Sand and Muddy Sand, Coarse Sediment) and another predominant benthic habitat type nearshore (Mud and Sandy Mud) (Figure 4 in Ocean Wind 2022b). Sampling locations would be randomly stratified by these habitats. At triplicate locations (each approximately 1 km apart) within each habitat type sampling stratum, a 25 m wide belt transect would be laid perpendicular to the cable route (three replicate transects per habitat stratum) (Figures 6 and 7 in Ocean Wind 2022b). Along each transect, a total of 16 stations would be

sampled. At each station, triplicate SPI/PV images would be collected and analyzed. Near the centerline these stations would be distributed roughly 10 meters apart and the distance intervals between stations would increase with distance from the centerline (Figures 6 and 7 in Ocean Wind 2022b). The selected sampling locations and sampling intervals relative to the cable would remain fixed for the duration of the survey. Sampling along the export cables would occur within the first calendar year post-installation (Y0) and at Y1 and Y2 during operation. After Y2, if benthic function measured with SPI/PV is indistinguishable from baseline conditions, and no difference is observed with distance from cable centerline, no further monitoring would occur. Alternatively, if benthic function is impaired (e.g., apparent redox potential discontinuity and/or successional stage) and differences along the export cables persist compared with baseline and with distance from cable centerline, monitoring would continue at defined intervals until the benthos resemble baseline conditions or are no longer impaired (up to a maximum of 5 years of monitoring).

- Sand Ridges: Based on benthic habitat mapping results, the predominant benthic habitat type in this region of the WFA is mobile Sand and Muddy Sand (Figure 3 in Ocean Wind 2022b). Bathymetric profiles show the sand ridge heights are approximately eight meters, with a length of approximately 1.5 km (Figure 3 in Ocean Wind 2022b). A higher spatial resolution of baseline conditions of the benthic habitat across the sand ridges, including within the troughs and along the crests, will be collected prior to construction. This pre-construction surveying across the sand ridges will be conducted to sufficiently document baseline conditions in these areas prior to any construction activity. Triplicate transects of SPI/PV stations will be set up across these large-scale sand ridge features, each transect will follow the planned inter-array cables (Figure 8 in Ocean Wind 2022b). An additional transect that runs perpendicular to the inter-array cable transects, but where no cable installation will occur, will serve as the control transect. Each transect will be approximately 5 km long and traverse the troughs and crests of the sand ridges. A total of 25 SPI/PV stations distributed equally along each transect will be sampled; at each station triplicate SPI/PV images will be collected and analyzed.
- Sampling along sand ridges will occur prior to installation and any seabed preparation activities (baseline data), and then within the first calendar year post-installation (Y0) and at year 1 and year 2 during operation. After year 2, if benthic function measured with SPI/PV is indistinguishable from baseline conditions, no further monitoring will occur. Alternatively, if benthic function is impaired (apparent redox potential discontinuity and/or successional stage) and differences along the inter-array cables persist compared with baseline, monitoring would continue at defined intervals until the benthos resemble baseline conditions or are no longer impaired (up to a maximum of 5 years of monitoring).

The underwater noise effects generated by the proposed survey methods used for benthic habitat monitoring are similar to, but of lower magnitude than HRG survey methods (Ocean Wind 2022a). As stated in that document, noise generated by this type of equipment is unlikely to have any significant biological effect on any EFH species.

2.5.4 HRG and Geotechnical Surveys

HRG surveys would occur intermittently before, during, and after construction, beginning upon the issuance of a Letter of Authorization under the Marine Mammal Protection Act. Surveys would include equipment operating at less than 180 kilohertz and consist of multibeam depth sounding, seafloor imaging, and shallow- and medium-penetration sub-bottom profiling within the Project area. Potential equipment used during HRG surveys would be side-scan sonar, MBES, magnetometers and gradiometers, parametric sub-bottom profiler, compressed high-intensity radiated pulses (CHIRP) sub-bottom profiler, boomers, or sparkers. Though survey plans are not yet finalized, Ocean Wind assumes HRG surveys would be conducted 24 hours a day with an assumed average daily distance of 43.5 miles (70 km). A maximum of three vessels would work concurrently within a 24-hour period with an assumed transit speed of 4 knots. Since the regulations promulgated for a Letter of Authorization are valid for 5 years, HRG survey effort is defined across 5 years. Years 1, 4, and 5 are expected to include approximately 88 days of HRG surveys per year (47.5 survey days for the offshore wind farm and 40.5 survey days for the offshore export cable and during construction years (Years 2, 3) would involve 180 days per year of HRG surveys. A total of 6,110 linear km (3,797 miles) would be anticipated for HRG survey needs for these years: 3,000 km (1,864 miles) for the offshore wind farm array cable; 2,300 km (1,429 miles) for the Oyster Creek export cable; 510 km (317 miles) for the BL England export cable; and 300 km (186 miles) for the OSS inter-link cable. Years 2 and 3, which represent the construction and installation phase are anticipated to include 180 days of HRG surveys per year. A total of 25,265-linear km (15,699 miles) would be anticipated for HRG survey needs for these years: 11,000 km (6,835 miles) for export cables; 10,500 km (6,524 miles) for array cables; 1,065 km (662 miles) for foundations; 250 km (155 miles) for WTGs; and 2,450 km (1,522 miles) for monitoring and verification. The total HRG survey days throughout the 5 years would be 624 days. Geotechnical surveys would take place prior to construction and the plans for these surveys were under review at the time of this writing. No geotechnical surveys are planned for the construction or post-construction phases.

2.5.5 Submerged Aquatic Vegetation Monitoring Plan

The proposed Submerged Aquatic Vegetation (SAV) Monitoring Plan (Inspire 2022c) is designed to document baseline delineations and conditions of SAV beds, assess potential impacts to these SAV beds as a result of the construction and operations of the inshore export cable(s) associated with the Project, and track recovery of these SAV beds over time to inform potential mitigation strategies. Survey protocols and methodologies were developed with input from stakeholder groups, including NJDEP, NOAA, and BOEM.

Baseline SAV mapping surveys to delineate the extent and percent cover of SAV beds in the vicinity of the Project were conducted between 2019 and 2022 using aerial imagery and underwater drop camera imagery. Six months prior to the commencement of cable installation activities, and within the SAV growing season (late-April to October), an additional pre-construction SAV characterization survey will be conducted to refine and update the results from the baseline SAV mapping surveys. The general approach to these surveys will entail in-water snorkeler/diver-based (or other appropriate advanced imaging techniques) SAV characterization (shoot density and other parameters). The pre-construction monitoring will be used to identify possible means to minimize impacts (e.g., adjusting the cable route, establishing designated anchoring locations outside of SAV beds), and to refine post-construction monitoring protocols for documenting impacts and informing potential mitigation plans.

Post-construction surveys, using the same methods as the pre-construction SAV characterization survey, will be conducted within six months of completion of construction activities and annually for three years following the completion of construction. All SAV monitoring surveys will be conducted within the seasonal growing window, late April-October. The post-construction results will be used to characterize the condition of SAV within the areas of potential influence of the Project to identify any impacts associated with construction spatially and document recovery of these areas over time.

The proposed SAV Mitigation Plan (Ocean Wind 2022d) further outlines Ocean Wind’s proposed process to ensure that any impacts on SAV incurred during construction and installation activities of the Ocean Wind 1 export cable, and which cannot be avoided and/or minimized, are adequately mitigated.

3. Existing Environment

This section details the existing environment within each Project component, including the lease area, offshore export cable routs, the landing area, and interior coastal habitats, all of which have the potential to be utilized by EFH-designated species. Ocean Wind conducted detailed habitat delineation surveys of the Project area to support preparation of the COP, which were subsequently updated in coordination with the NMFS. Supplemental information requests related to habitat characterization are described in Appendix 10-1 of this document. The surveys and data discussed in this section represent the most current information available for characterizing existing conditions within the Project area. This section also discusses habitat areas adjacent to the Project area that may be indirectly affected.

To support Ocean Wind site investigations, multiple high-resolution MBES and side-scan sonar surveys were conducted within the Project area (Inspire 2022a). Surveys were conducted in 2017 and 2018 by Gardline and Alpine Ocean Seismic Survey Inc. and by Fugro in the Lease Area; additional surveys were conducted by Gardline and Alpine in 2019 and 2020 to further characterize the WFA and the export cable route corridors. Additional benthic ground-truth data (sediment profile and plan view imaging (SPI/PV), and video imagery) were collected in June 2022 at the Wind Farm Area. Data results from this supplemental survey confirmed all existing habitat delineations. Detailed benthic habitat mapping methodology is included in Appendix 10-3 of this document. To aid engineering and construction design, the MBES was optimized for bathymetric data and backscatter data were collected as an ancillary data product. Bathymetric data were derived from the MBES and processed to a resolution of 50 cm (Inspire 2022a). Bathymetric data provide information on depth and seafloor topography (see Section 3.1.1 and 3.1.2). Backscatter data were derived from the MBES and processed to a resolution of 50 cm (Inspire 2022a). Backscatter data are based on the strength of the acoustic return to the instrument and provide information on seafloor sediment composition and texture and are best interpreted in concert with hill-shaded bathymetry (see Section 3.1.1 and 3.1.2). Backscatter returns are relative and referred to in terms of low, medium, and high reflectance rather than absolute decibel values. Nominally softer, fine-grained sediments absorb more of the acoustic signal and a weaker signal is returned to the MBES. Although backscatter data provide valuable information about sediment grain size, decibel values reflect not only sediment grain size, but also compaction, water content, and texture (Lurton and Lamarche 2015). For example, sand that is hard-packed and sand that has prominent ripples may have higher acoustic returns than sediments of similar grain size that do not exhibit these characteristics. Additional figures showing the location of boulders in the WFA, the OECRC and IECRC are provided in Appendix 10-2 of this document.

The National Oceanic and Atmospheric Administration (NOAA) Habitat Complexity Categories were defined by NOAA Habitat for the purposes of EFH consultation in their new recommendations (NOAA Habitat 2021). The NOAA Habitat Complexity Categories include soft bottom, complex, heterogeneous complex, and large-grained complex (large boulders). For purposes of the EFH consultation, NOAA has defined complex habitats SAV and sediments with >5% gravel of any size (pebbles to boulders; Coastal and Marine Ecological Classification Standard [CMECS] Substrate of Rock, Groups of Gravelly, Gravel Mixes, and Gravels) (NOAA Habitat 2021). Heterogenous complex is used for habitats with a combination of soft-bottom and complex features (NOAA Habitat 2021). Inspire (2022a) has developed a crosswalk between benthic habitat types with modifiers and NOAA Habitat Complexity Categories (Table 3-1). Six benthic habitat types with modifiers were cross-walked to the "complex" category, based either on having >5% gravel or on the recent or historical presence of SAV. Historical presence of SAV is classified the same as recent SAV because the New Jersey Department of Environmental Protection regulates historical SAV as well as current SAV habitat. The three sand and mud habitat types were classified as "soft bottom." Those soft-bottom habitats with low density boulder fields were categorized as "heterogeneous complex."

Table 3-1 Crosswalk of Benthic Habitat Types with Modifiers Mapped at the Project to NOAA Habitat Complexity Categories

Benthic Habitat Type with Modifiers	NOAA Habitat Complexity Category
Coarse Sediment	Complex
Course Sediment – Mobile	Complex
Sand and Muddy Sand with Low Density Boulder Field	Heterogenous Complex
Sand and Muddy Sand – Mobile	Soft Bottom
Sand and Muddy Sand with SAV	Complex
Sand and Muddy Sand with Historical SAV	Complex
Sand and Muddy Sand	Soft Bottom
Mud and Sandy Mud with Low Density Bolder Field	Heterogenous Complex
Mud and Sandy Mud with SAV	Complex
Mud and Sandy Mud with Historical SAV	Complex
Mud and Sandy Mud	Soft Bottom

Source: Table 3-3, Inspire 2022a
NOAA = National Oceanic and Atmospheric Administration; SAV = submerged aquatic vegetation

To provide additional context to the acres calculated for maximum potential impacts, tallies of benthic habitat types by modifiers and by NOAA Habitat Complexity Category are provided in Table 10.2-6 and Table 10.2-7 in Appendix 10-2.

Offshore benthic habitat of New Jersey has been studied by various entities. Byrnes and Hammer (2001) conducted a study to evaluate the feasibility of sand borrowing and documented a sandy benthic habitat dominated by polychaete worms and Atlantic nut clams. Boesch (1979) categorized offshore benthic habitat a few miles offshore of Atlantic City as inner shelf coarse substrate with dynamic, uniformly coarse sand containing a benthic community dependent on changes in subtle bottom topography, particularly ridges and swales. Communities were dominated by mollusks (*Tellina agilis*), crustaceans (*Tanaissus liljeborgi*), polychaetes, and the sand dollar (*Echinarachnius parma*).

As part of a New Jersey Department of Environmental Protection (NJDEP) study, Geo-Marine, Inc. reviewed available data for benthic invertebrate (epifauna) taxa that occur along the New Jersey inner shelf within the Lease Area and offshore export cable corridors. Common macrofauna include species from several taxa including echinoderms (e.g., sea stars, sea urchins, and sand dollars), cnidarians (e.g., sea anemones and corals), mollusks (e.g., bivalves, cephalopods, and gastropods), bryozoans, sponges, amphipods, and crustaceans (NJDEP 2010). The mid-shelf is dominated by sand dollars and surfclams from about 131 feet to 230 feet (40 to 70 meters) with various other epifauna (e.g., rock crabs, hermit crabs, cancer crabs, horseshoe crabs, spider crabs, and lobsters) found throughout the shelf (NJDEP 2010). Within the nearshore area, common crustaceans include hermit crabs (*Pagurus* spp.), Atlantic rock crab (*Cancer irrotatus*) and sevenspine bay shrimp (*Crangon septemspinosa*) (NJDEP 2010).

The U.S. Environmental Protection Agency's National Coastal Assessment program is the most spatially and temporally comprehensive survey conducted on New Jersey benthic communities (Ramey et al. 2011). The sampling program was designed to take into account episodic natural upwelling, offshore wastewater discharges, and state management zones. Samples were collected with a Van Veen grab from Sandy Hook to Cape May at 153 stations along the Atlantic Coastline in August and September 2007 and 2009. In total, over 110,000 individuals belonging to 273 species/taxa were identified. In a review of 19 studies on benthic soft-sediment fauna, Ramey et al. (2011) identified 540 benthic macrofaunal species/taxa in New Jersey Coastal Waters. Dominant taxonomic groups included polychaete and oligochaete worms (*Prionospio pygmaeus*, *Tharyx* sp., *Aricidea catherinae*, *Grania longiducta*, *Peosidrilus coeloprostatus*), amphipods (*Protohaustorius deichmannae*), and the bivalve (*Nucula proxima*). These benthic and epibenthic species are a vital food source for fish species.

The following sections provide detailed discussions of the existing environment broken out by Project component, including the Lease Area, the offshore cable corridors of the open ocean, and the inshore cable corridors within the estuarine environment of Barnegat Bay and Great Egg Harbor.

3.1 Wind Farm Area

Ocean Wind's geophysical survey recorded water depths in the WFA. Water depths varied from -49 feet (-15 meters) MLLW in the northern part to -125 feet (-38 meters) MLLW in the southern part (Figure 3-1).

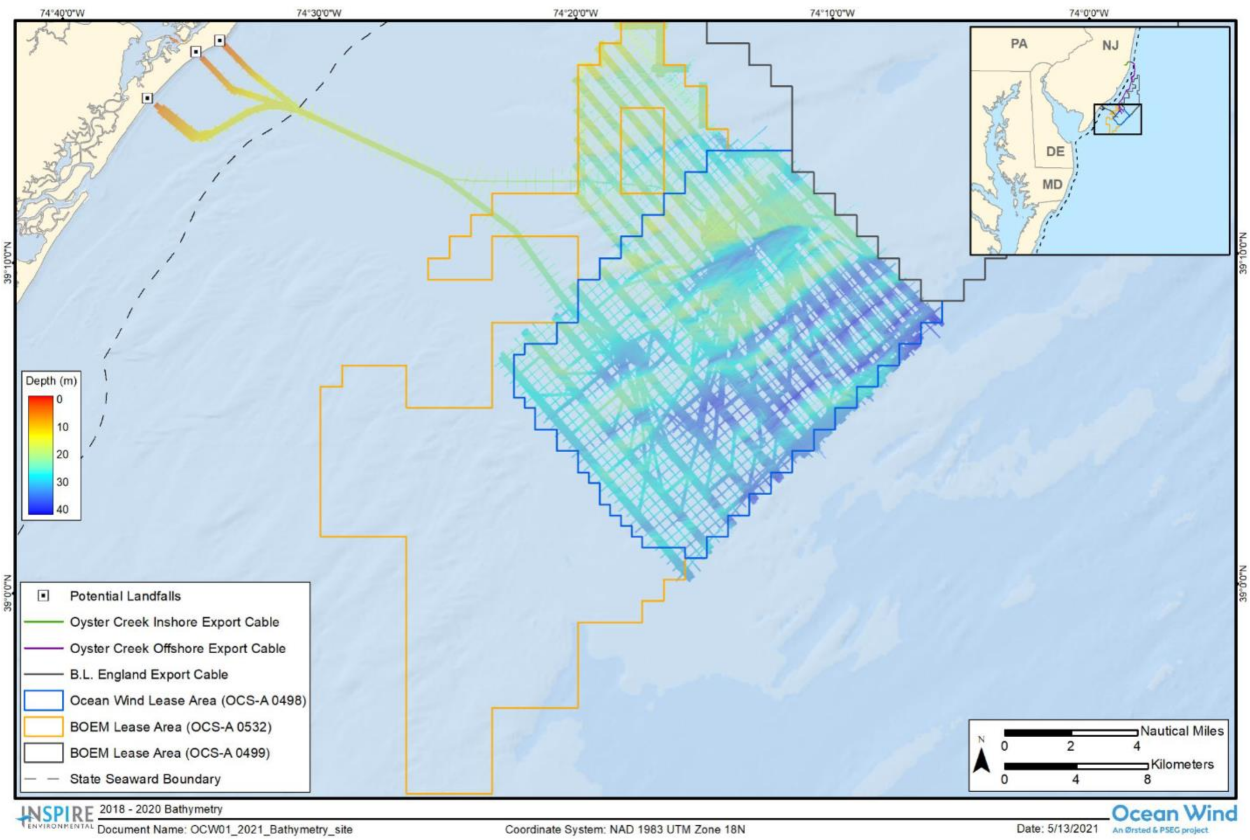


Figure 3-1 Bathymetric Data at the Wind Farm Area

Seabed morphology in the vicinity of the Project area generally consists of a gently sloping seabed; within the WFA the seafloor slopes are predominantly less than 1 degree (Guida et al. 2017). The largest slopes are associated with sand ridges that are a prominent seafloor feature of the OCS off the coast of New Jersey. They are oriented obliquely to the shoreline and are actively modified by ocean currents at depths up to 164 feet (50 meters) (Goff et al. 2005). Goff et al. (2005) report that these sand ridges range up to approximately 39 feet (12 meters) tall, are approximately 1.2 to 12.4 miles (2 to 20 km) long, and are spaced approximately 0.6 to 3.1 miles (1 to 5 km) apart. In and near portions of the WFA, Ocean Wind identified ridges up to 49 feet (15 meters) above the surrounding seabed (Ocean Wind COP, Volume II, Section 2.1.1.1.1; Ocean Wind 2022a) (Figure 3-2). Patches of ripples and mega-ripples with heights up to approximately 1.6 feet (0.5 meters) were also observed within portions of the Lease Area during Ocean Wind's geophysical survey. June 2022 data results from SPI/PV and video collected at the sand ridge area in the east part of the WFA indicate physical and biological differences between the crests and troughs of these ridges (Inspire 2022a). The sediments on the crests were more homogeneous, composed primarily of fine to medium sands (Figure 3-3). The majority of the sediments in the troughs were composed of fine to coarse sands and were more varied with a range of composition from very fine sand to sandy gravel (Figure 3-3). The video data is less resolute regarding variability between fine and coarse sand, and most habitat types recorded on crests and troughs were "sand or finer" (Figure 3-3). "Shelly sand" was also recorded along a portion of each transect along the troughs (Figure 3-3). In contrast, the seafloor of the WFA overlapping the Great Egg Valley zone is smoother than the adjacent physiographic zones, with no significant bedforms (Guida et al. 2017; Ocean Wind COP, Volume II, Section 2.1.1.1.1; Ocean Wind 2022a). Within the WFA, the seafloor sediment consists predominantly of medium- to coarse-grained sand with areas of gravelly sand and gravel deposits (Fugro 2017; Alpine 2017).

The SPI/PV images acquired during the 2022 survey increased the spatial density of samples in coarse sediment habitats with medium to high relative backscatter reflectance across the entire WFA (compared to the 2017- 2019 samples). Spatial coverage of these areas was also increased by employing towed video targeting these locations. These data provide further evidence that these medium to high backscatter areas of the WFA are highly dynamic habitats composed of rippled sands with bare granules and pebbles in ripple troughs or pebbles and granules without attached fauna overlaying sandy sediments. In addition, increased replication on a smaller scale was achieved by sampling three stations (623, 644, 648) with pogo PV in small areas of relatively high backscatter located within previously delineated coarse sediment polygons. Low variability in the CMECS Substrate Subgroup across replicates at each of these locations indicate that these habitats are relatively homogenous and well defined.

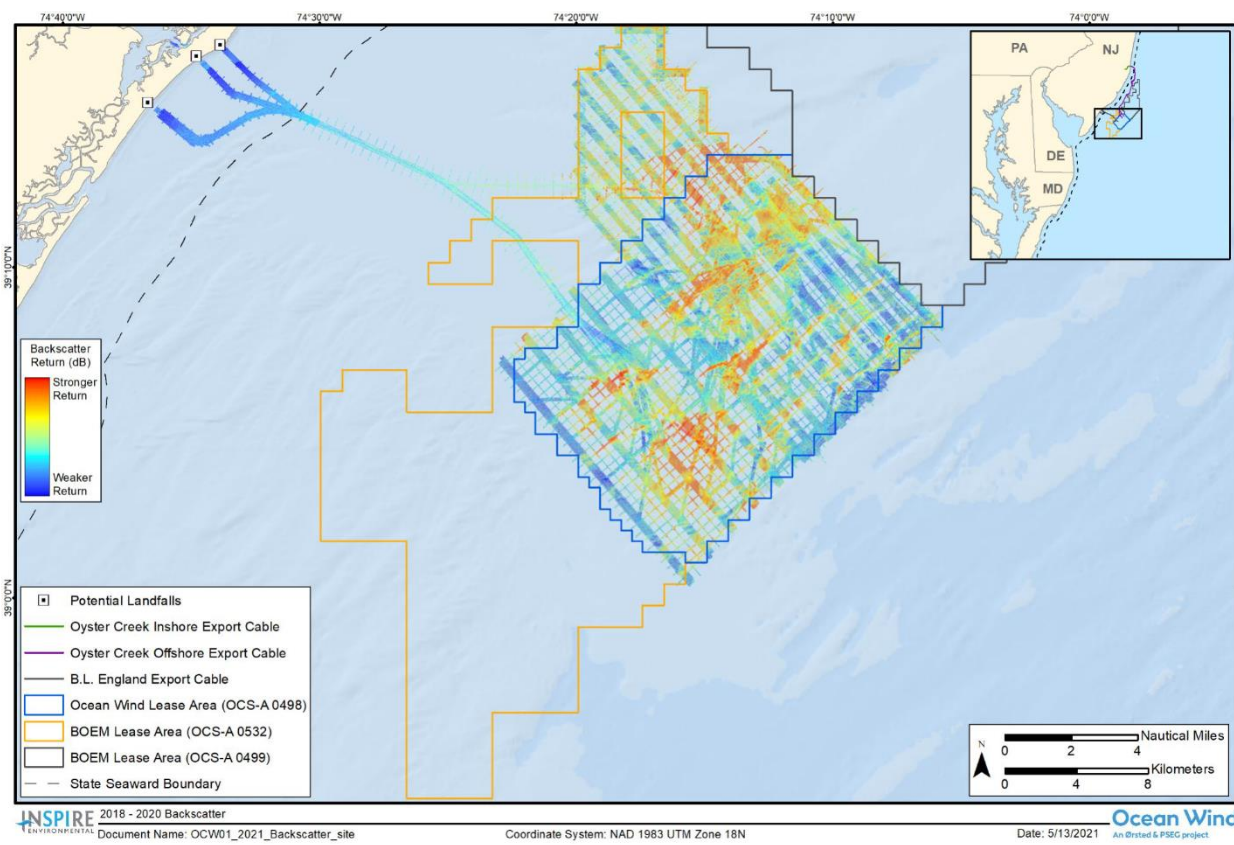


Figure 3-2 Backscatter Data Over Hill-Shaded Bathymetry at the Wind Farm Area

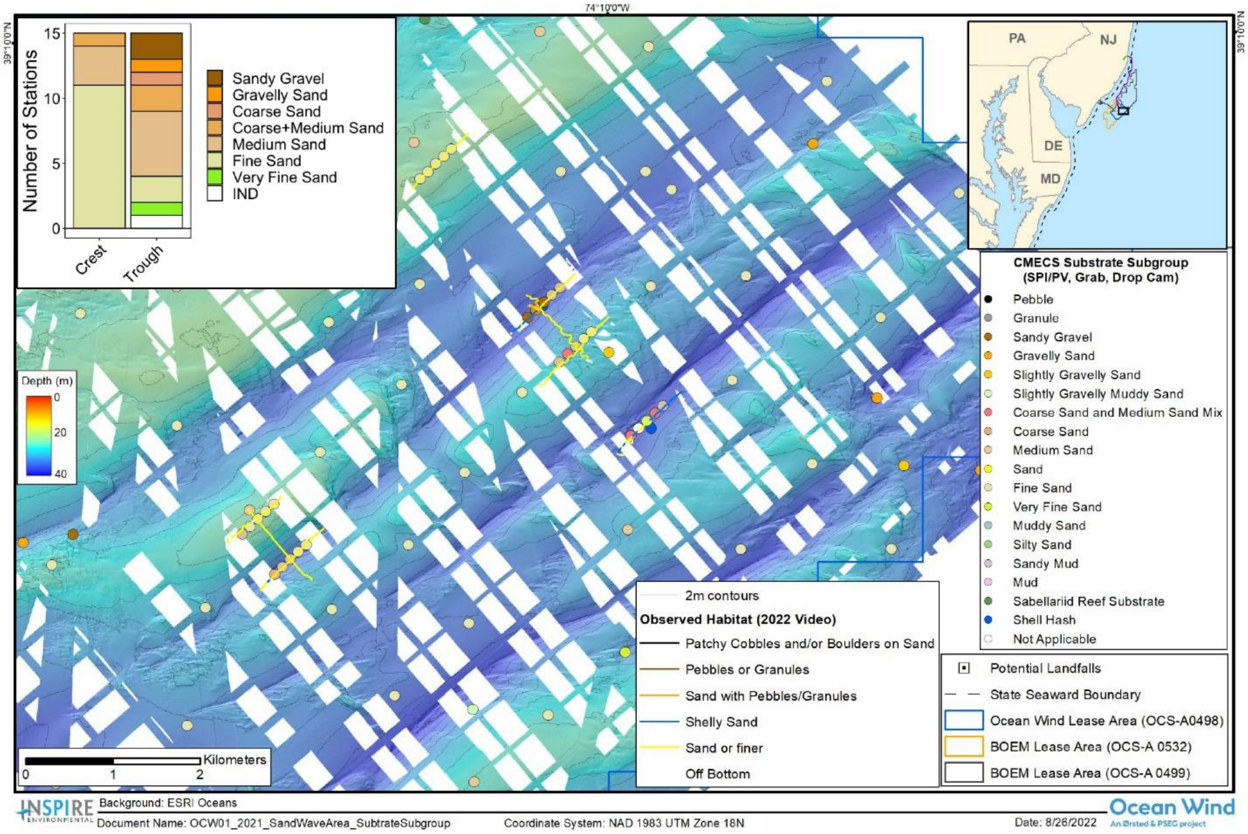


Figure 3-3 CMECS Substrate Subgroup from SPI/PV and Habitat Type from Video at the Sand Ridges Area

The Mid-Atlantic Ocean Data Portal and the Nature Conservancy have characterized species, habitats, and ecosystems of the Lease Area. According to these sources, the benthic habitat within the Lease Area comprises substrate ranging from fine (0.005–0.01 inches [0.125–0.25 millimeters; mm]) to coarse (0.02–0.04 inches [0.5–1 mm]) sands at depths of 82 to 148 feet (25 to 45 meters).

The WFA is on the Southern Mid-Atlantic Bight shelf (Guida et al. 2017), with the export cable routes extending from the WFA to coastal and back-bay areas. The WFA is relatively flat with low-degree seaward slopes and depth contours generally paralleling the shoreline. Predominant bottom features include a series of ridges and troughs that are closely oriented in a northeast-southwest direction, although side slopes are typically less than 1 degree (Guida et al. 2017). Troughs are characterized by finer sediments and higher organic matter, while ridges are characterized by relatively coarser sediments. Differences in benthic invertebrate assemblages, likely driven by differences in sediment characteristics, have been observed that include increased diversity and biomass within troughs (Rutecki at al. 2014). This may subsequently influence distribution of fish and shellfish. Ridge and trough habitat features are common in the mid-Atlantic OCS and not unique to the Project area.

The WFA is a relatively flat expanse of predominantly soft sediments. The Mid-Atlantic Ocean Data Portal and the Nature Conservancy (Greene et al. 2010) have characterized sediments of the Lease Area as ranging from fine (0.005 to 0.010 inch [0.125 to 0.25 mm]) to coarse (0.02 to 0.039 inch [0.5 to 1 mm]) sands at depths of 82 to 148 feet (25 to 45 meters). Based on sampling conducted on behalf of Ocean Wind (Inspire 2022a, 2022b), the Lease Area is dominated by sand and muddy sand interspersed with small to large patches of coarse sediment. Smaller areas of low-density boulders were also documented. As mentioned above, benthic habitats were cross-walked between benthic habitat types with modifiers and NOAA Habitat Complexity Categories; these habitats were then mapped for the WFA according to the NOAA Habitat Complexity Categories (Figure 3-4). The benthic habitats in the WFA are mapped as complex (8,123 acres or about 15 percent), soft bottom (46,926 acres or about 85 percent), and heterogeneous (254 acres or about <0.5 percent).

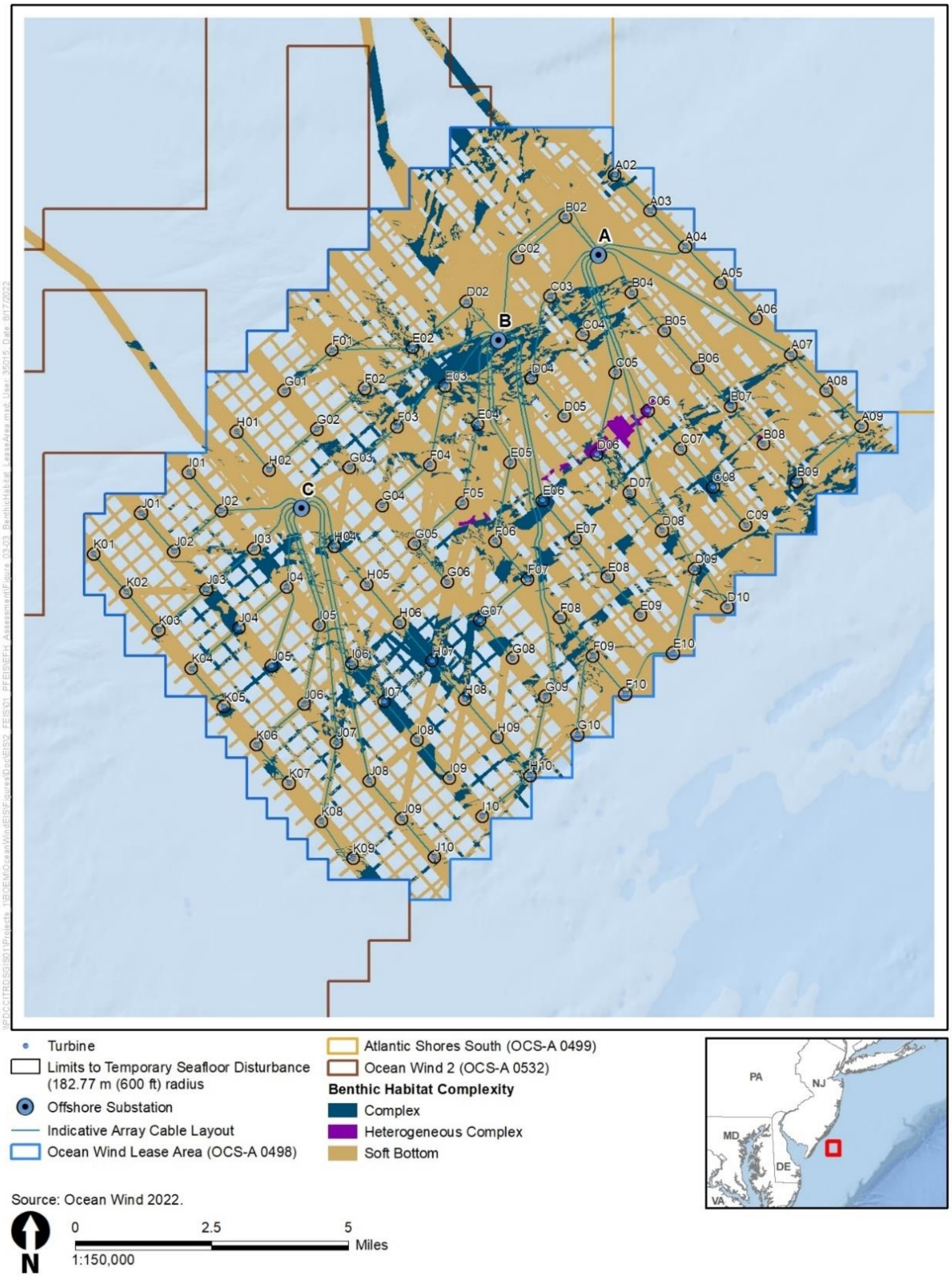


Figure 3-4 Benthic Habitats Categorized by NOAA Complexity Category at the Wind Farm Area, Foundation Footprints, Array Cables, Substation Interconnection Cables, and Export Cables, along with a Pie Chart of NOAA Complexity Category Composition with Total Acres Presented as Values

The pelagic aquatic component of the WFA is located in the open waters of the Atlantic OCS. The applicable CMECS aquatic settings for the pelagic habitat are marine offshore. Inspire Environmental conducted detailed bathymetric surveys of the WFA (Inspire 2022a). Water depth in the WFA ranges from 49 feet to 118 feet (15 to 36 meters) below MLLW.

The WFA is typical for the Atlantic OCS and characterized by summer stratification when surface temperatures may be 51.8 to 53.6 degrees Fahrenheit (°F) (11 to 12 degrees Celsius [°C]) higher than bottom temperatures. Over a monitoring period from 2003 to 2016, the average surface temperature ranged seasonally from approximately 39.2 degrees Fahrenheit (°F) to 75.2°F (4°C to 24°C) and the bottom temperature from approximately 39.2°F to 66.2°F (4°C to 19°C) (Guida et al 2017). Median salinity measured in the Lease Area for this period was 32.2 practical salinity units (PSU), with a full range spanning 29.4 to 34.4 PSU. This range is within the euhaline range (30 to 40 PSU), which is the typical salinity range for seawater (Venice salinity classification system, Anonymous 1958).

Total suspended sediment (TSS) is the pertinent water quality parameter likely to be measurably affected by Project activities. Bottom currents may resuspend silt and fine-grained sands, causing higher suspended particle levels in benthic waters. Storm events, particularly frequent intense wintertime storms, may also cause a short-term increase in suspended sediment loads (BOEM 2013). Vinhateiro et al. (2018) assumed that ambient TSS levels in the aquatic component of the Project area were generally low, less than 10 milligrams per liter (mg/L). However, Inspire (2022a) periodically encountered water column turbidity levels high enough to prevent observation of the benthos. Based on camera distance to the bed (Inspire 2020) and observed relationships between TSS and visibility (West and Scott 2016), baseline TSS levels during these observations likely exceeded 100 mg/L. Collectively, this information indicates that baseline TSS and turbidity in the Project area are generally low but could periodically exceed 100 mg/L near the seabed.

Vineyard Wind LLC used a HYDROMAP hydrodynamic model domain, which extended from approximately Provincetown, Massachusetts, to the northern tip of Cape Cod to Sandy Hook, New Jersey. The model results indicated that most of the suspended sediment mass settles out quickly and is not transported for long by currents (COP Volume II; Ocean Wind 2022a). TSS concentrations higher than 10 mg/L persisted at a given point for less than 6 or 12 hours and the plume is confined to the bottom 9.8 feet (3 meters) of the water column. Deposition greater than 0.008 inches (0.2 mm) that may occur from Project activities was confined within 656 feet (200 meters) to 919 feet (280 meters) of the trench center of the disturbance.

Nutrient concentrations, as approximated by phytoplankton concentration as chlorophyll a, were measured via remote sensing techniques (NJDEP 2010). In the coastal portions of the Project area, chlorophyll a values are higher than in the offshore areas due to input of nutrients from anthropogenic sources. The most recent phytoplankton blooms occur during the fall and winter seasons, when stratification decreases due to frequent storms and seasonal overturn. Phytoplankton blooms are also common during the summer months when winds blow surface waters away from the coast and the deeper, cooler, nutrient-rich waters well up from the depths, a phenomenon known as upwelling. When upwelling occurs, these nutrients combined with sunlight lead to phytoplankton blooms along the New Jersey coast.

Phytoplankton distribution is patchy and dependent on water temperature, light, and nutrient concentration. It is denser in nearshore areas where there is input of nutrients such as dissolved nitrogen, phosphorus, and silica from land sources. In general, in continental shelf and slope waters, the concentration of chlorophyll a (the means of measuring phytoplankton concentration) decreases with distance from shore and with increasing water depth. Phytoplankton within the coastal waters are typically dominated by chromophytic algae with diatoms being the major phytoplankton taxa present (NJDEP 2010).

The major zooplankton groups in the WFA include chaetognaths, copepods, gelatinous zooplankton, ichthyoplankton, amphipods, cladocerans, euphausiids, heteropods mostly of the copepods *Pseudocalanus* sp. and *Centropages typicus*, and pteropod *Limacina retroversa*. Seasonal water changes off the coast of New Jersey regulate zooplankton productivity, species composition, and spatial distribution. In general, zooplankton display a strong seasonal pattern with a spring enhancement of biomass within the upper 656 feet (200 meters) of the water column. Typically, maximum abundance occurs during spring between April and May on the outer shelf (dominated by *Pseudocalanus* sp. and *Calanus finmarchicus*), as well as late summer between August and September on the inner shelf (dominated by *C. typicus* and *Ternora longicornis*). The lowest abundance begins in November and reaches a minimum in February (NJDEP 2010). Thermal stratification is seasonal, and when it breaks down, nutrients are released to the surface waters, driving seasonal patterns.

High productivity is typical of the Northeast Continental Shelf large marine ecosystem, but productivity varies both spatially and seasonally. Large seasonal changes in water temperature occur in the Project area due to the influence of the Gulf Stream and ocean circulation patterns, which strongly regulate the productivity, species composition, and spatial distribution of zooplankton (NJDEP 2010). In 2021, for example, increasing zooplankton diversity in the Mid-Atlantic Bight was attributed to the declining dominance of a calanoid copepod (*C. typicus*), while the zooplankton community maintained a similar composition of other species (NOAA 2021). The temporal and spatial patterns of *Calanus* copepods (zooplankton) have been linked to the phases of the North Atlantic Oscillation, which has a direct effect on the position and strength of important North Atlantic Ocean currents (Fromentin and Planque 1996; Taylor and Stephens 1998).

Within the WFA, Guida et al. (2017) used the CMECS habitat classification system and identified the following benthic assemblages: small surface-burrowing fauna, small tube-building fauna, clam beds, and sand dollar beds. Amphipods were present but not a core assemblage. These communities perform important functions, such as water filtration and nutrient cycling, and are also a valuable food source for many species. Spatial and temporal variation in benthic prey organisms can affect growth, survival, and population levels of fish and other organisms. The region experiences seasonal variations in water temperature and phytoplankton concentrations, with corresponding seasonal changes in the densities of benthic organisms. The spatial and temporal variation in benthic prey organisms can affect the growth, survival, and population levels of fish and other organisms. Records of shellfish species of concern in the New Jersey Wind Energy Area include sea scallop (*Placopecten magellanicus*), surfclam and ocean quahog. Ocean quahog was not found in the Ocean Wind Lease Area. Sea scallops occurred in the Ocean Wind Lease Area and the adjacent OCS-A 0499 but were more commonly encountered in OCS-A 0499. In most cases, they were sampled only in small numbers and are not considered to be abundant within the Project area. Current sea scallop EFH does not intersect the New Jersey Wind Energy Area (Guida et al. 2017).

In 2017, Ocean Wind conducted benthic habitat surveys in the areas of two Floating Light Detecting and Ranging (FLiDAR) buoys within the WFA (Alpine 2017). Sediment samples were collected using a 1.2-square foot (0.1 square meter) Day grab sampler and ground-truthed with a camera. Sediments were characterized as sandy with shell fragments. The dominant fauna were tube worms and sand dollars. The benthic community at each FLiDAR location is typical of sandy bottom habitats and included Annelida, Arthropoda, Mollusca, and Echinodermata (Alpine 2017). Based on seabed imagery and sampling, there was no evidence of sensitive benthic habitats, as defined by BOEM (2013), such as exposed hard bottoms, algal beds, or the presence of anthozoan species.

Additional sampling performed by Inspire Environmental in 2018 and 2022 combined sediment profile and plan view imaging within the Lease Area (Inspire 2020, 2022b). Sediments were identified as sand sheets within the Lease Area. Nearly all of the benthic habitats mapped within the WFA were highly dynamic and mobile with over 52,500 acres (approximately 95% of the area) described further using the

CMECS Mobile modifier. Ripples observed within these areas were dynamic over relatively short temporal scales with the direction of the ripples often differing between surveys. Habitats without ripples were relatively small in spatial extent and were distributed mostly in the eastern and southeastern portions of the WFA (Inspire 2020, 2022b). A single station in the southern portion of the Lease Area consisted of continuous shell hash on sand.

The soft-sediment fauna were the predominant biotic subclass in the Lease Area. Other subclasses encountered consisted of attached fauna, inferred fauna (areas dominated by evidence of faunal activity, but where the fauna themselves are not currently present or evident), and worm reef biota, such as tube-building fauna, mobile crustaceans, and sand dollar beds (Inspire 2020). June 2022 survey results from SPI/PV and video collected at the sand ridge area in the east part of the WFA found sand dollars were present at both crests and troughs, with a distinctly higher average density along the crests (Inspire 2022a). A mop of longfin squid eggs was present at a single station; spent squid egg casings were present at three stations within the Lease Area (Inspire 2020). The only species of concern observed across the surveyed area was the sea scallop, observed at one station. No invasive species were identified within the surveyed area.

Benthic habitat for the Project area were characterized according to CMECS Standard Biotic Subclasses and were generally composed of Soft Sediment Fauna with a few isolated areas of Worm Reef Biota and Attached Fauna (Figure 3-5). Greater variability was present at the Biotic Group classification level, with Biotic Groups well suited to dynamic sandy environments, such as the prevalence of Sand Dollar Beds. Within the Lease Area, Sand Dollar Beds and Larger Tube-Building Fauna were observed most frequently. Tunicate Beds and various mobile epifauna, such as gastropods and crustaceans, were also observed. Both Small and Large Tube-Building Fauna were observed along the BL England OECRC. Along the Oyster Creek OECRC, the most frequently observed Biotic Group was Small Tube-Building Fauna. Other notable Biotic Groups were Sand Dollar Beds and Sabellariid Reefs. The Sabellariid Reef Biotic Groups documented within the Offshore Project area were patchy in nature and did not form large, continuous seafloor features (Inspire 2022a).

Guida et al. (2017) identified Atlantic surfclam, Atlantic sea scallop, and ocean quahog as species of concern that may potentially occur in the Offshore Project Area. According to survey results summarized in Guida et al. (2017), sea scallops are not abundant within the Offshore Project Area and the current EFH designation does not intersect with any of the project components. The June 2022 SPI/PV survey found a very small number of species of concern in the Wind Lease Area, including scallop and Atlantic surfclam (Figure 3-6); no species of concern were observed along the export cable route corridors.

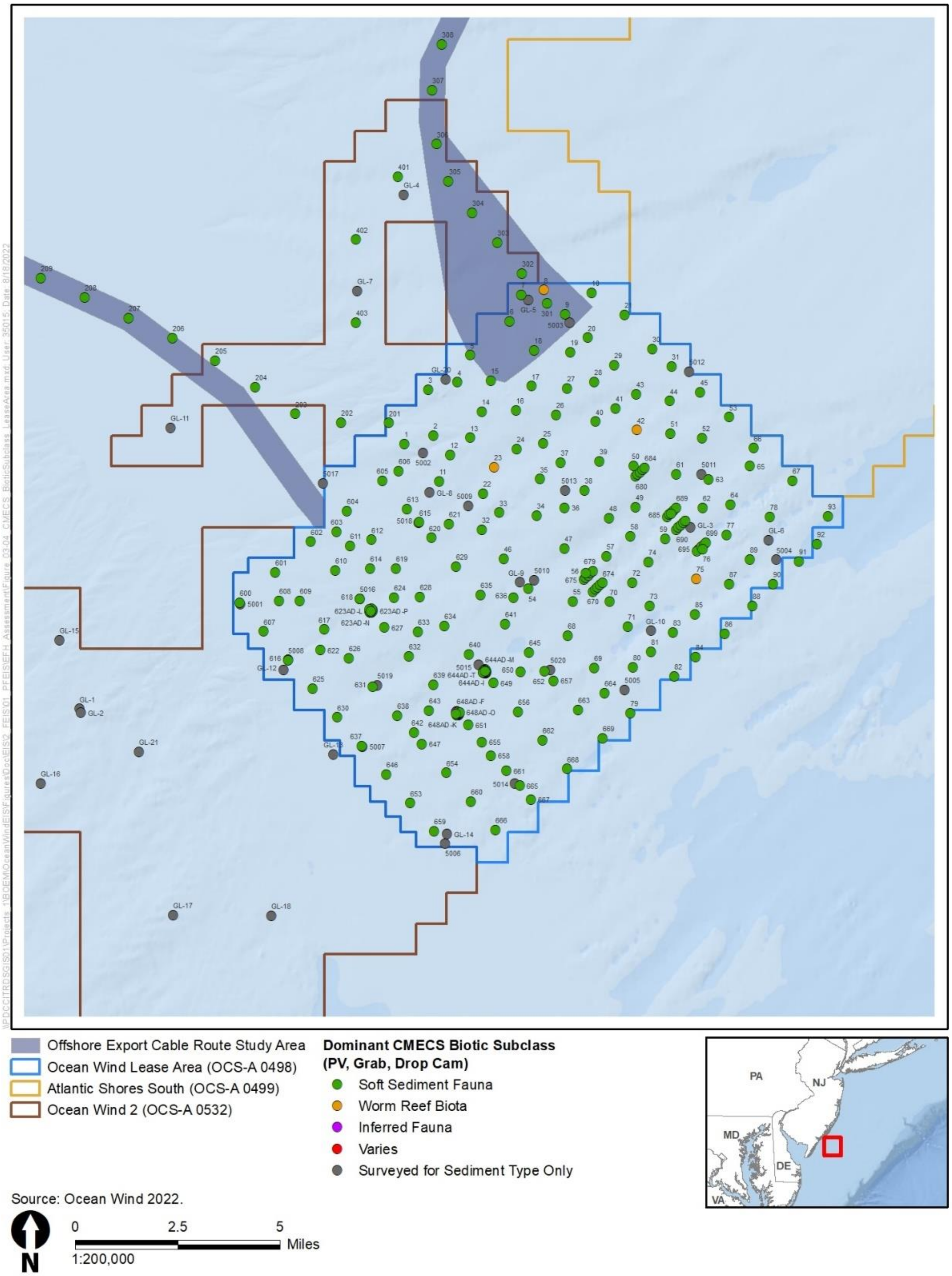
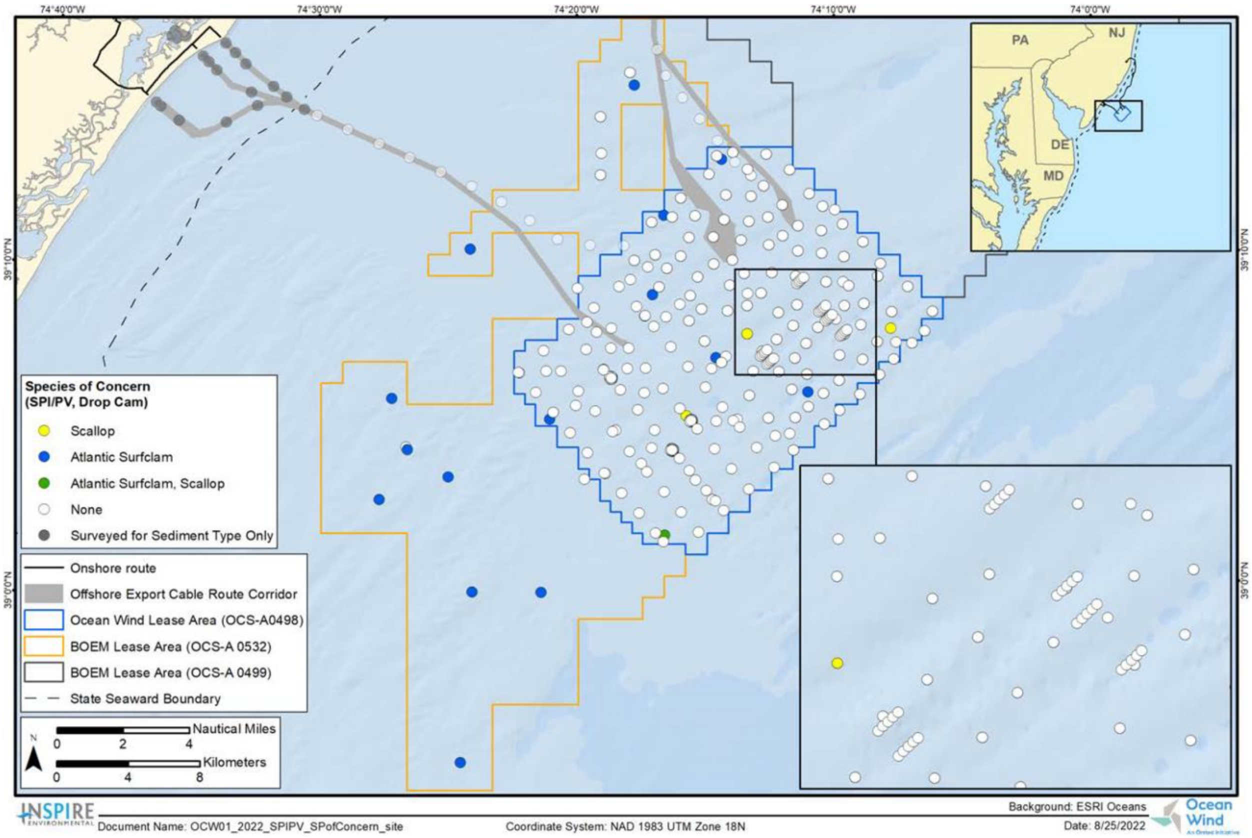


Figure 3-5 CMECS Biotic Subclass at Stations Sampled at the Ocean Wind Lease Area



No Species of Concern were found along the export cable corridors.

Figure 3-6 Distribution of Species of Concern at Stations Sampled at the Ocean Wind Lease Area

3.2 Offshore/Onshore Export Cable

3.2.1 Offshore Export Cable Route Corridors

Ocean Wind's geophysical survey recorded water depths in along the export cable route options. In federal waters outside the 3.5-mile (3 nm, 5.6 km) maritime limit, the water depths varied from -32.8 feet (-15 meters) MLLW to nearly -98.4 feet (-30 meters) MLLW (Figure 3-7).

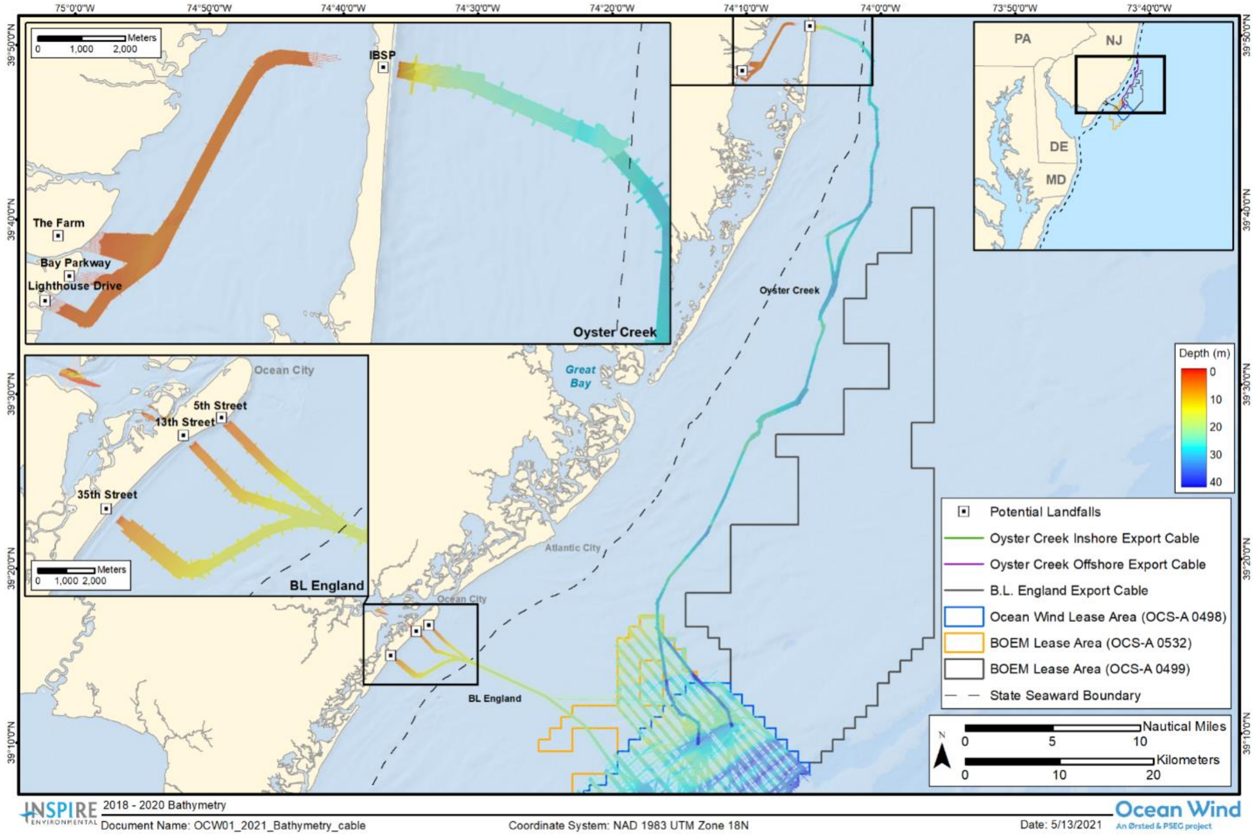


Figure 3-7 Bathymetric Data along the BL England Offshore Export Cable Route Corridor and the Oyster Creek Offshore and Inshore Export Cable Route Corridors

Along the export cable route options, the seafloor sediment consists predominantly of sand with various amounts of gravel and patches of fine-grained sediments (Figure 3-8). Several designated sand and gravel borrow areas are mapped in the vicinity of the Offshore Project area. Close to shore, surficial sediments of mixed fine-grained estuarine deposits and overwash of tidal-delta sands are found, as well as fine-grained estuarine clays and silts deposited by multiple rivers. Locally, gravel may be observed in the upper 9.8 feet (3 meters). Studies in the nearshore zone near Atlantic City (depths of approximately 50 feet [15 meters]) indicate that longshore currents can be sufficiently energetic to entrain and transport sands along the seafloor, but these currents are mainly limited to high-energy storm events (Miller et al. 2014).

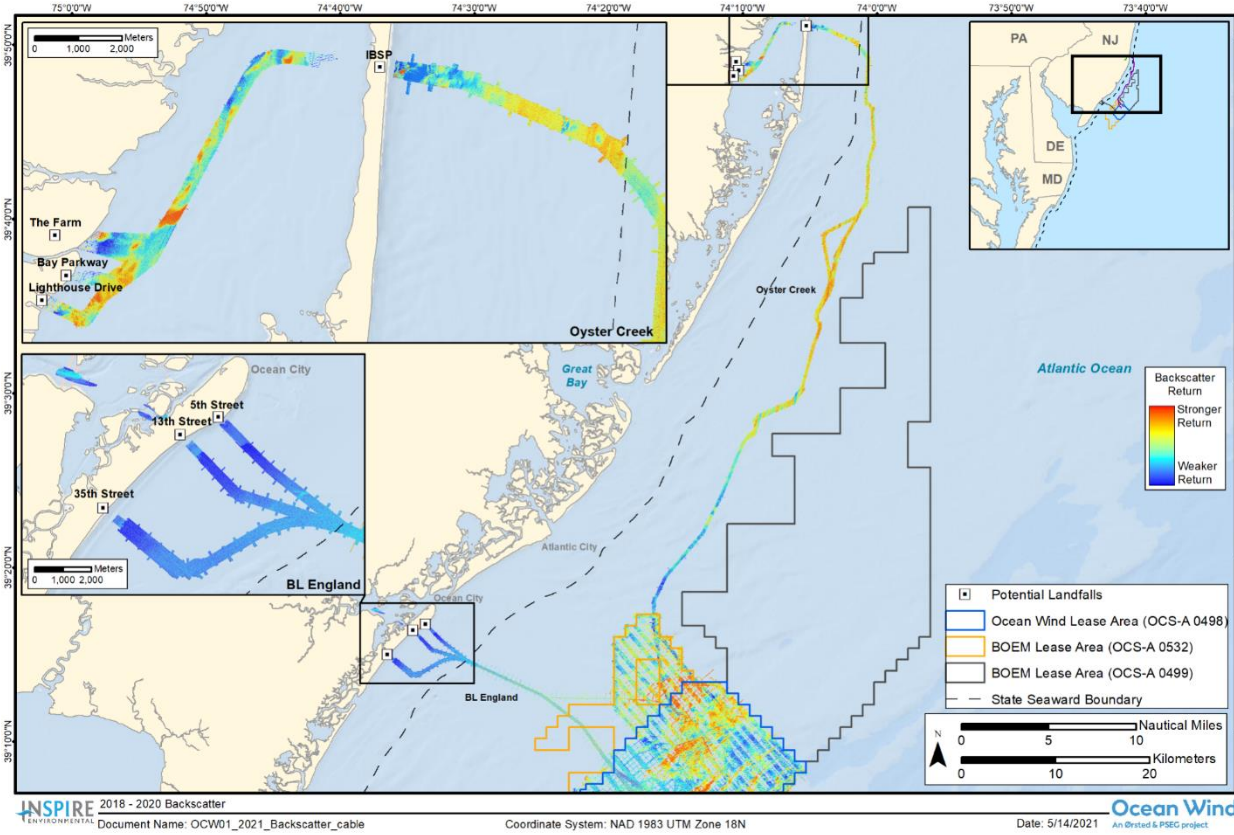


Figure 3-8 Backscatter Data Over Hill-Shaded Bathymetry Along the BL England Offshore Export Cable Route Corridor and the Oyster Creek Offshore and Inshore Export Cable Route Corridor

Inspire Environmental (2022a) described the BL England OECRC as being similar to the WFA, and was composed of Sand and Muddy Sand (2,897 acres; 85% of the area) (Inspire 2022a). Few of these habitats were classified as Mobile; closest to the WFA, the seafloor was relatively featureless with frequent small depressions of unknown origin. Closer to shore, Mud and Sandy Mud habitats totaling 470 acres (14% of the area) were mapped (Inspire 2022a). Two discrete areas of Mud and Sandy Mud with Low Density Boulder Field habitats were mapped along the corridors approaching the 15th and 5th St. Landfall locations (60 acres, 2% of the area). Habitats mapped within the BL England OECRC were relatively homogeneous with ground-truth data revealing sediments composed of varying degrees of sand and mud (Inspire 2022a). Biotic ground-truth data were only available in the portions of the corridor located further from shore. All biota observed within Sandy and Muddy Sand habitats along the BL England OECRC were Soft Sediment Fauna comprised predominantly of small and large tube-building taxa (Inspire 2022a).

The Oyster Creek OECRC exhibits differing results from that of other parts of the offshore Project area. Habitats along the corridor were Sand and Muddy Sand (4,686 acre; 51% of the areas) and Course Sediment (4,471 acres; 49% of the area) (Inspire 2022a). The federal water component of the corridor was comprised of highly dynamic substrate composition, with 8,400 acres (93% of the area) described as Mobile substrate. Sand and Muddy Sand, Mobile and Course Sediment, and Mobile substrates were interspersed and alternating along the length of the Oyster Creek OECRC. As mentioned above, benthic habitats were cross-walked between benthic habitat types with modifiers and NOAA Habitat Complexity Categories; these habitats were then mapped for the WFA according to the NOAA Habitat Complexity Categories (Figure 3-9). The benthic habitats along the Oyster Creek offshore export cable corridor and landfalls are mapped as complex (4,470 acres or 49 percent) and soft bottom (4,686 acres or 51 percent). The benthic habitats along the BL England offshore export cable corridor and landfalls are mapped as complex (40 acres or 1 percent), soft bottom (3,311 acres or 97 percent), and heterogeneous complex (60 acres or 2 percent). The Oyster Creek inshore export cables corridor and landfalls are mapped as complex (352 acres or 21 percent), soft bottom (1,343 acres or 79 percent), and heterogeneous complex (6 acres or <0.5 percent).

CMECS Biotic Subclasses along the OECRC and IECRC were generally composed of Soft Sediment Fauna with a few isolated areas of Worm Reef Biota and Attached Fauna (Figure 3-10). Greater variability was present at the Biotic Group classification level, with Biotic Groups well suited to dynamic sandy environments, such as Sand Dollar Beds, being prevalent. Both Small and Large Tube-Building Fauna were observed along the BL England OECRC (). Along the Oyster Creek OECRC, the most frequently observed Biotic Group was Small Tube-Building Fauna. Other notable Biotic Groups were Sand Dollar Beds and Sabellariid Reefs. Certain types of sabellariid reefs most often occur parallel to an ocean shoreline in shallow water, but many are also found in deeper waters where current energy is high (FGDC 2012). The Sabellariid Reef Biotic Groups documented within the Offshore Project Area were patchy in nature and did not form large continuous seafloor features.

Physical and biological parameters along the OECRC and IECRC are generally similar to those found in the lease area, and are discussed in Section 3.1.1. Information regarding the Barnegat Bay component of the IECRC is discussed in Section 3.1.2.3.

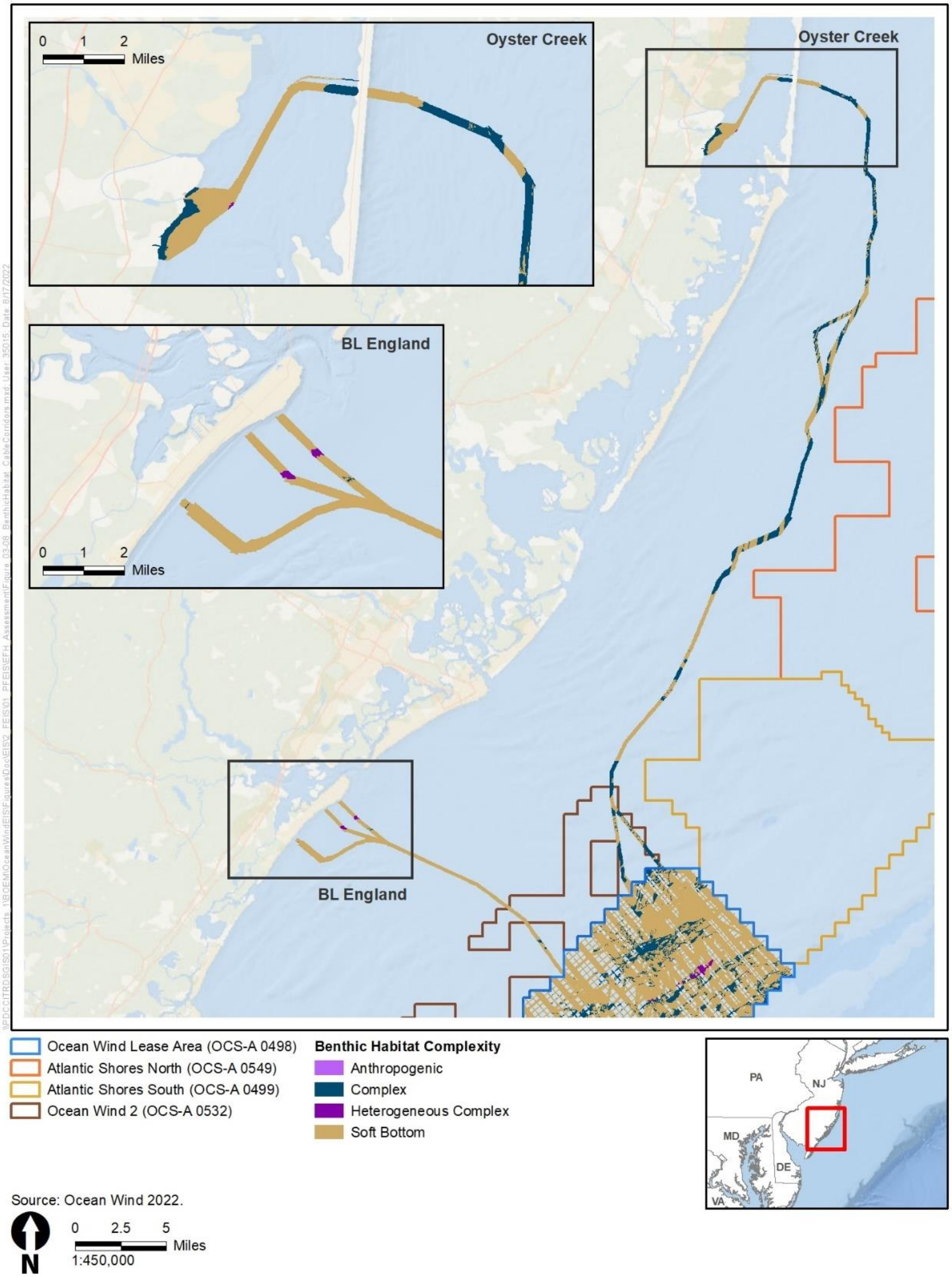


Figure 3-9 Benthic Habitats Categorized by NOAA Complexity Category BL England Offshore Export Cable Route Corridor and the Oyster Creek Offshore and Inshore Export Cable Route Corridors and Pie Charts of NOAA Complexity Category Composition with Total Acres Presented as Values for Each

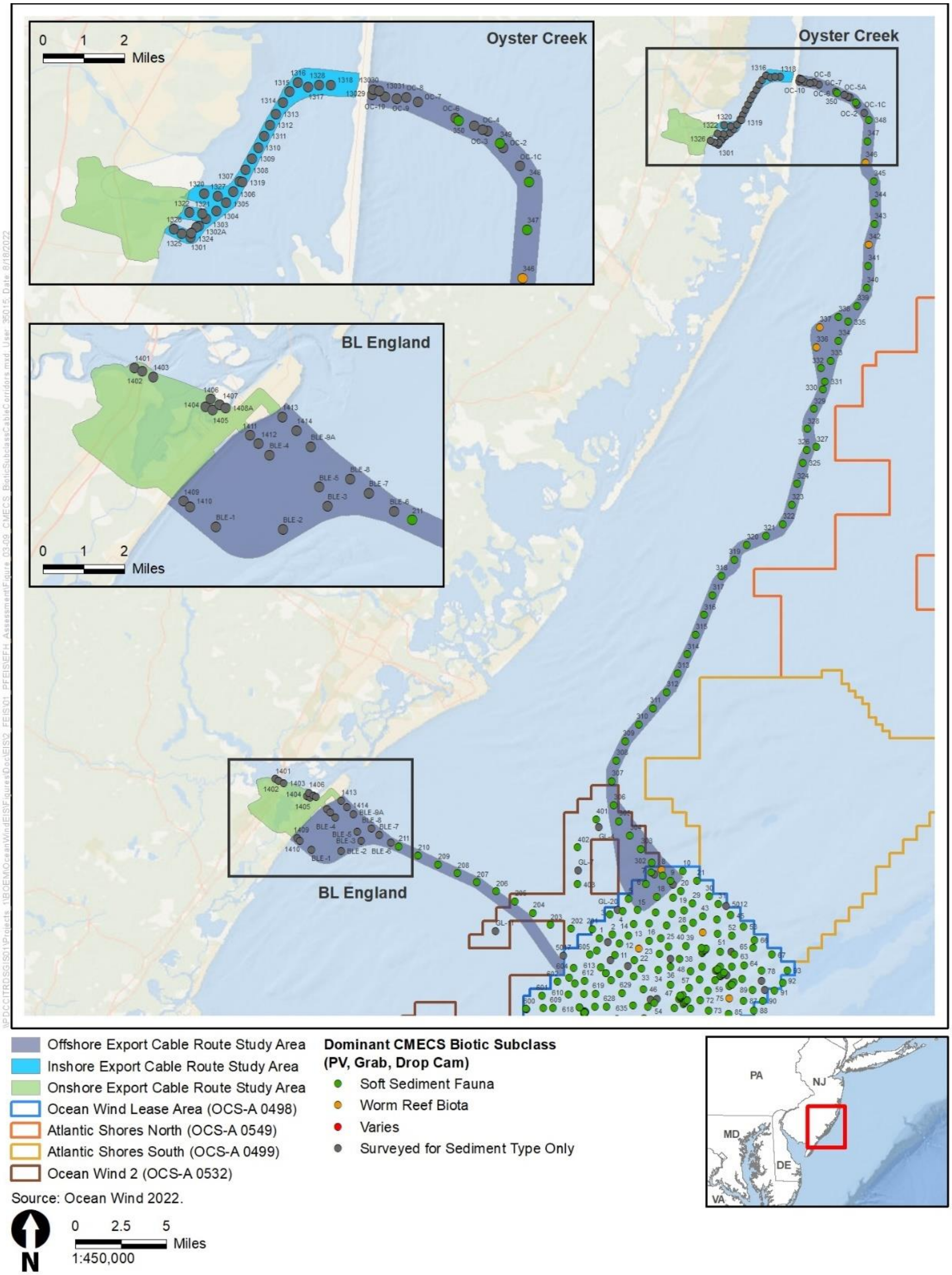


Figure 3-10 CMECS Biotic Subclass at Stations Sampled along the Export Cable Route Corridors

3.2.2 Interior Coastal – Oyster Creek Inshore Export Cable Route Corridor (IECRC)

The IECRC is the portion of the Oyster Creek export cable corridor that crosses the Barnegat Bay – Little Egg Harbor estuary. Water depths within the estuary of Barnegat Bay recorded on NOAA nautical charts range from -1.0 to -9.8 feet (-0.3 to -3.0 meters) MLLW, with a majority of the open water area within the study corridor ranging from -1.0 to -5.9 feet (-0.3 to -1.8 meters) MLLW. The deeper areas are found along the designated intracoastal waterway, which ranges in depth from -6.9 to -9.8 feet (-2.1 to -3.0 meters) MLLW. The channels leading to Barnegat Inlet, including Oyster Creek Channel and Double Creek Channel, have the greatest depths, ranging from -7.9 to -20.0 feet (-2.4 to -6.1 meters) MLLW.

Water depths for Great Egg Harbor Bay (within the BL England study area) recorded on NOAA nautical charts are shallow, ranging from -1.0 to -3.0 feet (-0.3 to -0.9 meters) MLLW. The deepest areas, ranging from -3.3 to -41.0 feet (-1.0 to -12.5 meters) MLLW, are found at Great Egg Harbor Inlet and channels leading to the southern portions of the study corridor and up Great Egg Harbor River.

Benthic communities in back bays such as Barnegat Bay and Great Egg Harbor differ from that of the open ocean because these areas are protected from the wave action and currents that occur in the open ocean. Reduced wave and current action influence substrate sediment type, which, along with other environmental factors such as water quality influence benthic communities. The Mid-Atlantic Ocean Data Portal and the Nature Conservancy (Greene et al. 2010) have characterized species, habitats, and ecosystems of the Estuarine Project Area—in particular, the Barnegat Bay and Great Egg Harbor estuaries. According to these sources, the majority of the benthic habitat within Barnegat Bay is composed of very fine (0.002–0.005 inches [0.06–0.125 mm]) and fine (0.005–0.01 inches [0.125–0.25 mm]) sands at depths of less than 32.8 feet (10 meters). The Great Egg Harbor estuary is mapped as mostly medium sand (0.01–0.02 inches [0.25–0.5 mm]) and depths of less than 32.8 feet (10 meters).

Taghon et al. (2017) studied the benthic community of the Barnegat Bay - Little Egg Harbor estuary using Van Veen grab samples. The benthic surveys were conducted in 2012, 2013 and 2014. The study found that benthic invertebrates were abundant and the community was, in general, highly diverse. Spatial variability in community structure was correlated to sediment size. These data were then compared, where possible, to historical data collected from 1965 to 2010 and demonstrated few changes in abundance and species composition. Scott and Bruce (1999) conducted sampling in and around Great Egg Harbor Inlet as part of the assessment of offshore borrow pits and nearshore placement. Sampling was conducted on soft sandy bottoms and hard rocky intertidal areas. The most abundant taxa included common surf-zone clam (*Donax variabilis*), haustorid amphipod (*Amphiporeia virginiana*), mole crab (*Emerita talpoida*), and polychaete (*Scolelepis squamata*).

The offshore export cable corridor is unlikely to cross any potential SAV as SAV growth is limited by water depth (light penetration) and wave/current energy (Long Island Sound Study 2003). Therefore, this section would only describe SAV growth within estuarine waters of the Inshore Cable Corridors.

SAV in New Jersey estuaries has been studied by various public and private entities over the last 40 years. Barnegat Bay and the Oyster Creek area have been extensively studied, the coastal areas south of Little Egg Harbor (near the BL England Generating Station) have been less extensively studied. The NJDEP has mapped SAV habitat along the New Jersey coast from Sandy Hook to Cape May. The majority of this mapping took place from 1979 to 1987, with a 2011 update to Little Egg Harbor Bay (NJDEP 2017). NJDEP stipulates that historical SAV areas must be considered current SAV habitat and are subject to NJDEP regulation.

Other research has been conducted that supplements NJDEP data and provides updated maps of SAV habitat in the Barnegat Bay-Little Egg Harbor estuary. Bologna et al. (2000), Lathrop et al. (2004), and Lathrop and Haag (2011) extensively studied the locations of seagrasses in Barnegat Bay. The Bologna et al. (2000) study was conducted in Little Egg Harbor in 1999 assessing eelgrass and widgeon grass (*Ruppia maritima*) distribution. The study compares past SAV distribution maps (Good et al. 1978; Macomber and Allen 1979; and McLain and McHale 1997) to current findings and indicates drastic declines in SAV coverage within Barnegat Bay and around Oyster Creek over a period of 25 years. The findings of Lathrop et al. (2004) document continued declines as they conclude an approximately 60% decline in seagrass density from 2003 to 2009, based on the use of aerial imaging to assess seagrass habitat in Barnegat Bay. A composite map of several SAV surveys is shown in Figure 3-11. Maps with individual surveys can be found in Appendix 10-2, Section 10.2.4.

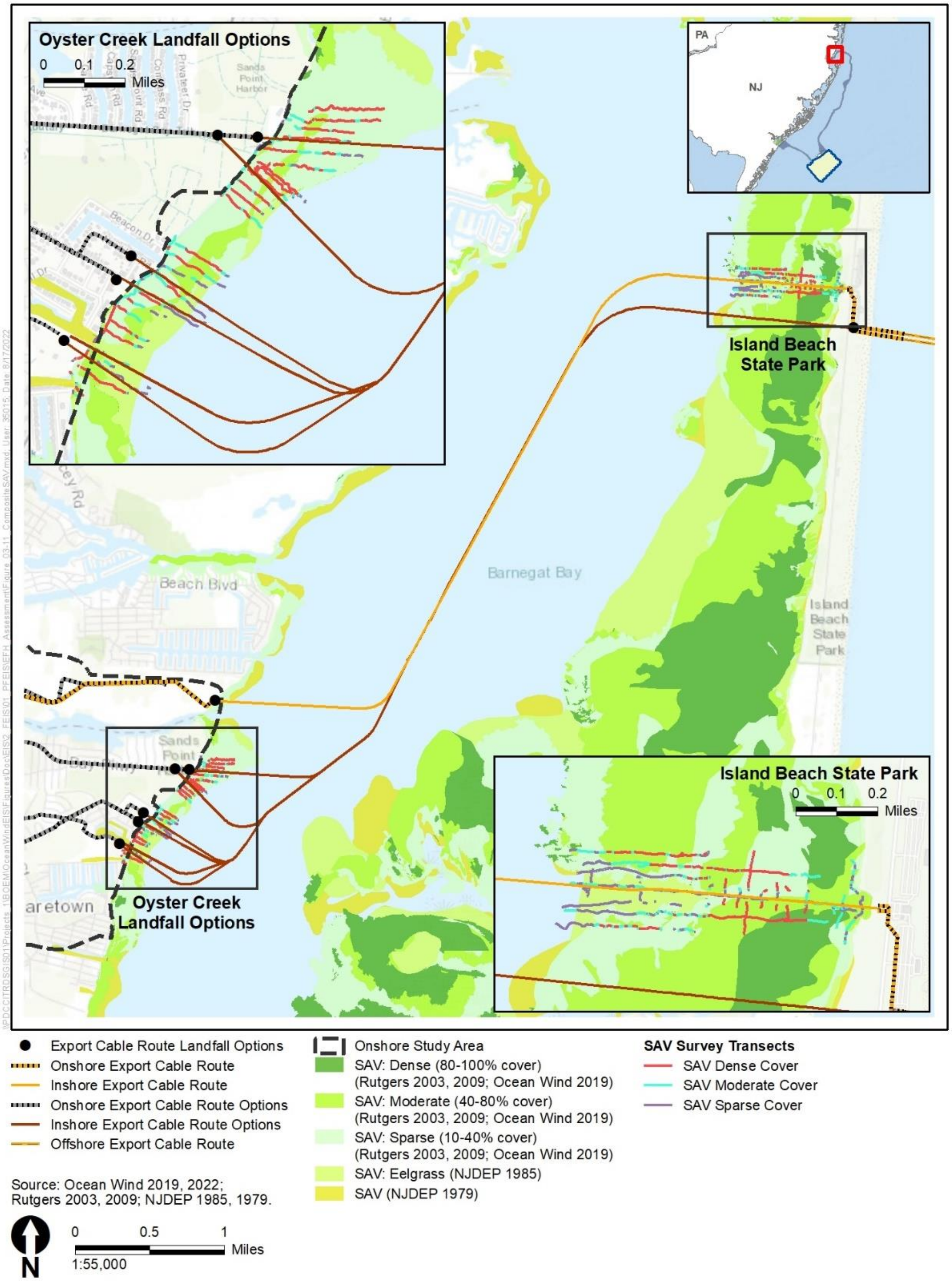
SAV serves several functions in estuarine ecosystems in New Jersey like that of Barnegat Bay (Oyster Creek area). SAV provides primary production for the Barnegat Bay estuary, and serves as critically important spawning, nursery, and feeding habitat for benthic and finfish communities. SAV also serves to stabilize the benthic habitat by attenuating waves and currents and minimizing substrate erosion. In the coastal waters and back bays of New Jersey, SAV species diversity peaks in the late spring and is highly dependent on solar radiation and water temperature. Dominant vascular and algal species within Barnegat Bay include sea lettuce (*Ulva lactuca)*, graceful red weed (*Gracilaria tikvahiae*), green sea fingers (*Codium fragile*), eelgrass (*Zostera marina*), and red algaes (*Ceramium fastigiatum* and *Agardhiella subulata*) (Kennish 2001).

In the fall of 2019, Ocean Wind conducted aerial SAV mapping surveys in Barnegat Bay and Great Egg Harbor. The survey was conducted to incorporate methodologies from previous studies (Lathrop and Haag 2011) and existing agency guidelines (Colarusso and Verkade 2016) with the main goals to inform Project design and quantify potential areas of impacts. The survey was conducted via aerial photography in October 2019 over the proposed inshore export cable route in Barnegat Bay in the Oyster Creek study area along with Great Egg Harbor in the BL England study area. The areas of SAV documented in the Phase 1 Survey are shown in Appendix 10-2, Section 10.2.4, and were used to inform the more intensive Phase 2 Survey effort.

A Phase 2 in-water drop camera SAV survey was conducted in October 2020 and included a field reconnaissance of Barnegat Bay where disturbance is anticipated to occur. The Phase 2 SAV survey was conducted to identify the presence, spatial extent, density, and species composition of SAV beds within the proposed export cable routes at the four potential landfall locations (Inspire 2022a). Survey protocols were coordinated with NJDEP, BOEM, and the NMFS. SAV was documented in 41.7% of the survey locations. Observed SAV consisted almost entirely of eelgrass, with the exception of a single location which contained widgeon grass. The results of the SAV aerial survey conducted in 2019 and in-water survey conducted in 2020 are shown in Appendix 10-2, Section 10.2.4.

In October 2021, an additional field survey was performed in Barnegat Bay to assess the presence or absence of SAV, general sediment characteristics, and water depth in a relict channel that extends west from the Island Beach State Park maintenance area. SAV was present at sites characterized as flats or channel edge (12 of 13 sites) where depths were 3 feet (0.9 meters) or less and absent from within the channel where depths were 3 to 7 feet (0.9 to 2.1 meters) (present at 1 of 20 stations with an additional channel station inconclusive due to turbidity). The results of the Island Beach State Park Prior Channel Route Option SAV survey are shown in Appendix 10-2, Section 10.2.4.

In July 2022, additional underwater video SAV data were collected in Barnegat Bay at four areas identified as The Farm, Bay Parkway, Lighthouse Drive, and IBSP. At each of the four survey areas the Oyster Creek IECRC options overlap with SAV beds as delineated by aerial survey in 2019. In general, the SAV data collected in July 2022 corroborate the previous project-specific SAV surveys conducted. Within each survey area, acreage obtained from delineations derived from aeral imagery in 2019 are similar to the acreage estimated from the 2022 underwater video transects. The exception was at the Farm landfall where no SAV beds were observed in the video data collected in 2022 (similar to the in-water data collected in 2020), although the aerial imagery from 2019 suggested about 9.5 acres of SAV. This discrepancy is likely due to challenges in discerning between SAV and macroalgal beds using aerial imagery and highlights the importance of ground truth in-water data. At the other survey areas, the SAV acreage estimated from the 2022 video transects was generally higher than what was derived from the 2019 delineations. This is likely due to the coarse spatial resolution of towed video transects, resulting in conservative polygon interpolations, compared to the aerial imagery approach. In the prior channel at IBSP, water depth limits SAV growth, however, SAV were observed with sparse coverage (single or double shoots) within the channel and with patchy or complete coverage along the shallow flanks of the channel (as also documented in the 2021 survey). Figure 3-11 shows the 2022 SAV survey transects and coverage density. More detailed survey maps and video pictures are shown in Appendix 10-2, Section 10.2.4.



Note: Maps showing individual surveys can be found in Appendix 10-2, Section 10.2.4.

Figure 3-11 Composite Map of Historic SAV Surveys of Barnegat Bay

Barnegat Bay is a shallow estuary, average depth 1.5 meters, which is approximately 70 km long and is separated from the Atlantic Ocean by a series of barrier islands (Gilbert et al. 2010). There are two inlets, Barnegat Inlet and Little Egg Inlet, which connect it to the Atlantic Ocean (Kennish et al. 2007). It is a highly eutrophic system with low freshwater input, low tidal-flushing, and a highly developed watershed (Kennish et al. 2007). As a result, it has a strong salinity gradient with high salinities near the inlets and lower salinities (to approximately 15 parts per thousand [ppt]) away from the inlets (Howson et al. 2017; Taghon et al. 2017).

The NJDEP conducts annual assessments of the state's waterways for water quality parameters and biological indicators (NJDEP 2014). These measurements include dissolved oxygen (DO), temperature, pH, turbidity, and Enterococci bacteria taken throughout the year (approximate 5-10 times per year). Approximately 440 sites in New Jersey within or near the Barnegat Bay are included in the assessment. Sampling in the 2013 season included DO, total suspended solids and clarity, and chlorophyll a.

Out of the 440 sites, there were five within Barnegat Bay that were non-attaining for turbidity and two non-attaining for DO. For Manahawkin Bay and Upper Little Egg Harbor areas of measurement, 50% of the 18 stations were below the > 5 mg/L DO target. For samples taken from 15 stations in Lower Little Egg Harbor, 44% were below the > 5 mg/L DO target (NJDEP 2014). Manahawkin Bay, Upper Little Egg Harbor, and Lower Little Egg Harbor Bay water quality were designated as fully supporting recreation and shellfish, but not supporting wildlife due to increased turbidity and low DO levels.

Extensive studies have been conducted on plankton in the Barnegat Bay-Little Egg Harbor Estuary to assess phytoplankton and zooplankton populations (Ren et al. 2017). Surveys were conducted to collect data on the zooplankton, including ichthyoplankton, gelatinous macrozooplankton, and copepods, decapods, and bivalves. The zooplankton community in Barnegat Bay is characterized by strong spatial and seasonal trends in abundance and diversity. Northern and southern regions of the bay show the most apparent spatial variability in their community assemblage and water quality characteristics. The northern bay was characterized by higher nitrogen and chlorophyll a, higher abundances of copepods, ctenophores, and barnacle larvae, and the lowest species diversity of zooplankton and ichthyoplankton in the bay. Alkalinity and phosphorus were higher in the southern bay, as was species diversity of both zooplankton and ichthyoplankton (Howson et al. 2017).

Water quality conditions driven by urbanization and lack of flushing in northern Barnegat Bay appear to be steering these trends. Similar extensive studies on phytoplankton and zooplankton assemblages and populations in Great Egg Harbor Bay are not readily available. However, because of its proximity, it is assumed the data collected from the Barnegat Bay-Little Egg Harbor Estuary provides representative information on zooplankton and phytoplankton communities, where spatial and seasonal variability are anticipated to be similar. Weather patterns appear to be directly and indirectly affecting zooplankton abundance in Barnegat Bay. Density-independent factors such as temperature strongly contribute to variability in biological systems seen on an interannual basis (Howson et al. 2017).

TSS levels are not routinely monitored in New Jersey. In general, TSS and turbidity levels are likely to be low in enclosed waterbodies such as Barnegat Bay and Great Egg Harbor, except on rare occasions during periodic maintenance dredging. TSS levels associated with dredging are useful for characterizing baseline TSS conditions associated with routine maintenance of the navigation channel and harbor. Anchor (2003) reviewed available literature on dredging-related water quality effects and found that maximum TSS concentrations during dredging ranged from 282 to 485 mg/L in proximity to dredging activities.

Vineyard Wind LLC used a HYDROMAP hydrodynamic model domain, which extended from approximately Provincetown, Massachusetts, to the northern tip of Cape Cod to Sandy Hook, New Jersey. The model results indicated that most of the suspended sediment mass settles out quickly and is not transported for long by currents (Vineyard Wind 2018). TSS concentrations higher than 10 mg/L persisted at a given point for less than 6 or 12 hours and the plume is confined to the bottom 9.8 feet (3 meters) of the water column. Deposition greater than 0.008 inches (0.2 mm) that may occur from Project activities was confined within 656 feet (200 meters) to 919 feet (280 meters) of the trench center of the disturbance.

Nutrient concentrations, as approximated by phytoplankton concentration as chlorophyll a, were measured via remote sensing techniques (NJDEP 2010). In the coastal portions of the Project area, chlorophyll a values are higher than in the offshore areas due to input of nutrients from anthropogenic sources. The most recent phytoplankton blooms occur during the fall and winter seasons, when stratification decreases due to frequent storms and seasonal overturn. Phytoplankton blooms are also common during the summer months when winds blow surface waters away from the coast and the deeper, cooler, nutrient-rich waters well up from the depths, a phenomenon known as upwelling. When upwelling occurs, these nutrients combined with sunlight lead to phytoplankton blooms along the New Jersey coast.

Figure 3-12 provides the inshore Oyster Creek export cable corridor within Barnegat Bay overlayed with NJDEP shellfish densities. Figure 3-13 provides the inshore BL England export cable corridor within Great Egg Harbor Bay overlayed with NJDEP shellfish densities.

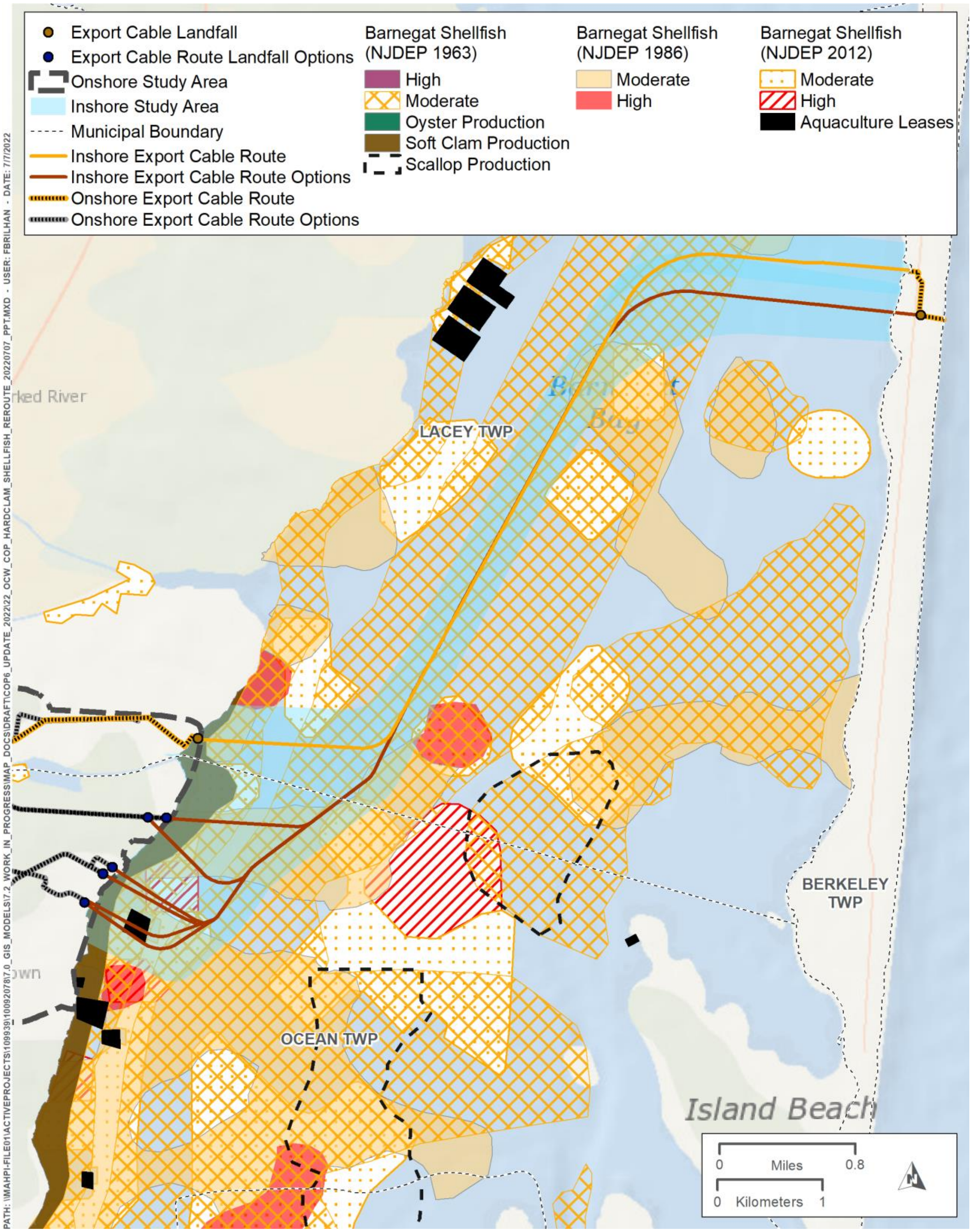


Figure 3-12 Mapping of Hard Clams by NJDEP in Central Barnegat Bay around Oyster Creek

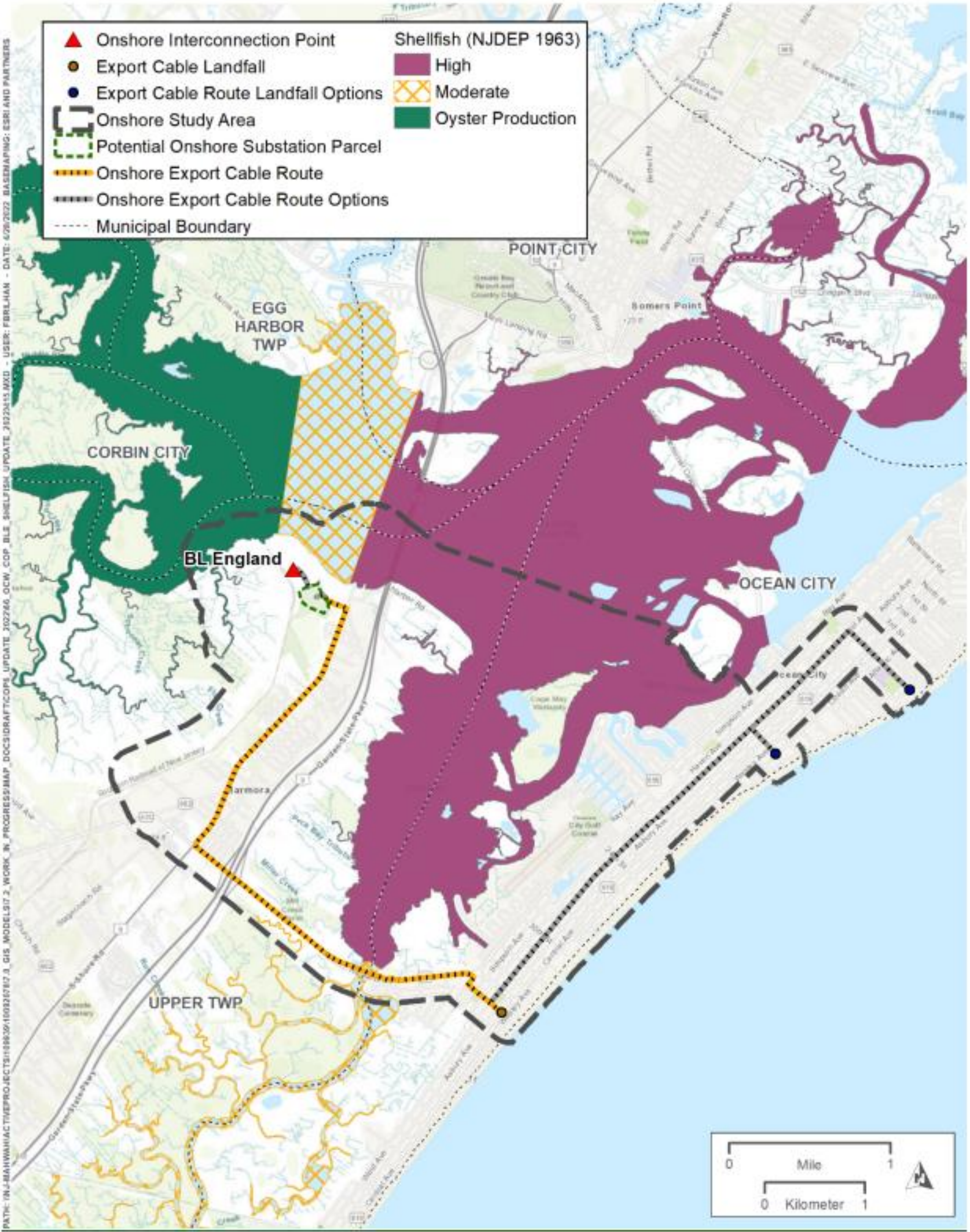


Figure 3-13 Mapping of Hardclams by NJDEP in Great Egg Harbor Bay around BL England

3.2.3 Landing Areas and Onshore Cable Route Corridors

Because there are two export cable corridors for this Project (Oyster Creek and BL England), the landfall locations and onshore cable routes for each will be discussed separately below. Tidal wetlands exist in the onshore portions of both export cable corridors. National Wetlands Inventory (NWI) and NJDEP wetland data were used to determine the potential presence of wetlands. NWI information is provided in this section and NJDEP information is provided in Appendix 10-2. NWI and NJDEP data rely on trained image analysts to identify potential wetlands. In order to confirm the extent and presence of regulated wetlands, a wetland delineation would be performed by Ocean Wind to identify the wetlands under jurisdiction of USACE and NJDEP. Authorization from USACE and NJDEP is required prior to dredge or fill of jurisdictional wetlands. Section 404 of the Clean Water Act requires that all appropriate and practicable steps be taken first to avoid and minimize impacts on jurisdictional wetlands; for unavoidable impacts, compensatory mitigation is required to replace the loss of wetlands and associated functions. Ocean Wind proposes to purchase wetland credits from the Great Bay Wetland Mitigation Bank through Evergreen Environmental, LLC, the mitigation banker. The proposed wetland impacts are entirely located within the Geographic Service area of the Great Bay Wetland Mitigation Bank. The Great Bay Wetland Mitigation Bank is a federally approved mitigation bank with available credits.

3.2.3.1 Oyster Creek Onshore Cable Route Corridor

The proposed route for the Oyster Creek onshore cable would first make landfall on the eastern side of Barnegat Peninsula (Long Beach Island) before crossing Barnegat Bay to one of six potential landfall sites on the mainland (see Section 2.2.2 for additional Project details). The ocean beach would be bypassed by the use of HDD to install the cable under the beach, with landfall occurring in the parking lot in Island Beach State Park. The beach borders the Atlantic Ocean and is a sandy, high-energy habitat characteristic of Atlantic coastal beaches, with vegetated dunes occurring above the high tide line. Ghost or sand crabs (Ocypodidae) are likely to occur along or above the high tide line on the upper beach and edge of the dunes (Wootton et al. 2016).

After landfall at Island Beach State Park, the Oyster Creek onshore cable route would then move westward across Island Beach State Park via one of two options, cross Barnegat Bay, and make a second landfall on the mainland (Figure 3-14). The northern route would landfall in an existing parking area associated with Swimming Beach #2, and then travel north for a short distance before turning west to enter Barnegat Bay in an existing maintenance area and travel along a previously dredged channel. The second option would traverse directly across Island Beach State Park, entering Barnegat Bay via open cut or HDD. There are six mainland landfall site options, and onshore export cable routes would be in Waretown (Ocean Township) and Forked River (Lacey Township), New Jersey. Lighthouse Drive, Marina, Nautilus Drive, and Bay Parkway are in developed areas, devoid of vegetation. Two proposed mainland landfall site options, Holtec Property (northernmost) and Bay Parkway 2, occur in wetland areas. The crossing of Oyster Creek would be conducted with HDD.

The Oyster Creek onshore cable route lies within two watersheds: Forked River-Barnegat Bay (HUC 12 No. 020403010405) and Oyster Creek-Barnegat Bay (HUC 12 No. 020403010407). Both watersheds are within the Barnegat Bay Watershed Management Area. Oyster Creek and the South Branch of the Forked River are the major river systems within this area. Tidal wetlands are found within the Oyster Creek onshore cable route (Figure 3-14). Low-saline marsh *Phragmites*-dominated coastal wetlands and scrub shrub wetlands dominate the area at the mouth of Oyster Creek (Ocean Wind 2022a).

3.2.3.2 BL England Onshore Cable Route

The three proposed coastal landfall sites for the BL England onshore cable route are along the eastern side of a peninsula/barrier island in Ocean City, New Jersey. The ocean beach would be bypassed by the use of HDD to install the cable under the beach, with landfall occurring primarily in developed areas. The beach borders the Atlantic Ocean and is a sandy, high-energy habitat characteristic of Atlantic coastal beaches, with vegetated dunes occurring above the high tide line. Ghost or sand crabs (Ocypodidae) are likely to occur along or above the high tide line on the upper beach and edge of the dunes (Wootton et al. 2016).

One cable route is proposed from the coastal landfall to the BL England facility. After making landfall, the cable would travel on local roads westward, cross Peck Bay using HDD, and then continue on local roads (Roosevelt Boulevard and Route 9) to the BL England substation. Tidal wetlands occur on either side of Roosevelt Blvd (Figure 3-15).

The BL England onshore cable route corridor and the O&M facility in Atlantic City, New Jersey lie within five watersheds: Absecon Bay (hydrologic unit code [HUC] 12 No. 020403020403), Cedar Swamp Creek (HUC 12 No. 020403020304), Corson Inlet-Ludlam Bay (HUC 12 No. 020403020407), Great Egg Harbor Bay-Atlantic Ocean Deep (HUC 12 No. 020403020500), and Great Egg Harbor Bay-Great Egg Harbor Inlet (HUC 12 No. 020403020408). All of these watersheds are within the Great Egg Harbor Watershed Management Area. The major watercourses draining these watersheds into the bays include Patcong Creek and the Great Egg Harbor, Middle, and Tuckahoe Rivers in the southern portion of the Project area. Estuarine wetlands within the BL England landing area are dominated by large, contiguous swaths of tidal saline low marsh communities fringed by *Phragmites* (Figure 3-15). Tidal wetlands are limited to areas adjacent to Roosevelt Boulevard and the Great Egg Harbor shoreline at the BL England substation.

3.2.3.3 Wetlands

Wetlands are important features in the landscape that provide numerous beneficial services or functions. Some of these include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, providing aesthetic value, ensuring biological productivity, filtering pollutant loads, and maintaining surface water flow during dry periods. Wetlands in and around Barnegat Bay provide flood protection during storm events and function to sequester a significant amount of the nitrogen and phosphorous loading to the bay. These coastal wetlands can remove (through deposition and plant growth) approximately 85% of the nitrogen and 54% of the phosphorus entering the bay from upland sources (NJDEP 2021). Wetlands can provide habitat for a variety of wildlife species. With more than 28% of Barnegat Bay’s salt marshes having been lost to development, stabilizing and restoring existing wetlands and preventing the loss of any more wetlands is of significant importance (NJDEP 2021).

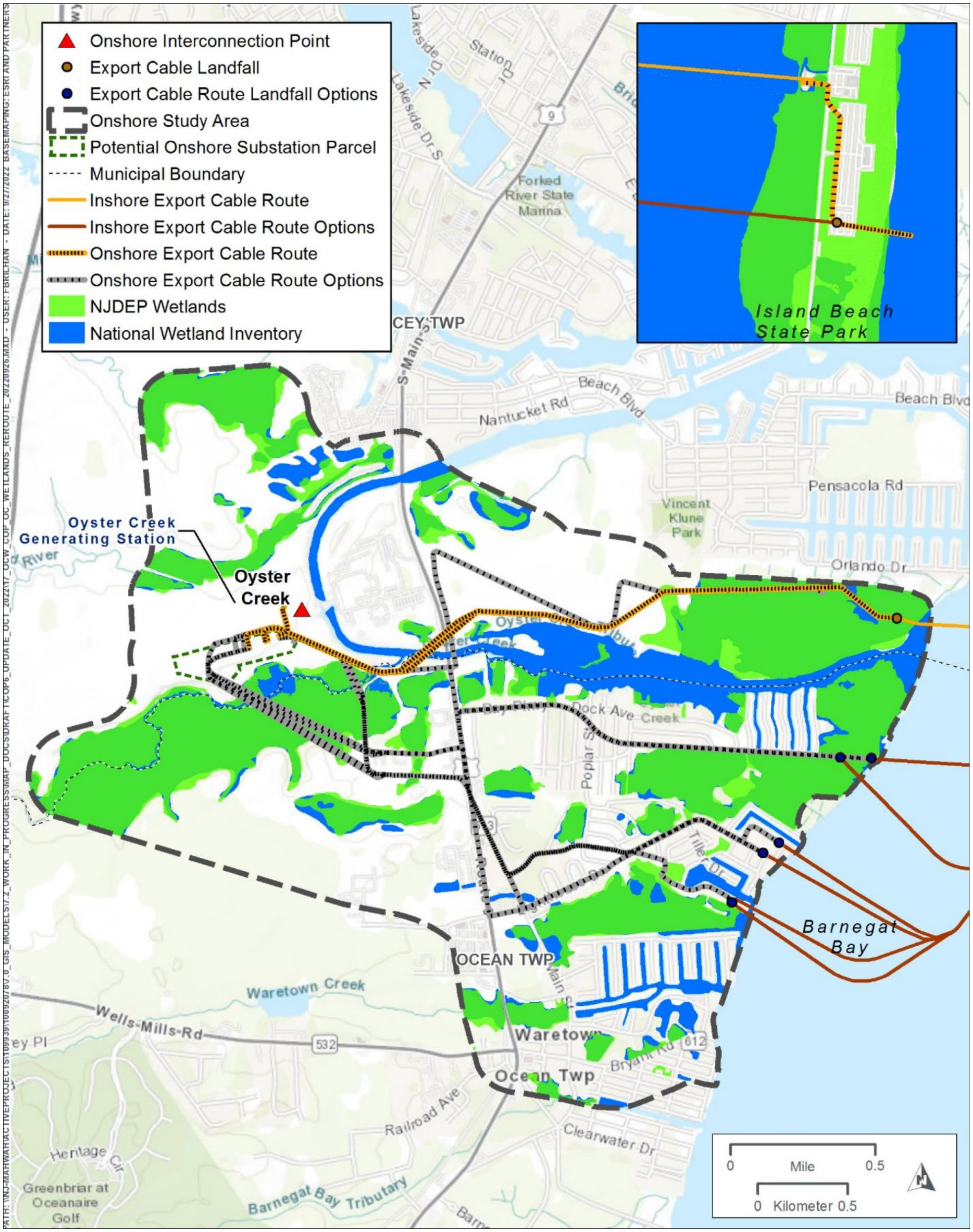


Figure 3-14 Wetland Data for the Oyster Creek Landfall Areas

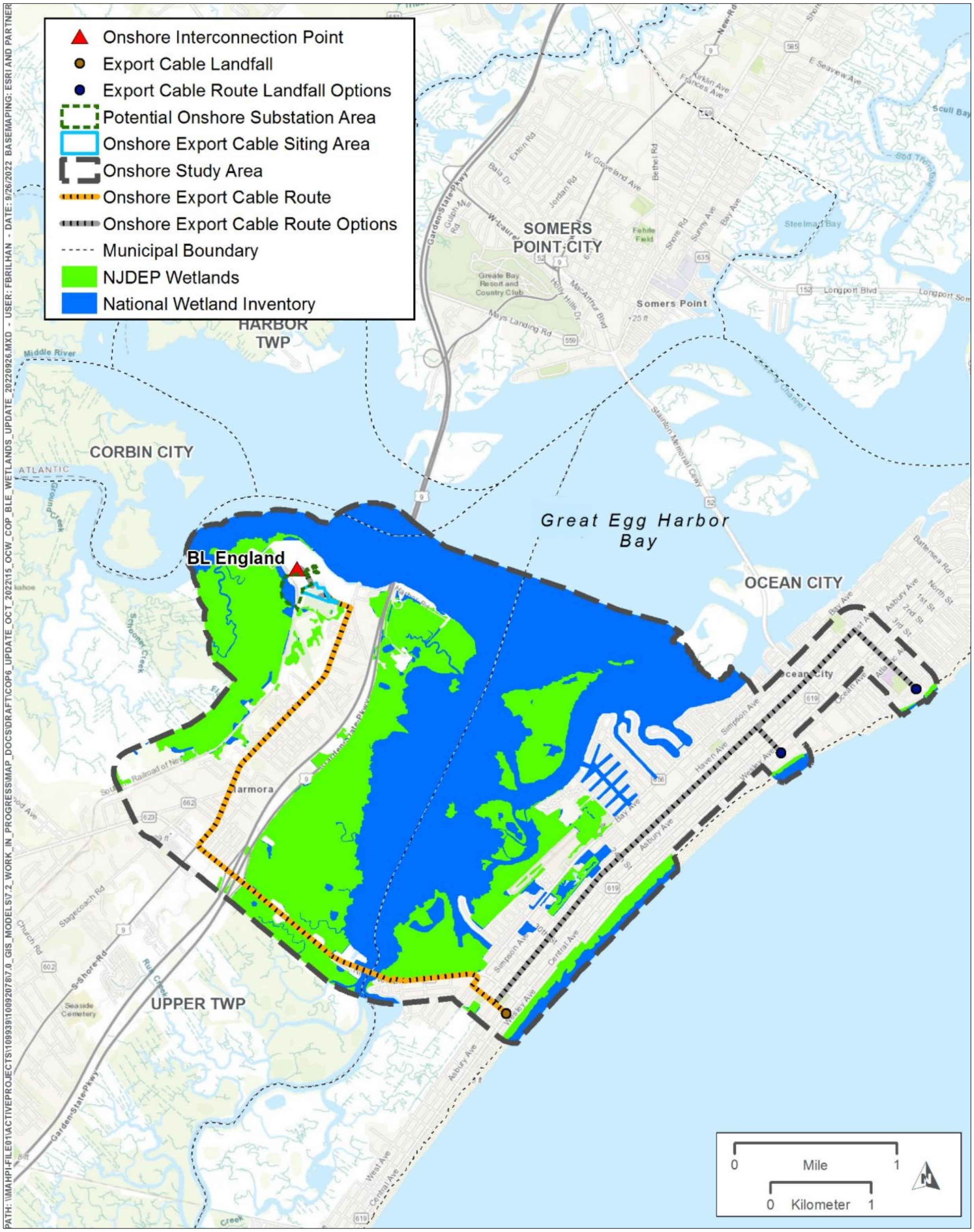


Figure 3-15 Wetland Data for the BL England Landfall Areas

3.3 Adjacent Habitats

For the purposes of discussing adjacent habitats that may be indirectly affected by construction, this section discuses resources within both a 10-mile (16.1 km) radius/buffer around the WFA and a 330-foot buffer around the export cable route corridors. This buffer is based upon where the most widespread indirect impact (namely, suspended sediment) from the proposed Project could affect benthic resources. This area would account for some transport of water masses and for benthic invertebrate larval transport due to ocean currents. Although sediment transport beyond 10 miles (16.1 km) is possible, sediment transport related to proposed Project activities would likely be on a smaller spatial scale than 10 miles (16.1 km).

3.3.1 Artificial Reefs

The location of existing artificial reef sites near the Project were identified from the NOAA Office of Coastal Management InPort library. Eleven artificial reefs were identified in the general vicinity of the Project area; however, only four are entirely or in part within the buffer around the WFA and export cable route corridors (Figure 3-16): Atlantic City Reef, Great Egg Reef, Ocean City Reef, and Deepwater Reef. Collectively, these four reef areas represent approximately 6.5 square miles (16.8 km^2) of extensively modified seafloor due to the placement of structures such as ships, tanks, railroad cars, concrete debris, and reef balls.

3.3.2 Carl N. Shuster Horseshoe Crab Reserve

The Carl N Shuster, Jr. Horseshoe Crab Reserve is a NMFS-established sanctuary located in Federal waters off the New Jersey coast just south of Little Egg Harbor and extending to the southern edge of the Delaware Bay (Figure 3-17). The sanctuary was created to protect the overwintering population of horseshoe crabs in the Delaware Bay. No commercial harvest of horseshoe crabs is permitted within the waters of the Reserve, but State and Federal regulations do not limit development activities within these waters. The horseshoe crab spawning season in the mid-Atlantic area usually occurs during May and June when large numbers of horseshoe crabs move onto sandy beaches to mate and lay eggs. During the May and June horseshoe crab spawning season, migratory shorebirds, especially the red knot, are likely to be present on the beaches feeding on horseshoe crab eggs to replenish their body weight and continue the migration to their arctic breeding grounds (NJDEP 2010).

The NJDEP Ocean Trawl Surveys are bottom trawl surveys conducted from 1988 through 2019 seasonally within inshore (<30 foot depth), mid-shore (30- to 60-foot depth), and offshore (60- to 90-foot depth) waters from Sandy Hook, New Jersey to Cape Henlopen, Delaware (Figure 3-17). Results from the survey indicate that horseshoe crab collections appear to decrease with increasing water depth. The collections were highest in the inshore strata areas of less than 30-foot water depth during spring, summer, and fall. Winter had the lowest collections.

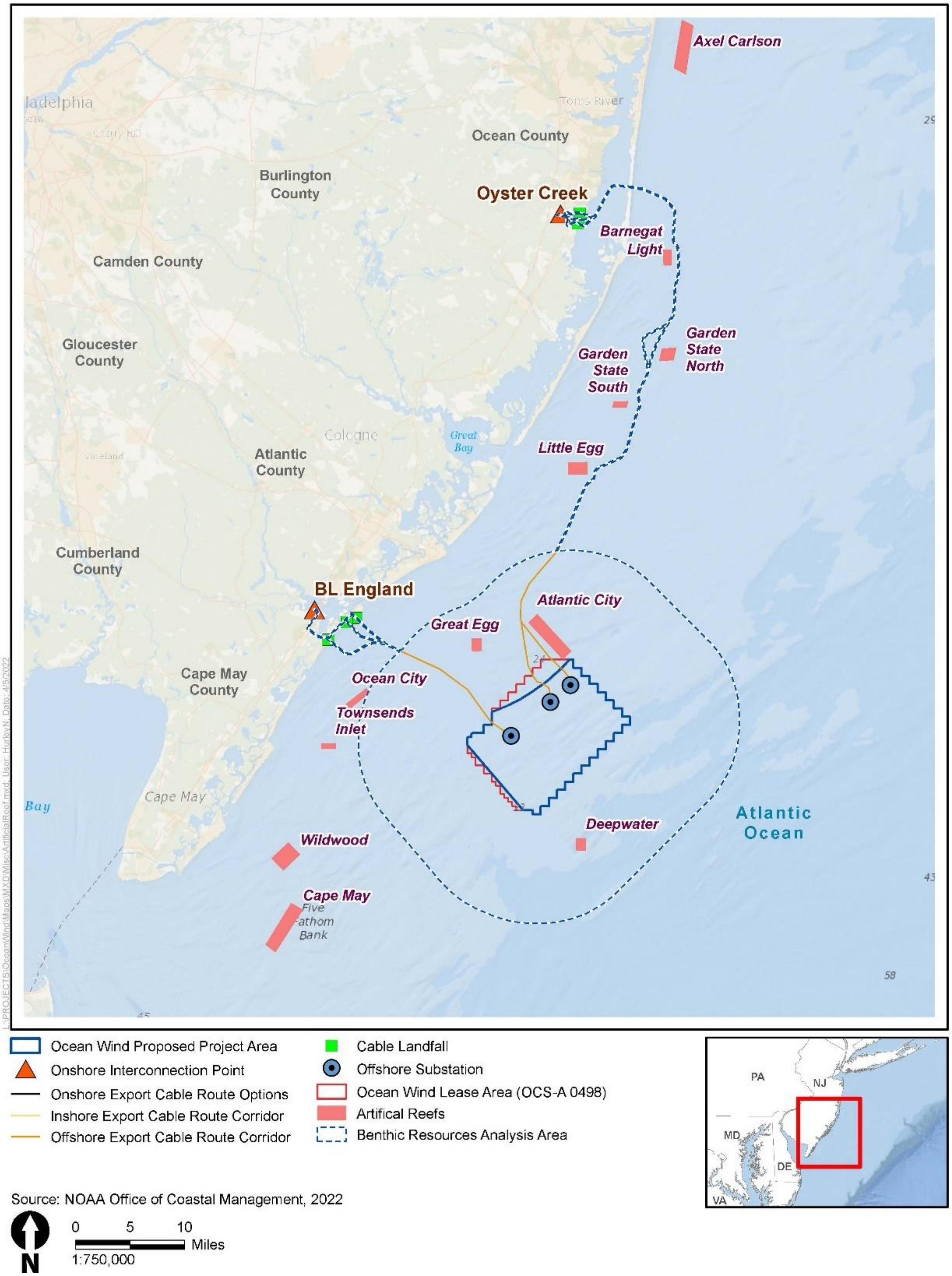


Figure 3-16 Artificial Reef Sites

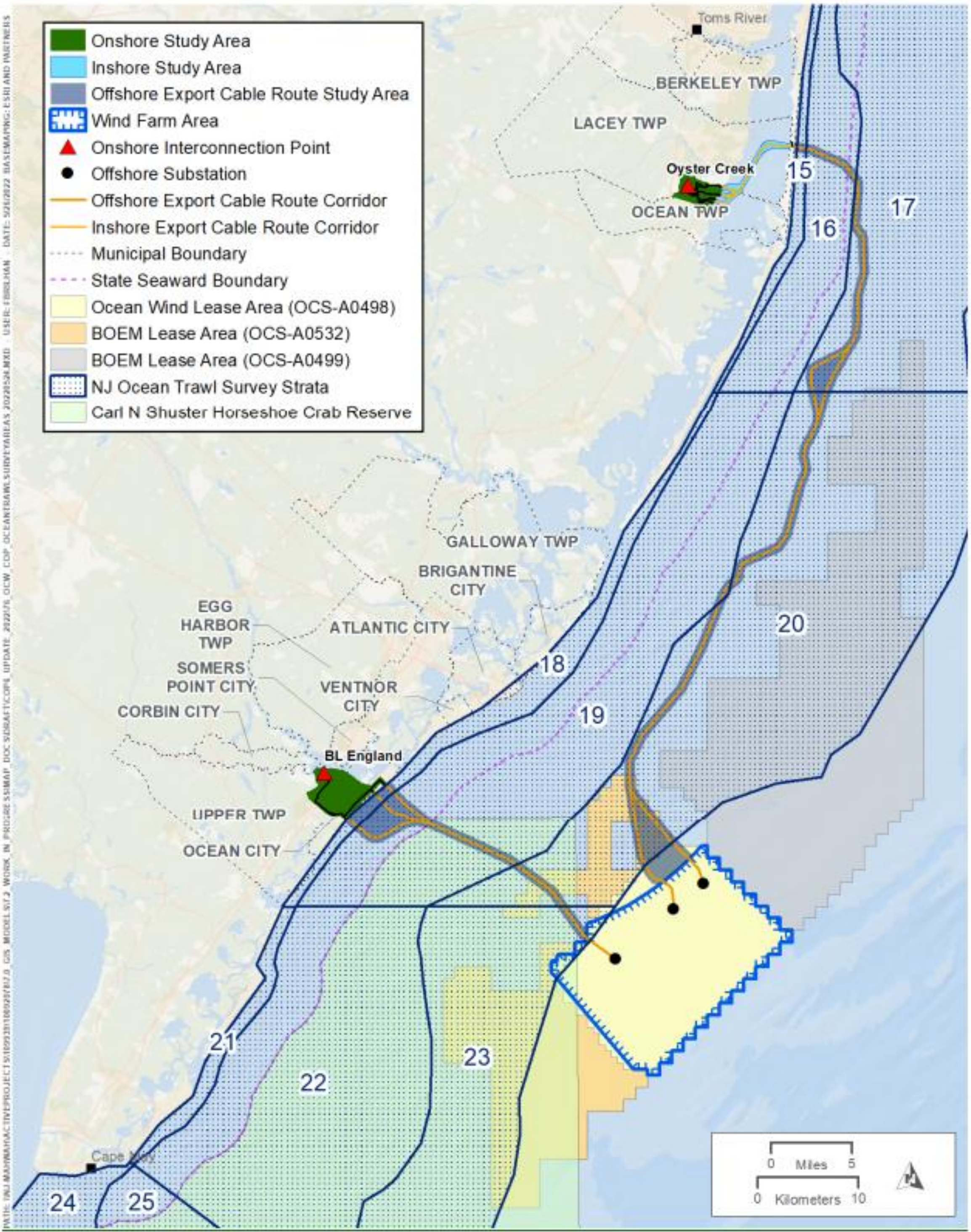


Figure 3-17 Carl N. Shuster, Jr. Horseshoe Crab Reserve and New Jersey Ocean Trawl Survey Areas

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4. Species with Essential Fish Habitat Designations

The Project area includes EFH designations developed by the New England Fishery Management Council (NEFMC), the Mid-Atlantic Fishery Management Council (MAFMC), and NMFS.

The management councils and NMFS designate EFH for species in association with a mapped grid of 10- by 10-minute squares covering all marine habitat along the U.S. coast (Appendix 10-2). The quadrangles are used are used by the NEFMC and the MAFMC to delineate specific areas for the purpose of EFH designations. The site of the Proposed Action lies within 10 of the 10- by 10-minute squares within the Atlantic Ocean, Barnegat Bay, and Great Egg Harbor Bay regions. Figure 10.2-1 in Appendix 10-2 provides an overlay of the Project components on the mapped grid, and Table 10.2-1 in Appendix 10-2 correlates the Project components to the specific grid designation. Table 4-1 and Table 4-2 in Section 4.1 summarize information on the EFH designations within the Project area. Detailed species and life stage descriptions of designated EFH occurrence within the Project area are provided in Appendix 10-2.

EFH-designated species descriptions and their habitat designations presented in this assessment were drawn from the following sources:

- Species descriptions provided in COP Volume III, Appendix P (Ocean Wind 2022a);
- Final Omnibus Essential Fish Habitat Amendment 2 (NEFMC 2017);
- MAFMC fishery management plans (FMPs);
- NEFMC FMPs;
- Final Amendment 10 to the 2006 Consolidated Atlantic Highly Migratory Species FMP (NMFS 2017); and
- Essential Fish Habitat Mapper species descriptions from November 1–November 18, 2021.

Also discussed below are subsets of EFH known as habitat areas of particular concern (HAPCs). These areas are considered high priority for conservation, management, and research due to their status as rare, sensitive, stressed by development, or important to ecosystem function. The only designated HAPCs that are known to potentially occur in the Project area and vicinity are specific habitats to all life stages of summer flounder (*Paralichthys dentatus*). HAPC descriptions for summer flounder and occurrence within the Project area are described in Section 4.2.

4.1 Essential Fish Habitat Designations Within the Project Area

The Project area includes designated EFH for 44 fish and invertebrate species, with varying species and life stage distribution throughout the Project area. Resources are managed under various FMPs. NEFMC FMPs include Northeast Multispecies FMP, Sea Scallop FMP, Monkfish FMP, Atlantic Herring FMP, Skate FMP, Small-Mesh Multispecies (whiting) FMP, Red Crab FMP, Spiny Dogfish FMP, and Atlantic Salmon FMP. MAFMC FMPs include Summer Flounder, Scup, Black Sea Bas FMP, Mackerel, Squid, Butterfish FMP, Surfclams and Ocean Quahogs FMP, Bluefish FMP, Golder and Blueline Tilefish FMP, Spiny Dogfish FMP, and Monkfish FMP. NMFS FMPs include the Highly Migratory Species FMP. The Project area includes designated EFH for 16 elasmobranch species with varying species and life stage distribution throughout the Project area. Designated EFH occurrence by taxonomic grouping, individual species, and life stage is summarized in Table 4-1 and Table 4-2.

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Table 4-1 EFH-Designated Fish and Invertebrate Species within the Project Area

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	Egg			Larvae			Juvenile			Adult			
	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	
Gadids													
Atlantic Cod *Gadus morhua*	X	X	X	X	X	-	-	-	-	X	X	-	**General habitat description**: Prefers muddy, gravelly, or rocky substrates. In state waters, cod can be found year-round but peak in winter and spring both nearshore and offshore. Cod typically move south and into deeper water in the winter and spring, and spawn nearshore in the winter months (Collette and Klein-MacPhee 2002) **Eggs/Larvae**: Pelagic waters around the perimeter of the Gulf of Maine, Georges Bank, and in the Mid-Atlantic region, as well as the high-salinity zones of bays and estuaries. Cod larvae are most abundant throughout their range during the spring. **Adults**: Demersal/Structure Oriented. Sub-tidal benthic habitats in the Gulf of Maine, south of Cape Cod, and on Georges Bank between 98 and 525 feet (30 and 160 meters), as well as high-salinity zones in bays and estuaries.
Pollock *Pollachius*	-	-	-	X	X	X	-	-	-	-	-	-	**General habitat description**: Atlantic pollock are found in pelagic habitats on the Scotian Shelf, Georges Bank, in the Great South Channel, and in the Gulf of Maine (Cargnelli et al. 1999a). The geographic distribution, life history, and habitat characteristics by life stage are described in NOAA Technical Memorandum NMFS-NE-131 (Cargnelli et al. 1999a). **Larvae**: Pelagic inshore and offshore habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region, including Great South Bay (NEFMC 2017).
Red Hake *Urophycis chuss*	X	X	X	X	X	X	X	X	X	X	X	-	**General habitat description**: Groundfish species that prefers deep water environments with bottom habitat consisting of both soft and pebbly substrate. Red hake range from Newfoundland to North Carolina, but most are concentrated around Georges Bank. In inland waters of New Jersey, red hake are rare. **Eggs/Larvae**: Pelagic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region south to Cape Hatteras, and selected bays and estuaries. **Juveniles/ Adults:** Demersal life stages that inhabit sandy or muddy substrates. Juveniles are found in intertidal and subtidal areas to a maximum depth of 263 feet (80 meters). Benthic habitats providing shelter are essential for juveniles, including mud substrates with depressional features, substrates providing biogenic complexity, and artificial reefs. Adults are found where water temperatures are below 60.8°F (16°C), at depths from 32.8 to 426.5 feet (10 to 130 meters), and within a salinity range from 31 to 33 parts per thousand (ppt). Older juveniles are commonly associated with shelter or structure and often inside live bivalves.
Silver Hake *Merluccius bilenaris*	X	X	X	X	X	X	X	X	-	X	X	-	**General habitat description**: Groundfish species that prefers deep water environments and are concentrated in deep basins in the Gulf of Maine and along the continental slope in winter and spring. Silver hake have been found associated with all bottom types, from gravel to fine silt and clay, but mainly with silts and clay (Scott 1982), but mainly with silts and clay (Scott 1982). **Eggs/Larvae**: Pelagic habitats from the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the Mid-Atlantic south to Cape Hatteras (NEFMC 2017). **Juveniles/Adults:** Juveniles are found in association with sandwaves, flat sand with amphipod tubes, and shells, and in biogenic depressions. Juvenile EFH is the pelagic and benthic habitats in the Gulf of Maine, including selected coastal bays and estuaries, and on the continental shelf as far south as Cape May, New Jersey, at depths greater than 32.8 feet (10 meters) in coastal waters in the Mid-Atlantic and between 131.2 and 1,312.3 feet (40 and 400 meters) in the Gulf of Maine, Georges Bank, and in the middle continental shelf in the Mid-Atlantic, on sandy substrates. Adults are usually found in water temperatures below 71.6°F (22°C) and at depths between 66 and 886 feet (20 and 270 meters), in benthic habitats of all substrate types in the Gulf of Maine, on Georges Bank, the continental shelf off southern New England, and the Mid-Atlantic south to Cape Hatteras (NEFMC 2017).

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	Egg			Larvae			Juvenile			Adult			
	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	
White Hake *Urophycis tenuis*	-	-	-	-	-	-	-	-	-	X	X	X	**General habitat description**: Groundfish species that prefers that prefers deep water environments and is predominantly found along the edge of the OCS between Cape Hatteras and Cape Cod, becoming more prevalent on the coastal shelf and inshore waters moving northward into the Gulf of Maine. **Adults:** These demersal fish inhabit benthic habitats in the Gulf of Maine comprised of fine-grained, muddy substrates and mixed soft and rocky habitat types. Adults are primarily found at temperatures ranging from 42.8°F to 51.8°F (6°C to 11°C) in the spring and autumn and are most abundant at depth of 164 to 1,066 feet (50 to 325 meters).
Flatfish													
Summer Flounder *Paralichthys dentatus*	X	X	X	X	X	X	X	X	X	X	X	X	**General habitat description**: This demersal fish species has a range from Maine to South Carolina but is predominantly concentrated south of Cape Cod. Present in Mid-Atlantic waters during summer and fall and has been found at depths between 48 and 450 feet (15 and 137 meters). Prefer sandy or muddy bottom habitats. Spawning is believed to occur offshore in open ocean along the continental shelf (Packer et al. 1999a). HAPC for summer flounder includes all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, wherever they may occur within adult and juvenile summer flounder EFH. **Eggs/Larvae**: Pelagic waters found over the continental shelf from the Gulf of Maine to Cape Hatteras. Eggs are typically most abundant between Cape Cod and Cape Hatteras, with the heaviest concentrations within 9 miles (7.8 nm, 14.5 km) of shore off New Jersey and New York. They are generally found between October and May. Larvae are generally most abundant nearshore (12 to 50 miles [10.4 to 43.4 nm], [19 to 80.5 km] from shore) at depths between 30 to 230 feet (9 to 70 meters). Rare observations of larvae within inland New Jersey waters from January to May, and October to December. **Juveniles/ Adults:** North of Cape Hatteras, EFH is demersal waters over the continental shelf, from the Gulf of Maine to Cape Hatteras. Juveniles are most abundant from May to September but are present year-round. They tend to use estuarine habitats as nursery areas, including salt marsh creeks, seagrass beds, mudflats, and open bay areas (with temperatures greater than 37.4°F (3°C) and salinities from 10 to 30 ppt). Adults tend to inhabit shallow coastal and estuarine waters during warmer months, ranging in depths from 1 to 82 feet (0 to 25 meters), with an extensive range of salinities. In winter, adult summer flounder move offshore on the OCS at depths of 500 feet (152 meters).
Windowpane Flounder *Scophthalmus aquosus*	X	X	X	X	X	X	X	X	X	X	X	X	**General habitat description**: This groundfish fish species is typically associated with non-complex benthic habitats (Collette and Klein-MacPhee 2002) and is found from the Gulf of Saint Lawrence to Florida (Gutherz 1967). In New Jersey, windowpane flounder are abundant in inland bay systems and offshore near waters around Atlantic City (Stone et al. 1994; Chang et al. 1999). Spawning occurs from April to December along areas of the northwest Atlantic. **Eggs/Larvae**: Pelagic habitats on the continental shelf from Georges Bank to Cape Hatteras and in mixed and high-salinity zones of coastal bays and estuaries throughout the region. **Juveniles/Adults**: Found in intertidal and subtidal benthic habitats in estuarine, coastal marine, and continental shelf waters from the Gulf of Maine to northern Florida (juveniles)/ Cape Hatteras (adults), including mixed and high-salinity zones in selected bays and estuaries. EFH for these demersal lifestages is found on mud and sand substrates and extends from the intertidal zone to a maximum depth of 197 feet (60 meters) for juveniles and 230 feet (70 meters) for adults. Juveniles prefer sand over mud.

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	Egg			Larvae			Juvenile			Adult			
	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	
Winter Flounder *Pseudopleuronectes americanus*	-	X	X	-	X	X	X	X	X	X	X	X	**General habitat description**: This groundfish fish species inhabit deep waters in their range from coastal waters in the Strait of Belle Isle, Newfoundland, south to Georgia (Collette and Klein-MacPhee 2002) and are known to occur regularly in New Jersey waters. They prefer muddy, sandy, cobbled, gravely, or boulder substrates (Pereira et al. 1999). Adult females spawn on sandy bottom in shallow habitats. **Eggs/Larvae**: Subtidal estuarine and coastal benthic habitats in New Jersey inland bay systems. Essential habitats for winter flounder eggs include mud, muddy sand, sand, gravel, macroalgae, and SAV. Larvae hatch in nearshore waters and estuaries or are transported shoreward from offshore spawning sites where they metamorphose and settle to the bottom as juveniles. They are initially planktonic but become increasingly less buoyant and occupy the lower water column as they get older. **Juveniles/Adults:** Estuarine, coastal, and continental shelf benthic habitats, as well as the mixed and high-salinity zones in New Jersey bays and estuaries (NEFMC 2017). EFH extends from the intertidal zone (mean high water) to a maximum depth of 197 feet (60 meters) for juveniles and to a maximum depth of 230 feet (70 meters) for adults. Juveniles are found inshore on muddy and sandy sediments in and adjacent to eelgrass and macroalgae, in bottom debris, and in marsh creeks. They tend to settle to the bottom in soft-sediment depositional areas where currents concentrate late-stage larvae and disperse into coarser-grained substrates as they get older. Adult EFH occurs on muddy and sandy substrates, and on hard bottom on offshore banks. In inshore spawning areas, EFH includes a variety of substrates where eggs are deposited on the bottom.
Witch Flounder *Glyptocephalus cynoglossus*	X	X	-	X	X	-	-	-	-	X	X	-	**General habitat description**: This groundfish species range from the Gulf of Maine to Cape Hatteras, North Carolina (Cargnelli et al. 1999b), and tend to concentrate near the southwest portion of the Gulf of Maine (Collette and Klein-MacPhee 2002). Spawning occurs from May through September and peaks in July and August. **Eggs/Larvae**: Pelagic habitats on the continental shelf throughout the northeast region. Eggs are most often observed from March through October, whereas, larvae are most often observed from March through November, with peaks from May through July. **Adults**: This demersal lifestage inhabits subtidal benthic habitats between 115 and 1,312 feet (35 and 400 meters) in the Gulf of Maine and as deep as 4,921 feet (1,500 meters) on the OCS and slope, with mud and muddy sand substrates.
Yellowtail Flounder *Limanda ferruginea*	X	X	-	X	X	X	X	X	-	X	X	-	**General habitat description**: This groundfish species range along the Atlantic coast of North America from Newfoundland to the Chesapeake Bay, with the majority located on the western half of Georges Bank, the western Gulf of Maine, east of Cape Cod, and southern New England (Collette and Klein-MacPhee 2002). Present on Georges Bank from March to August. Spawning occurs in both inshore areas as well as offshore on Georges Bank in July. **Eggs/Larvae**: For these pelagic lifestages, EFH is subtidal benthic habitats between 15 and 1,312 feet (35 and 400 meters) depth in the Gulf of Maine, on Georges Bank, and the Mid-Atlantic region (for eggs) and coastal marine and continental shelf pelagic habitats in the Gulf of Maine, and from Georges Bank to Cape Hatteras, including the high-salinity zones of bays and estuaries (for larvae). **Juveniles/Adults**: These demersal lifestages are found in subtidal benthic habitats in coastal waters in the Gulf of Maine, and on the continental shelf on Georges Bank and in the Mid-Atlantic, including the high-salinity zones of selected bays and estuaries. EFH for juveniles occurs on sand and muddy sand between 66 and 263 feet (20 and 80 meters); whereas for adults, the EFH occurs on sand and sand with mud, shell hash, gravel, and rocks at depths between 82 and 295 feet (25 and 90 meters).

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	Egg			Larvae			Juvenile			Adult			
	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	
Other Finfish													
Atlantic Herring *Clupea harengus*	X	X	X	X	X	-	X	X	X	X	X	X	**General habitat description**: Atlantic herring is a schooling, pelagic, commercially important coastal species that ranges from northern Labrador, Canada to Cape Hatteras, North Carolina, in the western Atlantic and, depending on feeding, spawning, and wintering, migrates extensively north and south of their range. **Larvae**: Pelagic waters in the Gulf of Maine, Georges Bank, the upper Mid-Atlantic Bight, and listed bays and estuaries (NEFMC 2017). Generally found at sea surface temperatures below 60.8°F (16°C), at depths between 164 to 295 feet (50 to 90 meters), and in salinities around 32 ppt. Larvae are observed between August and April, with peaks in September through November. **Juveniles/Adults:** Pelagic waters and bottom habitats in the Gulf of Maine, Georges Bank, southern New England, and the Mid-Atlantic south to Cape Hatteras. Juveniles are generally found in water temperatures below 50°F (10°C), at depths between 49 and 443 feet (15 to 135 meters), and in salinities ranging from 26 to 32 ppt. Adults are generally found in water temperatures below 50°F (10°C), at depths between 66 and 427 feet (20 to 130 meters), and in salinities above 28 ppt.
Monkfish *Lophius americanuys*	X	X	X	X	X	X	-	-X	-	X	X	-	**General habitat description:** Monkfish can be on the Mid-Atlantic OCS from the tideline down to 2,159 feet (658 meters) during summer and fall (Collette and Klein-MacPhee 2002). Monkfish are common and are found in abundance on Georges Bank. Monkfish prefer hard sand, pebbly bottom, gravel, and broken shells for their habitats (Collette and Klein-MacPhee 2002). **Eggs/Larvae**: Pelagic waters in the Gulf of Maine, Georges Bank, southern New England, and the Mid-Atlantic south to Cape Hatteras. Eggs are found at sea surface temperatures below 18°C and in water depths from 49 to 3,281 feet (15 to 1,000 meters); whereas larvae are found at water temperatures 64.4°F (15°C) and in water depths from 82 to 3,281 feet (25 to 1,000 meters). Eggs are most often observed from March through September and larvae are most often observed from March through September. **Juveniles/Adults**: These demersal lifestages inhabit bottom habitats with substrates of a sand-shell mix, algae-covered rocks, hard sand, pebbly gravel, or mud along the OCS in the Mid-Atlantic. Diverse habitats, including hard sand, pebbles, gravel, shell, and soft mud are preferred by juveniles. Juveniles are generally found at water temperatures below 55.4°F (13°C), at depths from 82 to 656 feet (25 to 200 meters), and in a salinity range from 29.9 to 36.7 ppt (Steimle et al. 1999a). For adults, they are typically found at water temperatures below 59°F (15°C), at depths from 82 to 656 feet (25 to 200 meters), and in a salinity range from 29.9 to 36.7 ppt (Fowler 1952).
Ocean Pout *Macrozoacres amercanus*	X	X	-	-	-	-	X	X	X	X	X	X	**General habitat description**: This finfish is typically present in southern New England from late summer to winter. Ocean pout are present in habitats that contain sandy mud, sticky sand, broken bottom, or on pebbles and gravel (Collette and Klein-MacPhee 2002). They spawn in protected habitats, such as rock crevices and man-made artifacts, where it lays eggs in nests that it guards (Steimle et al. 1999b). **Eggs**: Hard-bottom habitats in the Gulf of Maine, Georges Bank, and in the Mid-Atlantic Bight, as well as high-salinity zones in estuaries. Eggs are typically found in water depths less than 328 feet (100 meters) and egg development takes 2 to 3 months during late fall and winter. **Juveniles/Adults**: EFH for juveniles is intertidal and subtidal benthic habitats in the Gulf of Maine and on the continental shelf north of Cape May, New Jersey, on the southern portion of Georges Bank, and in the high-salinity zones of a number of bays and estuaries north of Cape Cod. Adult EFH is subtidal benthic habitats in the Gulf of Maine, on Georges Bank, in coastal and continental shelf waters north of Cape May, New Jersey, and in the high-salinity zones of selected bays and estuaries north of Cape Cod. Adult habitat includes mud and sand, particularly in association with structure forming habitat types like shell, gravel, or boulder.

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	Egg			Larvae			Juvenile			Adult			
	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	
Atlantic Butterfish *Peprilus triacanthus*	X	X	X	X	X	-	X	X	X	X	X	X	**General habitat description:** The Atlantic butterfish is a pelagic, surface-dwelling fish that tends to form schools and ranges from the Gulf of St. Lawrence to Florida, (Bigelow and Schroeder 1953; Overholtz 2006). These finfish are found in the Mid-Atlantic shelf in the summer and autumn but migrate to the edge of the continental shelf where they aggregate in response to seasonal cooling of water temperatures (Grosslein and Azarovitz 1982). Preference for sandy benthic habitat and spawning occurs on the continental shelf and nearshore areas. **Eggs/Larvae**: Pelagic habitats in inshore estuaries and embayments. EFH for eggs is generally found over bottom depths of 4,921 feet (1,500 meters) or less where average temperatures are 43.7°F to 70.7°F (6.5°C to 21.5°C). EFH for larvae is bottom depths between 135 and 1,148 feet (41 and 350 meters) where average temperatures are 47.3°F to 70.7°F (8.5 to 21.5 °C). **Juveniles/Adults:** Pelagic habitats in inshore estuaries and embayments, inshore waters, and on the inner and outer continental shelf. EFH for juveniles is generally found over bottom depths between 33 and 919 feet (10 and 280 meters) where bottom water temperatures are between 6.5 and 27 °C and salinities are above 5 ppt. Juveniles feed mainly on planktonic prey. EFH for adults is generally found over bottom depths between 33 and 820 feet (10 and 250 meters) where bottom water temperatures are between 40.1°F and 81.2°F (4.5°C and 27.5°C), and salinities are above 5 ppt.
Atlantic Mackerel *Scomber scombrus*	X	X	-	X	X	-	X	X	-	X	X	-	**General habitat description:** Atlantic mackerel ranges from the Gulf of St. Lawrence to Cape Lookout, North Carolina (MAFMC 2011), tending to congregate in open waters toward the surface and in nearshore environments. These finfish spawn in in deeper waters off the coast (between Cape Hatteras to the Gulf of St. Lawrence) in early summer and continue spawning until the water temperature reaches 46.4°F (8 °C). **Eggs/Larvae**: Pelagic habitats in inshore estuaries and embayments and inshore and offshore waters of the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina. EFH for eggs is generally found over bottom depths of 328 feet (100 meters) or less with average water temperatures of 43.7°F to 54.5°F (6.5°C to 12.5°C). For larvae, EFH is generally found over bottom depths between 69 and 328 feet (21 and 100 meters) with average water temperatures of 41.9°F to 52.7 (5.5°C to 11.5°C). **Juveniles/Adults**: Pelagic habitats in inshore estuaries and embayments in the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina. EFH for juveniles is generally found over bottom depths between 33 and 328 feet (10 and 110 meters) and in water temperatures of 41°F to 68°F (5°C to 20°C). Designated EFH is found within the WFA and OECRC footprints. For adults, EFH is generally found over bottom depths less than 558 feet (170 meters) and in water temperatures of 5 to 20 °C. Spawning occurs at temperatures above 44.6°F (7°C), with a peak between 48.2°F and 57.2°F (9°C and 14°C).

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	Egg			Larvae			Juvenile			Adult			
	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	
Black Sea Bass *Centropristis striata*	X	X	X	X	X	X	X	X	X	X	X	X	**General habitat description**: This demersal finfish species is found in the western Atlantic, ranging from southern Nova Scotia to Florida (Drohan et al. 2007), within a depth range from the tide line down to 420 feet (128 meters). Prefers structured habitats such as reefs, shipwrecks, and lobster pots along the continental shelf (Steimle et al. 1999c). Adults spawn from the middle of May until the end of June in New Jersey, New York, and southern New England waters (Collette and Klein-MacPhee 2002). **Larvae**: Pelagic waters found over the continental shelf. Habitats for the transforming (to juveniles) larvae are near the coastal areas and into marine parts of estuaries between Virginia and New York. Larval sea bass settle in benthic habitats during juvenile transformation, favoring structurally complex inshore habitat such as sponge beds. **Juveniles/Adults**: EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina. Black sea bass are also found in estuaries from May through October. Juveniles are found in waters warmer than 43°F (6.1°C), with salinities greater than 18 ppt and coastal areas between Virginia and Massachusetts, but winter offshore from New Jersey and south. Wintering adults (November through April) are generally offshore, south of New York to North Carolina. Juveniles are usually found in association with rough bottom, shellfish and eelgrass beds, man-made structures in sandy shelly areas; offshore clam beds and shell patches may also be used during the wintering. Adults are also structure oriented, with sand and shell usually the substrate preference. Temperatures above 6.1°C seem to be the minimum requirements for adults.
Bluefish *Pomatomus saltatrix*	X	X	-	X	X	-	X	X	X	X	X	X	**General habitat description**: Bluefish range from Nova Scotia to Bermuda and seasonally migrate to the Mid-Atlantic Bight during the spring (Fahay et al. 1999), returning to deeper offshore water of southeastern Florida in November (Grosslein and Azarovitz 1982; Stone et al. 1994). **Eggs/Larvae**: Eggs are found in mid-shelf waters ranging from 98 to 230 feet (30 to 70 meters) in southern New England to Cape Hatteras, in temperatures ranging from 64.4°F to 71.6°F (18°C to 22°C), with salinities greater than 31 ppt (Hardy 1978; Fahay et al. 1999). Eggs are not found in estuarine waters. Larvae are found in oceanic waters in temperatures of 18°C, with salinities of greater than 30 ppt (Able and Fahay 1998; Shepherd and Packer 2006). Larvae are transported across the shelf to estuarine nurseries via active migration presumably facilitated by oceanographic features or Eckman transport, which is critical for recruitment success. Bluefish larvae consume primarily copepods (Shepherd and Packer 2006). **Juveniles/Adults**: Juveniles inhabit pelagic, nearshore areas and estuaries in temperatures between 66.2°F and 75.2°F (19°C and 24°C), with salinities that range from 23 to 36 ppt (Shepherd and Packer 2006). Juveniles are found in the inland waters of New Jersey from May through November, with peak abundances observed from June through October (Stone et al. 1994). Adults are found in oceanic, nearshore, and continental shelf waters and prefer temperatures above 14-16°C and salinities above 25 ppt (Fahay et al. 1999). Adults are observed in the inland bays of New Jersey from May through October and are not associated with a specific substrate (Stone et al. 1994). The species migrates extensively and is distributed based on season and size of the individuals within the schools (Shepherd and Packer 2006). There are two predominant spawning areas on the east coast: one during the spring that is located offshore from southern Florida to North Carolina and the other during summer in the Mid-Atlantic Bight (Wilk 1982). Juveniles prey on locally abundant macroinvertebrates and fish, whereas, adults prey on schooling species.

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	Egg			Larvae			Juvenile			Adult			
	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	
Scup *Stenotomus chrysops*	-	-	X	-	-	X	X	X	X	X	X	X	**General habitat description**: This demersal finfish range from the Gulf of Maine to North Carolina. Scup are known to congregate in nearshore areas of New England from early April to December, at depths between 269 and 420 feet (82 and 128 meters) (Collette and Klein-MacPhee 2002). Scup are an important food species for other commercially important species (Collette and Klein-MacPhee 2002). Preference for smooth to rocky bottom habitats and these fish usually form schools around such bottoms. Spawning occurs nearshore and in relatively shallow waters over sandy bottom between May and August (Steimle et al. 1999d). **Eggs/Larvae**: Eggs and larvae are found in estuaries in southern New England to coastal Virginia, in waters between 54.9°F and 73.0°F (12.7°C and 22.8°C) and in salinities greater than 15 ppt. Eggs and larvae are found from May through August. **Juveniles/Adults**: Offshore, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina. Inshore, EFH is the estuaries where scup has been identified as common, abundant, or highly abundant. During spring and summer, juveniles are found in estuaries and bays between Virginia and Massachusetts, in association with various sands, mud, mussel, and eelgrass bed type substrates, and in water temperatures greater than 44.6°F (7°C) and salinities greater than 15 ppt. Wintering adults (November through April) are usually offshore, south of New York to North Carolina, in waters above 44.6°F (7°C).
Highly Migratory Species													
Albacore Tuna *Thunnus alalunga*	-	-	-	-	-	-	X	X	X	X	X	-	**General habitat description**: Pelagic species with a wide range, north to Newfoundland and south to the Gulf of Mexico, and east from the western Atlantic west to the Mediterranean (NOAA 2009). Spawn in the spring and summer in the western tropical areas of the Atlantic, and they move northward to the central and northern portions of the Atlantic as wintering areas. EFH includes offshore pelagic regions of the Atlantic Ocean from north of Cape Hatteras, North Carolina, to Cape Cod. **Juveniles**: Offshore pelagic habitats are seaward of the continental shelf break to the extent of the U.S. EEZ boundary on Georges Bank and Cape Cod. Offshore and coastal habitats also range from Cape Cod to the middle east coast of Florida, and in the central Gulf of Mexico from the Florida Panhandle to southern Texas. Localized EFH is southeast of Puerto Rico. **Adults**: Offshore pelagic habitats are seaward of the continental shelf break to the extent of the U.S. EEZ boundary on Georges Bank and Cape Cod. Also, adults are found in offshore and coastal habitats from Cape Cod to North Carolina, and in offshore pelagic habitats of the Blake Plateau. EFH in the Gulf of Mexico spans throughout much of the offshore pelagic habitat from the West Florida Shelf to the continental shelf off southern Texas.
Bluefin Tuna *Thunnus thynnus*	-	-	-	-	-	-	X	X	X	X	X	-	**General habitat description**: Bluefin tuna range from Labrador south to the Gulf of Mexico (NOAA 2009) and inhabit open ocean environments with variable temperature and salinity levels. They migrate north from the Gulf of Mexico spawning ground in the spring to New England and Canada through the summer and beginning of fall. In June they can be found off the coast of New Jersey, Long Island, and southern New England (Collette and Klein-MacPhee 2002). These fish are found at depths ranging from near the surface to 300 feet (91 meters) deep. Bluefin tuna is considered overfished but remains an important commercial and recreational target species (NOAA 2009). **Juveniles**: Coastal and pelagic habitats extend from the Gulf of Maine to the Mid-Atlantic Bight, continuing south to Cape Hatteras. EFH follows the continental shelf from the outer extent of the U.S. EEZ on Georges Bank to Cape Lookout. EFH is associated with certain environmental conditions in the Gulf of Maine (60.8°F to 66.2°F [16°C to 19°C]; 0 to 131.2 feet [40 meters] deep). EFH in other locations is associated with temperatures ranging from 39.2°F to 78.8°F (4°C to 26 °C), often in depths of less than 65.6 feet (20 meters), but juveniles can be found in waters that are 131.2 to 328 feet [40 to 100 meters] in depth in winter. **Adults**: Offshore and coastal pelagic habitats from the Gulf of Maine to the outer extent of the U.S. EEZ (NMFS 2009).

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	Egg			Larvae			Juvenile			Adult			
	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	
Skipjack Tuna *Katsuwonus pelamis*	-	-	-	-	-	-	X	X	X	X	X	X	**General habitat description**: Global, pelagic species that has a range from Newfoundland to Brazil (NOAA 2009). They spawn opportunistically in warm waters near the equator from spring to fall, with most spawning occurring in the summer. Although, this species is commercially and recreationally important, the overfishing status of this tuna is unknown. Designated EFH for spawning, eggs, and larvae is restricted to the Gulf of Mexico and Atlantic waters off the coast of Florida. **Juveniles**: Offshore pelagic habitats are located seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank; coastal and offshore habitats between Massachusetts and South Carolina; localized in areas off Georgia and South Carolina; and from the Blake Plateau through the Florida Straits. Juveniles are also found in offshore waters in the central Gulf of Mexico from Texas through the Florida Panhandle. In all areas juveniles are found if water is greater than 65.6 feet (20 meters). **Adults**: Coastal and offshore pelagic habitats between Massachusetts and Cape Lookout, North Carolina and localized areas are in the Atlantic off South Carolina and Georgia, and the northeast coast of Florida. EFH in the Atlantic Ocean also is located on the Blake Plateau and in the Florida Straits through the Florida Keys. EFH also includes areas in the central Gulf of Mexico, offshore in pelagic habitats seaward of the southeastern edge of the West Florida Shelf to Texas.
Yellowfin Tuna *Thunnus albacares*	-	-	-	-	-	-	X	X	X	X	X	-	**General habitat description:** Global species with a wide range from the central region of the Gulf of Mexico from Florida to Southern Texas and from the mid-east coast of Florida and Georgia to Cape Cod. They are also located south of Puerto Rico. Yellowfin tuna travel in schools and prefer the water surface in open ocean. Spawning occurs throughout the year between 15°N and 15°S latitude and in the Gulf of Mexico and the Caribbean in May through November and are believed to spawn serially. **Juveniles**: Offshore pelagic habitats are seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank and Cape Cod, Massachusetts, and offshore and coastal habitats from Cape Cod to the mid-east coast of Florida and the Blake Plateau. Juveniles are locally distributed in the Florida Straits and off the southwestern edge of the West Florida Shelf. Yellowfish tuna juveniles are also found in the central Gulf of Mexico from the Florida Panhandle to southern Texas. Localized EFH is southeast of Puerto Rico. Designated EFH is found within the WFA and OECRC footprints. **Adults**: Offshore pelagic habitats are seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank and Cape Cod, Massachusetts, and offshore and coastal habitats from Cape Cod to the mid-east coast of Florida and the Blake Plateau. Adults are locally distributed in the Florida Straits and off the southwestern edge of the West Florida Shelf. Yellowfish tuna adults are also found in the central Gulf of Mexico from the Florida Panhandle to southern Texas. Localized EFH is southeast of Puerto Rico.
Swordfish *Xiphias gladius*	-	-	-	-	-	-	X	X	-	X	X	-	**General habitat description**: Pelagic, highly migratory species that can be found in tropical, temperate, and occasionally cold waters and is distributed in the western North Atlantic from the Grand Banks of Newfoundland south to the Gulf Stream (NOAA n.d.). **Juveniles**: Generally found in the middle of the oceanic water column at depths ranging from 656 to 1968 feet (200 to 600 meters) in temperatures between 18°C and 22°C. However, they can be found in waters ranging from 41°F) to 80.6°F (5°C to 27°C) (Florida Museum of Natural History 2017). Frequently observed close to the surface but are believed to swim to depths greater than 2,132 feet (650 meters) (Florida Museum of Natural History 2017). Juveniles grow rapidly and feed on a variety of pelagic fish and invertebrates, including squid and other cephalopods (NOAA n.d.; Florida Museum of Natural History 2017).

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	Egg			Larvae			Juvenile			Adult			
	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	
Invertebrates													
Atlantic Sea Scallop *Placopecten melanics*	X	X	-	X	X	-	X	X	-	X	X	-	**General habitat description**: The Atlantic sea scallop occurs along the continental shelf at depths ranging from 59 to 360.9 feet (18 to 110 meters) and is generally found in seabed areas with coast substrates consisting of gravel, shells, and rocks (Packer et al. 1999b). They spawn in September and rely on the currents to spread eggs and larvae in different areas. They often occur in aggregations called beds which may be sporadic or essentially permanent, depending on how suitable the habitat conditions are (temperature, food availability, and substrate) and whether oceanographic features (fronts, currents) keep larval stages near to the spawning population. **Eggs:** Benthic habitats in inshore areas and on the continental shelf in the vicinity of adult scallops. Demersal eggs remain on the seafloor until they develop into the first free-swimming larval stage. **Larvae**: Benthic (demersal) and water column (pelagic) habitats in inshore and offshore areas throughout the greater Atlantic region south to Cape Hatteras. Any hard surface can provide an essential habitat for settling pelagic larvae (“spat”), including shells, pebbles, gravel, and macroalgae and other benthic organisms. Spat that settle on shifting sand do not survive. In laboratory studies, maximum survival of juvenile scallops occurred between 1.2°C and 15°C and above salinities of 25 ppt. **Juveniles/Adults**: Demersal benthic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic in depths of 59 to 360.9 feet (18 to 110 meters) for adults and older juveniles. Younger juveniles (0.2- to 0.5-inch [5 to 12 mm] shell height) leave the original substrate on which they settle (see spat, above) and attach themselves by byssal threads to shells, gravel, and small rocks (pebble, cobble), preferring gravel. Juvenile scallops are relatively active and swim to escape predation when they can be carried long distances by currents. EFH for older juveniles and adults is sand and gravel substrates in depths of 59 to 360.9 feet (18 to 110 meters), but they are also found in shallower water and as deep as 360.9 feet (180 meters) in the Gulf of Maine. Growth of adult scallops is optimal between 50°F and 15°F (10°C and 15°C), and they prefer full strength seawater.
Atlantic Surfclam *Spisula solidissima*	-	-	-	-	-	-	X	X	X	X	X	X	**General habitat description**: The Atlantic surfclam occupies areas along the continental shelf from southern portions of the Gulf of St. Lawrence to Cape Hatteras, North Carolina (Cargnelli et al. 1999c). Preference for sandy habitats and spawns in the summer and early fall. **Juveniles and Adults**: Inhabits demersal benthic habitat throughout the substrate, to a depth of 3.3 feet (1 meter) below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ. Generally occur from the beach zone to a depth of about 200 feet (61 meters), but beyond about 125 feet (38 meters), abundance is low.
Ocean Quahog *Artica islandica*	-	-	-	-	-	-	X	X	-	X	-	-	**General habitat description**: The ocean quahog is a bivalve mollusk that is slow to mature and is found in a range from Newfoundland to Cape Hatteras distributed along the continental shelf (Cargnelli et al. 1999d). The highest concentrations of quahogs are offshore south of Nantucket to the Delmarva Peninsula. The quahog prefers medium to fine sandy bottom with mud and silt. Spawning occurs from spring to fall with multiple annual spawning events (Cargnelli et al. 1999d). **Juveniles and Adults**: Inhabits demersal benthic habitat throughout the substrate, to a depth of 3 feet (0.9 meter) below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ. Distribution in the western Atlantic ranges in depths from 29.5 feet (9 meters) to about 800.5 feet (244 meters). Rarely found where bottom water temperatures exceed 59.9°F (15.5°C)

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	Egg			Larvae			Juvenile			Adult			
	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	
Longfin Squid *Loligo pealeii*	X	-	-	X	X	X	X	X	X	X	X	X	**General habitat description:** Pelagic, schooling species that has a general range from Newfoundland to the Gulf of Venezuela but is abundant enough to be considered commercially important from Georges Bank to Cape Hatteras (Cargnelli et al. 1999e). Typically found in waters that have a temperature of at least 48.2°F (9°C); therefore, they move with a pattern of seasonal migrations. They move offshore in late fall and overwinter along the edge of the continental shelf; they move both inshore and north as the water temperatures raise with the seasons. Most eggs are spawned in May and hatch in July, although there are two broods, an early spring and late summer (Cargnelli et al. 1999e). **Eggs/Larvae**: Demersal eggs found in inshore and offshore bottom habitats from Georges Bank southward to Cape Hatteras, generally where bottom water temperatures are between 50°F and 73.4°F (10°C and 23°C), salinities are between 30 and 32 ppt, and typically in depths are less than 164 feet (50 meters). Females deposit eggs in gelatinous capsules (that are attached in clusters to rocks, boulders, and aquatic vegetation and on sand or mud bottom, generally in depths less than 164 feet (50 meters). Egg masses or "mops" are demersal and anchored to the substrates on which they are laid. Larvae are pelagic near the surface and occur at temperatures of between 50 to 78.8°F (10 to 26°C) and salinities of 31.5 to 34.0 ppt. **Juveniles/Adults**: Pelagic habitats in inshore and offshore continental shelf waters from Georges Bank to South Carolina, in the southwestern Gulf of Maine, and in embayments, including Narragansett Bay, Long Island Sound, and Raritan Bay (MAFMC 2011). EFH for juveniles is generally found over bottom depths between 19.7 and 524.9 feet (6 and 160 meters) where bottom water temperatures are 47.3°F to 76.1°F (8.5°C to 24.5ºC and salinities are 28.5 to 36.5 ppt (MAFMC 2011). With respect to adults, the EFH for recruit longfin squid is generally found over bottom depths between 19.7 and 656.2 feet (6 and 200 meters) where bottom water temperatures are 47.3°F to 57.2°F (8.5°C to 14°C) and salinities are 24 to 36.5 ppt. Recruits inhabit the continental shelf and upper continental slope to depths of 1,312.3 feet (400 meters). They migrate offshore in the fall and overwinter in warmer waters along the edge of the shelf. Like larvae they also make daily vertical migrations. Individuals larger than 4.7 inches (12 cm) feed on fish, and those larger than 6.3 inches (16 cm) feed on fish and squid.
Northern Shortfin Squid *Illex illecebrosus*	-	-	-	-	-	-	X	X	-	X	-	-	**General habitat description**: Highly migratory species distributed in the northwest Atlantic Ocean between the Sea of Labrador and the Florida Straits. Its range is from Newfoundland to Cape Hatteras, North Carolina (Hendrickson and Holmes 2004). **Juveniles**: EFH for pre-recruits is pelagic habitats along the OCS and slope to South Carolina, on Georges Bank, and on the inner continental shelf off New Jersey and southern Maine and New Hampshire (MAFMC 2011). Juvenile shortfin squid are referred to as pre-recruits. Pre-recruit EFH is found over bottom depths between 134.5 and 1,312 feet (41 and 400 meters), with bottom temperatures between 49.1°F and 61.7°F (9.5°C and 16.5ºC) and salinities between 34.5 to 36.5 ppt (MAFMC 2011). Pre-recruits also inhabit pelagic habitats in the Gulf Stream and migrate onto the shelf as they grow. Pre-recruits make daily vertical migrations though the water column (MAFMC 2011). **Adults:** In the summer months adults are most abundant at depths of 328 to 656 ft (100 to 200 m) and generally not in waters shallower than 59 ft (18 m). In the fall and winter months adults migrate offshore.

Source: Modified from COP, Volume III, Appendix P; Ocean Wind 2022a
°C = degrees Celsius; °F = degrees Fahrenheit; COP = Construction and Operations Plan; EFH = Essential Fish Habitat; EEZ = Exclusive Economic Zone; HAPC = Habitat Area of Particular Concern; IECRC = Inshore Export Cable Route Corridor; km = kilometers; nm = nautical miles; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Administration; OCS = Outer Continental Shelf; OECRC = Offshore Export Cable Route Corridor; ppt = parts per thousand; WFA = Wind Farm Area

Table 4-2 EFH-Designated Elasmobranchs within the Project Area

Common Name/ Scientific Name	EFH Habitat within Project Area									Habitat Association
	Neonate			Juvenile			Adult			
	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	
Skates										
Clearnose Skate *Raja eglanteria*	-	-	-	X	X	X	X	X	X	**General habitat description**: Clearnose skate occurs from Nova Scotia to northeastern Florida and includes the northern Gulf of Mexico from northwestern Florida to Texas (Packer et al. 2003a). This is considered a southern species and is considered rare in the northern portion of its range (Packer et al. 2003a). Bigelow and Schroeder (1953) reported clearnose skate inshore between April and November off the shore of New Jersey. **Juveniles**: Juveniles are fully developed at hatching. EFH includes subtidal benthic habitats in coastal and inner continental shelf waters from New Jersey to the St. John's River in Florida, in addition to the high-salinity zones of bays and estuaries, including the Chesapeake and Delaware Bays. Demersal benthic habitats primarily consist of mud and sand, but also gravelly and rocky bottoms from the shoreline to 30 meters (NEFMC 2017). **Adults**: Most abundant in water depths of 3–98 feet (1–30 meters) during NEFSC spring trawl surveys, and water temperatures from 39.2°F to 69.8°F (4°C to 21ºC) (Packer et al. 2003a). Adults feed on polychaetes, amphipods, mysid shrimps, shrimp, mantis shrimp, crabs, bivalves, squids, and small fishes (Packer et al. 2003a). This species is regularly preyed upon by sand tiger shark. Adult EFH includes subtidal benthic habitats in coastal and inner continental shelf waters from New Jersey to Cape Hatteras, in addition to the high-salinity zones of bays and estuaries, including the Chesapeake and Delaware Bays. Demersal benthic habitats primarily consist of mud and sand, but also gravelly and rocky bottoms from the shoreline to 131 feet (40 meters) (NEFMC 2017).
Little Skate *Leucoraja erinacea*	-	-	-	X	X	X	X	X	X	**General habitat description**: Demersal species that has a range from Nova Scotia to Cape Hatteras and is highly concentrated in the Mid-Atlantic Bight and on Georges Bank. Found year-round on Georges Bank and tolerates a wide range of temperatures (Packer et al. 2003b). Prefers sandy or pebbly bottom but can also be found on mud and ledges (Collette and Klein-MacPhee 2002). **Juveniles/Adults**: Intertidal and subtidal benthic habitats in coastal waters of the Gulf of Maine and in the Mid-Atlantic region as far south as Delaware Bay, and on Georges Bank, extending to a maximum depth of 262.5 feet (80 meters) for juveniles and 328 feet (100 meters) for adults. EFH also includes high-salinity zones in selected bays and estuaries. EFH occurs on sand and gravel substrates, but also mud, where they are found.
Winter Skate *Leucoraja ocellata*	-	-	-	X	X	X	X	X	X	**General habitat description**: Demersal species that has a range from the southern coast of Newfoundland to Cape Hatteras and has concentrated populations on Georges Bank and the northern section of the Mid-Atlantic Bight (Packer et al. 2003c. The winter skate has very similar temperature ranges and migration patterns as the little skate. **Juveniles**: Subtidal benthic habitats in coastal waters from eastern Maine to Delaware Bay and on the continental shelf in southern New England and the Mid-Atlantic region, and on Georges Bank, from the shoreline to a maximum depth of 295.3 feet (90 meters), including the high-salinity zones of selected bays and estuaries. EFH for juvenile winter skates occurs on sand and gravel substrates, but also mud, where they are found. **Adults**: Subtidal benthic habitats in coastal waters in the southwestern Gulf of Maine, in coastal and continental shelf waters in southern New England and the Mid-Atlantic region, and on Georges Bank, from the shoreline to a maximum depth of 262.5 feet (80 meters), including the high-salinity zones of selected bays and estuaries. EFH for adult winter skates occurs on sand and gravel substrates, but also mud, where they are found.
Sharks										
Atlantic Angel Shark *Squatina dumeril*	X	X	-	X	X	-	X	X	-	**General habitat description**: A benthic, flattened shark inhabiting coastal waters from Massachusetts to the Florida Keys, the Gulf of Mexico, and the Caribbean (NMFS 2017). This shark species is commonly found from southern New England to the Maryland coast and migrates seasonally from shallow to deep water (Castro 2011). **Neonates, Juveniles, and Adults**: EFH for these demersal lifestages includes continental shelf habitats from Cape May, New Jersey, to Cape Lookout, North Carolina (NMFS 2017). Accurate age and growth models have not been developed and maturity is probably reached at a length of 35 to 41 inches (90 to 105 cm) (Baremore 2010; NFMS 2017). Birth of Atlantic angel shark occurs at depths of 59.1 to 88.6 feet (18 to 27 meters) during the spring or early summer months (Castro 2011). The diet of the Atlantic angel shark is dominated by teleost fishes as well as squid, crustaceans, and portunid crabs (Baremore et al. 2008, 2009).

Common Name/ Scientific Name	EFH Habitat within Project Area									Habitat Association
	Neonate			Juvenile			Adult			
	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	
Atlantic Sharpnose Shark *Rhizopriondon terraenovae*	-	-	-	-	-	-	X	X	-	**General habitat description**: The Atlantic sharpnose shark occurs in warm-temperate and tropical waters, ranging primarily from New Brunswick, Canada to Florida, including the Gulf of Mexico and the coast of Brazil (Florida Museum of Natural History 2018). **Adults**: Found in coastal, shallow pelagic habitats at depths ranging from the surface to 918.6 feet (280 meters), although they remain primarily in waters less than 32.8 feet (10 meters) deep (Florida Museum of Natural History 2018). Forages close to the surf zone and in enclosed bays, sounds, harbors, and marine to brackish estuaries (RI Sea Grant/NMFS 2003). Male Atlantic sharpnose sharks reach maturity at approximately 2 to 2.4 years and are generally 31.5 to 33.5 inches (80 to 85 cm) in length, and females reach maturity at 2.4 to 2.8 years and measure 33.5 to 35.4 inches (85 to 90 cm) in length (Florida Museum of Natural History 2018). The adult Atlantic sharpnose shark migrates inshore to offshore seasonally, forming large sexually segregated schools during migration (Florida Museum of Natural History 2018). Mating occurs during late spring and early summer, followed by a 10- to 11-month gestation period, after which females return inshore from their offshore overwintering habitat to give birth (Florida Museum of Natural History 2018). Adult Atlantic sharpnose shark prey on small bony fish, toadfish, and filefish), worms, shrimp, crabs, and mollusks.
Basking Shark *Cetorhinus maximus*	X	X	-	X	X	-	X	X	-	**General habitat description**: In the northwestern and eastern Atlantic, basking sharks occur in coastal regions from April to October, usually with a peak in sightings from May until August (Kenney et al. 1985; Southall et al. 2005; Witt et al. 2012). The temporal and spatial distribution of basking sharks in both the northwestern and eastern Atlantic are thought to be influenced by seasonal water stratifications, temperature, and prey abundance (Owen 1984; Sims and Merrett 1997; Sims and Quayle 1998; Sims 1999; Sims et al. 2003; Skomal et al. 2004; Cotton et al. 2005; Witt et al. 2012). Basking sharks are filter-feeders and are known to migrate from the Northern to the Southern Hemisphere (Skomal et al. 2009). **Neonates, Juveniles, and Adults**: Insufficient data is available to differentiate EFH between size classes; therefore, EFH designations for all life stages have been combined and are considered the same. EFH for basking shark includes the Atlantic east coast from the Gulf of Maine to the northern Outer Banks of North Carolina, following the mid-South Carolina to coastal areas of northeast Florida (NMFS 2017). Aggregations of basking sharks have been observed south and southeast of Long Island, east of Cape Cod, and along the coast of Maine. Aggregations have been associated with persistent thermal fronts within areas of high prey density (NMFS 2017). These aggregations tend to be associated with persistent thermal fronts within areas of high prey density (plankton).
Blue Shark *Prionace glauca*	X	X	-	X	X	-	X	X	-	**General habitat description**: The blue shark is a pelagic, highly migratory species, occurring in temperate and tropical inshore and offshore waters, and ranging from Newfoundland and the Gulf of St. Lawrence south to Argentina (DFO 2018). Prefers deep, clear waters with temperatures ranging from 50°F to 68°F (10°C to 20°C) (Castro 1983). **Neonates:** EFH is in the Atlantic in areas offshore of Cape Cod through New Jersey, seaward of the 98.4-foot (30-meter) bathymetric line (and excluding inshore waters such as Long Island Sound). EFH follows the continental shelf south of Georges Bank to the outer extent of the U.S. EEZ in the Gulf of Maine. **Juveniles and Adults:** EFH is localized areas in the Atlantic Ocean in the Gulf of Maine, from Georges Bank to North Carolina, South Carolina, Georgia, and Florida.
Common Thresher Shark *Alopias vulpinus*	X	X	-	X	X	-	X	X	-	**General habitat description**: The common thresher shark is found in both coastal and oceanic and cool and warm waters (Natanson and Gervelis 2013) and has a range from the south Atlantic to the Gulf of Maine. Females give birth to young once a year in the spring. **Neonates, Juveniles, and Adults:** EFH is located in the Atlantic Ocean, from Georges Bank (at the offshore extent of the U.S. EEZ boundary) to Cape Lookout, North Carolina; and from Maine to locations offshore of Cape Ann, Massachusetts. EFH occurs with certain habitat associations in nearshore waters of North Carolina, especially in areas with temperatures from 64.8°F to 69.6°F (18.2°C to 20.9°C) and at depths from 15.1 to 44.5 feet (4.6 to 13.7 meters) (McCandless et al. 2002).
Dusky Shark *Carcharhinus obscurus*	X	X	-	X	X	-	X	X	-	**General habitat description**: The dusky shark has a range among warm and temperate coastal waters in the Atlantic, Pacific, and Indian oceans (McCandless et al. 2014). Prefers both inshore waters and deeper waters along the continental shelf edge and often uses coastal waters as nurseries. The shark species gives birth in the Chesapeake Bay in Maryland in June and July (NOAA 2009). **Neonates**: EFH includes areas along the Atlantic east coast of Florida to the mid-coast of Georgia, and South Carolina to southern Cape Cod. Designated EFH is found within the WFA and OECRC footprints. **Juveniles and Adults**: EFH designation for juvenile and adult life stages have been combined and are considered the same. EFH includes localized areas in the central Gulf of Mexico, southern Texas, the Florida Panhandle, mid-west coast of Florida, and Florida Keys. EFH also includes the Atlantic east coast of Florida and South Carolina to southern Cape Cod.

Common Name/ Scientific Name	EFH Habitat within Project Area									Habitat Association
	Neonate			Juvenile			Adult			
	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	
Sand Tiger Shark *Carcharias taurus*	X	X	-	X	X	-	X	X	-	**General habitat description**: Sand tiger sharks occur off the coast of the northwest Atlantic and have been known to make transoceanic migrations (NOAA 2009) and in North America, they are rarely encountered north of the Mid-Atlantic Bight. Nurseries for tiger sharks are most likely offshore, although little is known about the pupping grounds. **Neonates and Juveniles**: EFH for both neonate and juvenile life stages occurs along the Atlantic east coast from northern Florida to Cape Cod and includes the Plymouth, Kingston, Duxbury Bay system, Sandy Hook, and Narragansett Bays as well as coastal sounds, lower Chesapeake Bay, Delaware Bay, and Raleigh Bay (NMFS 2009). Nursery habitat for sand tiger shark was characterized for the Delaware Bay, which consisted of temperatures from 66.2°F to 77°F (19°F to 25°C), salinities from 23 to 30 ppt at depths of 2.8-7 m in sand and mud areas (McCandless et al. 2002). Nursery characteristics of nearshore waters of North Carolina consist of temperatures from 66.2°F to 80.6°F (19°C to 27°C), salinities of 30 to 31 ppt at depths of 26.2 to 42.7 feet (8 to 13 meters) in rocky and mud areas and in areas containing artificial reefs or wrecks (McCandless et al. 2002). **Adults:** Shallow coastal waters to the 25 m isobath from Barnegat Inlet, NJ to Cape Lookout; from St. Augustine to Cape Canaveral, FL.
Sandbar Shark *Carcharhinus plumbeus*	X	X	-	X	X	-	X	X	-	**General habitat description**: The sandbar shark ranges within subtropical and warm-temperate waters with the North Atlantic population ranging from Cape Cod to the western Gulf of Mexico. Prefers bottom habitats and is most common in 65.6 to 180.4 feet (20 to 55 meters) of water, but occasionally found at depths of about 656.2 feet (200 meters). In the United States, sandbar shark nursery areas consist of shallow coastal waters from Cape Canaveral, Florida, to Martha's Vineyard, Massachusetts. **Neonates**: Designated EFH is identified in localized coastal areas on the Florida Panhandle, as well as localized areas along the Georgia and South Carolina coastlines and from Cape Lookout to Long Island, New York (NMFS 2009). Sandbar shark nursery areas are typically in shallow coastal waters for neonates and young-of-the-year life stages and have been identified in Great Bay, New Jersey (Merson and Pratt 2001, 2007). The juvenile diet consists of blue crabs, mantis shrimp and other crustaceans, and a variety of fish, such as menhaden, black sea bass, and flatfish. **Juveniles**: Designated EFH is in localized areas of the Atlantic coast of Florida, South Carolina, and southern North Carolina, and from Cape Lookout to southern New England (NFMS 2009). Juveniles will remain in or near the nursery grounds until late fall, later forming schools and migrating to deeper waters (NFMS 2009). Juvenile sandbar sharks return to nursery grounds during warmer months and repeat this migratory pattern until they are approximately 7 to 10 years of age and begin a wider migration into the adult life stage. The diet of juvenile sandbar sharks consists of hakes, mackerels, monkfish, flatfish, squids, and crabs (Stillwell and Kohler 1993). **Adults**: EFH designations for sandbar shark occur within localized areas off Alabama and coastal areas from the Florida Panhandle to the Florida Keys in the Gulf of Mexico. Adults are found along the Atlantic coast from the shore to a depth of 918.6 feet (280 meters) in southern Nantucket, Massachusetts, to the Florida Keys (NMFS 2009). They migrate seasonally along the western Atlantic coast, moving north with warming water temperatures during the summer and south as temperatures begin to decrease during the fall (Collette and Klein-MacPhee 2002). Adults are opportunistic bottom feeders that prey on bony fishes, smaller sharks, rays, cephalopods, gastropods, crabs, and shrimps (Collette and Klein-MacPhee 2002; Bowman et al. 2000; Stillwell and Kohler 1993).
Shortfin Mako Shark *Isurus oxyrinchus*	X	X	-	X	X	-	X	X	-	General habitat description: Oceanic species found in warm and warm-temperate waters throughout all oceans. It feeds on fast-moving fishes such as swordfish, tuna, and other sharks (Castro 1983), as well as clupeids, needlefishes, crustaceans, and cephalopods (Maia et al. 2007). MacNeil et al. (2005) found evidence of a dietary shift from cephalopods to bluefish in the spring. **Neonates, Juveniles, and Adults:** Pelagic waters in the Atlantic from southern New England through Cape Lookout, and specific areas off Maine, South Carolina, and Florida (NMFS 2009). Neonate are less than 50.4 inches (128 cm), juveniles are 50.4 to 107.9 inches (129 to 274 cm), and adults are greater than 108.3 inches (275 cm) (NMFS 2017).
Smooth Dogfish *Mustelus canis*	X	X	-	X	X	-	X	X	-	**General habitat description**: Common coastal shark species found from Massachusetts to northern Argentina. They are primarily demersal sharks that inhabit coastal shelves and inshore waters to a maximum depth of 656.2 feet (200 meters) (NMFS 2017). Smooth dogfish is a migratory species that responds to water temperature and congregates between southern North Carolina and the Chesapeake Bay in the winter. **Neonates, Juveniles, and Adults**: Demersal EFH for smooth dogfish identified in the Atlantic is exclusively for smooth dogfish. EFH for smooth dogfish includes coastal areas from Cape Cod Bay, Massachusetts, to South Carolina, inclusive of inshore bays and estuaries (e.g., Delaware Bay, Long Island Sound). EFH also includes continental shelf habitats between southern New Jersey and Cape Hatteras, North Carolina (NMFS 2017). Smooth dogfish have diets that are predominantly invertebrates, such as large crustaceans consisting mostly of crabs, but also American lobsters (Scharf et al. 2000).

Common Name/ Scientific Name	EFH Habitat within Project Area									Habitat Association
	Neonate			Juvenile			Adult			
	WFA	OECRC	IECRC	WFA	OECRC	IECRC	WFA	OECRC	IECRC	
Spiny Dogfish *Squalus acanthias*	-	-	-	X	X	-	X	X	-	**General habitat description**: The spiny dogfish is widely distributed throughout the world, with populations existing on the continental shelf of the northern and southern temperate zones, which includes the North Atlantic from Greenland to northeastern Florida, with concentrations from Nova Scotia to Cape Hatteras.). Individuals travel in schools by size until maturity, at which point they form schools segregated by size and sex (Collette and Klein-MacPhee 2002; Nammack et al. 1985; Bigelow and Schroeder 1953). Spawning occurs offshore during the winter (Bigelow and Schroeder 1953). Based on seasonal temperatures, spiny dogfish migrate up to 994.2 miles (1,600 km) along the east coast, and Spiny dogfish have been observed along the New Jersey coast in March (Bigelow and Schroeder 1953). **Juveniles**: Spiny dogfish are born offshore in fall or winter, ranging from approximately 8 to 13 inches (20 to 33 cm (Soldat 1979; Nammack et al. 1985; Burgess 2002). From 1963 to 2003, NEFSC bottom trawl surveys collected spiny dogfish juveniles at depths ranging from 36 to 1,640.4 feet (11 to 500 meters), in water approximately 37.4°F to 62.6°F (3°C to 17°C), with salinities ranging from 24 to 36 ppt. **Adults**: Adults are found in deeper waters inshore and offshore from the shallows to approximately 2,952.7 feet (900 meters) deep, in water temperatures that range from 42.8°F to 46.4°F (6°C to 8°C, and seldom over 59.0°F (15°C) (Collette and Klein-MacPhee 2002). Adults will feed on a variety of fish including mackerel, herring, scup, flatfish, and cod, shrimp, crabs, squid, siphonophores, and sipunculid worms (Bigelow and Schroeder 1953; Bowman et al. 2000).
Tiger Shark *Galeocerdo cuvieri*	-	-	-	X	X	-	X	X	-	**General habitat description:** The tiger shark is found from Cape Cod, Massachusetts, to Uruguay, including the Gulf of Mexico and the Caribbean Sea. They are found near inshore coastal waters to the OCS, as well as offshore including oceanic island groups. The tiger shark inhabits warm waters in both deep oceanic and shallow coastal regions (Castro 1983). They occur in the western North Atlantic, but rarely occur north of the Mid-Atlantic Bight (Skomal 2007). **Juveniles and Adults**: EFH extends from offshore pelagic habitats associated with the continental shelf break at the seaward extent of the U.S. EEZ boundary to the Florida Keys and is found in the central Gulf of Mexico and off Texas and Louisiana, and from Mississippi through the Florida Keys. EFH in the Atlantic Ocean extends from offshore pelagic habitats associated with the continental shelf break (NMFS 2017).
White Shark *Carcharodon carcharias*	X	X	-	X	X	-	X	X	-	**General habitat description**: The white shark ranges within all temperate and tropical belts of oceans, including the Mediterranean Sea. The white shark occurs in coastal and offshore waters and has a very sporadic presence. Because of the shark's sporadic presence, very little is known about its breeding habits. Sightings of the white shark in the Mid-Atlantic Bight occur from April to December. The white shark prefers open ocean habitat. **Neonates**: EFH includes inshore waters out to 65.2 miles (56.7 nm, 105 km) from Cape Cod, Massachusetts, to an area offshore of Ocean City, New Jersey. **Juveniles and Adults**: EFH includes inshore waters to habitats 65.2 miles (56.7 nm, 105 km) from shore, in water temperatures ranging from 9 to 28 °C, but more commonly found in water temperatures from 57.2°F to 73.4°F (14°C to 23 °C) from Cape Ann, Massachusetts, including parts of the Gulf of Maine, to Long Island, New York, and from Jacksonville to Cape Canaveral, Florida.

Source: Modified from COP, Volume III, Appendix P; Ocean Wind 2022a
°C = degrees Celsius; °F = degrees Fahrenheit; cm = centimeters; COP = Construction and Operations Plan; EEZ = Exclusive Economic Zone; EFH = Essential Fish Habitat; HAPC = Habitat Area of Particular Concern; IECRC = Inshore Export Cable Route Corridor; km = kilometers; nm = nautical miles; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Administration; OCS = Outer Continental Shelf; OECRC = Offshore Export Cable Route Corridor; ppt = parts per thousand; WFA = Wind Farm Area

4.1.1 Vulnerable Species, Life Stages, and Habitat

Many mobile species are less susceptible to potential Project impacts because they can leave or avoid areas of impacts. However, certain EFH species or lifestages are more susceptible because they are immobile or have limited mobility. Certain habitats are also considered sensitive.

- Winter flounder eggs (adhesive and demersal in mud, sand, gravel, and SAV) and larvae, are found in Mid-Atlantic estuaries in late winter through spring.
- Sessile or slow-moving benthic/epibenthic invertebrates (bivalve juveniles and adults, squid egg mops).
- Skate egg cases.
- Ocean pout eggs and larvae.
- Tidal saltmarshes, especially those dominated by *Spartina alterniflora* and/or *Spartina patens*. Marshes dominated by *Phragmites australis*, while still providing important wetlands functions, are not as sensitive to disturbance.
- SAV, especially beds dominated by *Zostera marina* (See Appendix 10-2, Section 10.2.4)
- Shellfish beds in Barnegat Bay-Little Egg Harbor estuary

4.1.2 Habitat Areas of Particular Concern (HAPC)

4.1.2.1 Summer Flounder HAPC

Summer flounder HAPC is defined as all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed (SAV), as well as loose aggregations, within adult and juvenile summer flounder EFH. If native species are eliminated, then exotic species should be protected because of functional value. For a discussion of existing SAV in New Jersey estuaries, see Section 3.2.2.

Juvenile and adult summer flounder have both been documented as having a preference for sandy habitats (Timmons 1995; Bigelow and Schroeder 1953; Schwartz 1964; Smith 1969) but are also commonly found in mudflats and seagrass beds within coastal bays and estuaries (Packer et al. 1999a; MAFMC 1998). In general, adult and older juveniles can be found in shallow, inshore and estuarine waters during the summer and fall and then move offshore to deeper waters in the winter and spring, although some juveniles will remain in the bays and estuaries for the winter (Packer et al. 1999a; Smith and Daiber 1977; Able and Kaiser 1994). Within the Project area, only inshore cable corridors within Barnegat Bay, e.g., BL England onshore cable route corridor and Oyster Creek IECRC, include areas with SAV and therefore juvenile and adult summer flounder HAPC (Figure 4-1 and Figure 4-2). Impacts of Project activities to juvenile and adult summer flounder HAPC will be analyzed in Section 5.

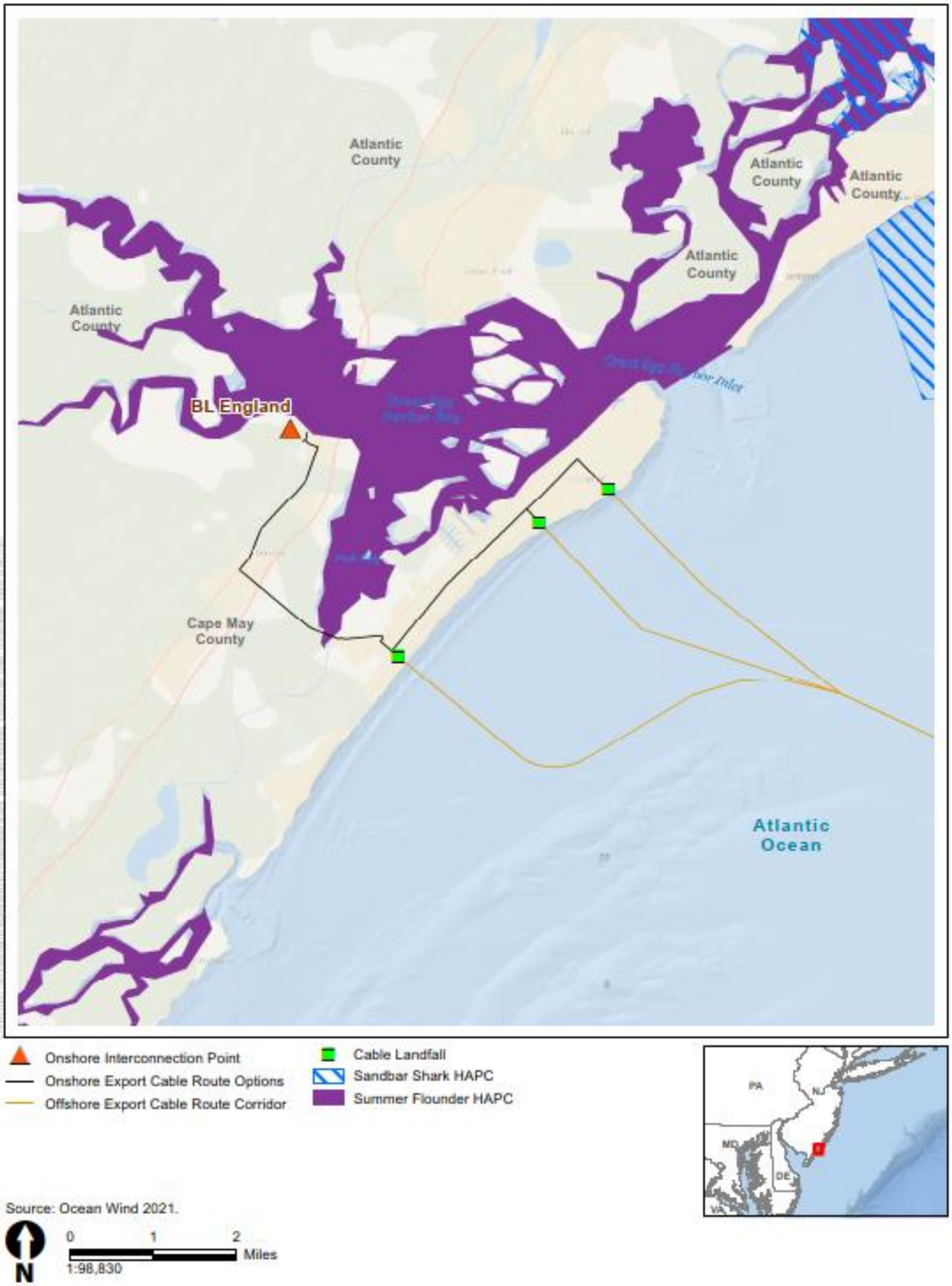


Figure 4-1 Summer Flounder HAPC near the BL England IECRC

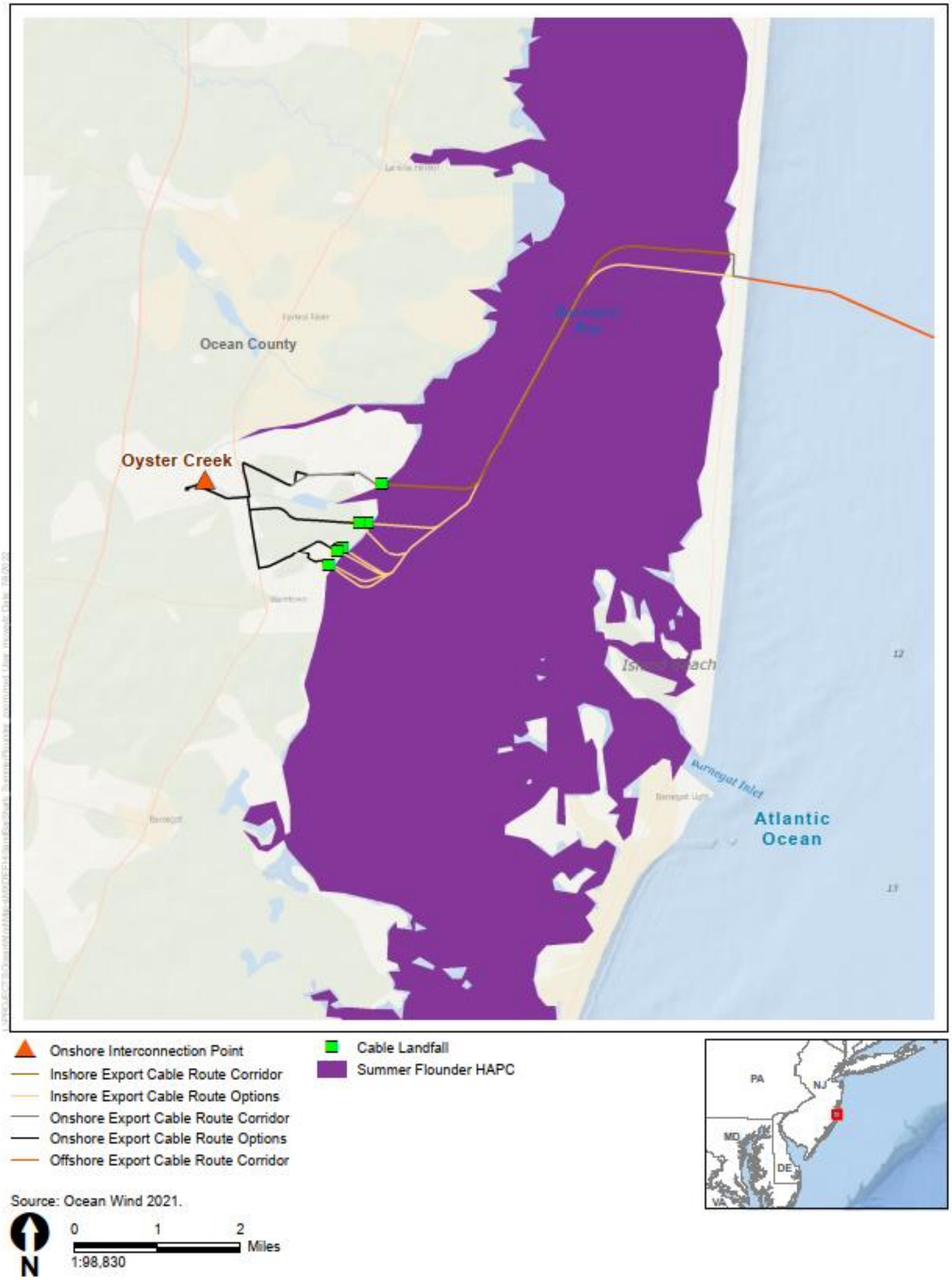
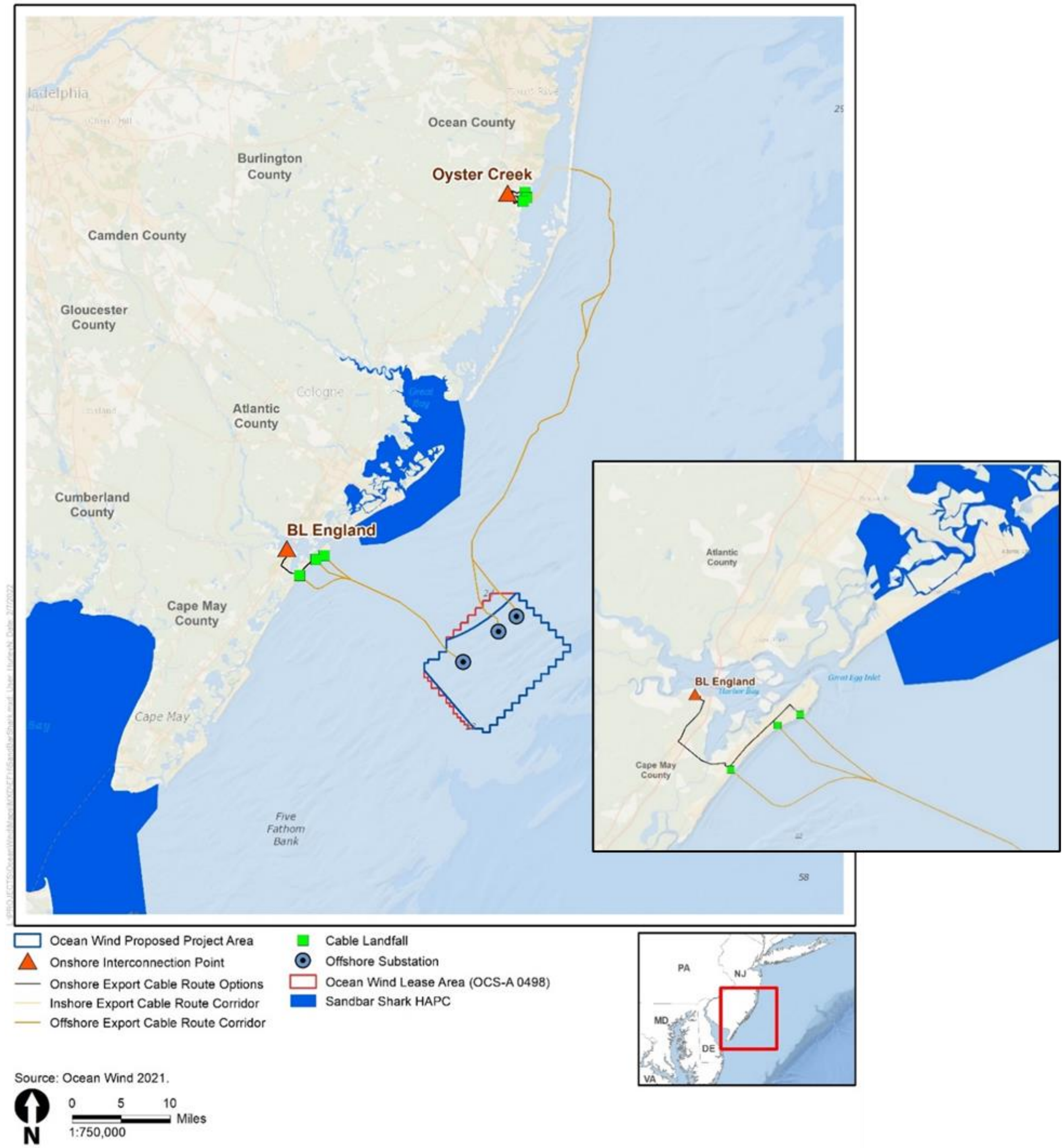


Figure 4-2 Summer Flounder HAPC near the Oyster Creek IECRC

4.1.2.2 Sandbar Shark HAPC

In New Jersey, sandbar shark HAPC is located in the Mullica River estuary (Great Bay/Little Egg Harbor) and in Delaware Bay (Figure 4-3). Sandbar shark HAPC includes nursery and pupping grounds in shallow areas and at the mouth of Great Bay, New Jersey, in lower and middle Delaware Bay, in lower Chesapeake Bay, and offshore of the Outer Banks of North Carolina in depths ranging from 0.8 to 23 m with sand and mud habitats (NMFS 2017).

The BL England IECRC would pass within 3.9 miles of the southernmost point of the Great Bay/Little Egg Harbor HAPC but would not overlap it. Project activities associated with the installation of the BL England IECRC near sandbar shark HAPC will be analyzed in Section 5.



Note: Inset shows detail of the onshore landing options of the BL England IECRC

Figure 4-3 Sandbar Shark HAPC near the Project Area

4.1.3 Prey Species

Prey species are those species consumed by EFH fish and invertebrate species as prey and are thus a component of EFH. Species include forage fish such as sand lance, anchovy, and river herring, as well as invertebrates such as clams, crabs and worms. Sand lance (*Ammodytes* spp.) have been found to be prey species to at least 45 species of fish in the northwest Atlantic Ocean (Staudinger et al. 2020). Bay anchovy (*Anchoa mitchilli*), which is the most abundant of several anchovy species, may also be the most abundant fish species in the western north Atlantic (Houde and Zastrow 1991) and is an important trophic link between planktonic production and larger piscivores. Epibenthic and infaunal species, primarily invertebrates, similarly provide important trophic linkages to upper trophic level species. Invertebrates, including worm-like invertebrates (e.g., oligochaetes, polychaetes, flatworms [Platyhelminthes], and nematodes [Nematoda]), burrowing amphipods, mysids, copepods, crabs (Brachyura), sand dollars (Clypeasteroida), starfish (Asteroidea), sea urchins (Echinoidea), bivalves (Bivalvia), snails (Gastropoda) and burrowing anemones (Anthozoa), provide the prey base for several EFH species. Impacts to prey species may indirectly lead to impacts to EFH and EFH species and life stages due to lost foraging opportunities or reduced foraging efficiency.

4.1.4 Species Groups

Species groups will be used throughout this assessment. Species groups are groups of EFH species and/or life history stages that predominantly share the same habitat type. Benthic/epibenthic species groups are sorted into two habitat types (soft bottom or complex) based on the benthic habitat with which the species is most typically associated, with the potential for any species to be found in heterogenous complex as that habitat type could include both soft-bottom and complex habitat.

Prey species are included as species groups because they are consumed by managed fish and invertebrate species as prey, and thus are a component of EFH.

Note that for acoustic impacts, acoustic groups are defined according to Popper et al. (2014). See Section 5.1.1.2 for more information.

<u>Sessile Benthic/Epibenthic – Soft Bottom</u> (includes slow-moving benthic/epibenthic species and/or life stages; could include heterogenous complex habitat)

- Atlantic scallop (juveniles, adults)
- Atlantic surfclam (juveniles, adults)
- Flatfish (eggs and larvae of winter flounder)
- Longfin and northern shortfin squid (eggs)
- Ocean pout (eggs, larvae)
- Ocean quahog (juveniles, adults)
- Skates (eggs)

<u>Mobile Benthic/Epibenthic – Soft Bottom</u> (could include heterogenous complex habitat)

- Flatfish (juveniles, adults)
- Monkfish (juveniles, adults)
- Ocean pout (juveniles, adults)
- Red hake (juveniles, adults)
- Scup (juveniles, adults)
- Sharks (neonates, juveniles, adults)
- Skates (neonates, juveniles, adults)
- Silver hake
- White hake

<u>Sessile Benthic/Epibenthic – Complex Habitat</u> (includes slow-moving species and/or life stages; could include heterogenous complex habitat)

- Longfin and northern shortfin squid (eggs)
- Skates (eggs)

Mobile Benthic/Epibenthic – Complex Habitat (could include heterogenous complex habitat)

- Atlantic cod
- Black sea bass
- Scup (juveniles, adults)
- Sharks (neonates, juveniles, adults)
- White hake

Pelagic

- Atlantic butterfish (eggs, larvae, juveniles, adults)
- Atlantic herring (eggs, larvae, juveniles, adults)
- Atlantic mackerel (eggs, larvae, juveniles, adults)
- Bluefish (eggs, larvae, juveniles, adults)
- HMS (eggs, larvae, juveniles, adults)
- Longfin squid (larvae, juveniles, adults)
- Northern shortfin squid (larvae, juveniles, adults)
- Pollock (juveniles, adults)
- Sharks (neonates, juveniles, adults)
- All other finfish, flatfish, and bivalves except ocean pout and winter flounder (eggs, larvae for both)

Prey Species – Benthic/Epibenthic

- Bivalves such as blue mussel (*Mytilus edulis*), eastern oyster (*Crassostrea virginica*), hard clams (*Mercenaria mercenaria*), soft-shell clams (*Mya arenaria*)
- Annelid worms
- Crustaceans – e.g., amphipods, shrimps, crabs,

Prey Species – Pelagic

- Anchovy, bay (*Anchoa mitchilli*) and striped (*Anchoa hepsetus*)
- Atlantic menhaden
- River herring (alewife, blueback herring)
- Sand lance

4.1.5 NOAA Trust Resources

NOAA Trust Resources have also been identified in the vicinity of the WFA, OECRC, and IECRC. NOAA Trust Resources are summarized in Table 4-3 and discussed in detail in Section 7.

Table 4-3 NOAA Trust Resources within the Project Area

Species	Life Stage within Project Area			
	Egg	Larvae	Juvenile	Adult
River herring (alewife, blueback herring)			X	X
American eel		X	X	X

Species	Life Stage within Project Area			
	Egg	Larvae	Juvenile	Adult
Striped bass			X	X
Blackfish/tautog			X	X
Weakfish	X	X	X	X
Forage species (Atlantic menhaden, bay anchovy, sand lance)	X	X	X	X
American shad			X	X
Blue crab	X	X	X	X
Horseshoe crab	X	X	X	X
Bivalves (blue mussel, eastern oyster, ocean quahog, soft-shell clam)	X	X	X	X
Spot	X	X	X	X
Atlantic croaker	X	X	X	X
Spotted hake	X	X	X	X
Smallmouth flounder	X	X	X	X
Bobtail squid	X	X	X	X
Northern kingfish	X	X	X	X
Sea robins	X	X	X	X
Gulf stream flounder	X	X	X	X

NOAA = National Oceanic and Atmospheric Administration

5. Analysis of Potential Impacts on EFH

This section provides an analysis of the effects of the proposed Project on designated EFH for managed species and life stages in the Project area defined in Section 4. As defined by NOAA, adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate as well as the loss of and/or injury to benthic organisms, prey species, their habitat, and other ecosystem components. Adverse effects may be site-specific or habitat-wide impacts including individual, cumulative, or synergistic consequences of actions (50 CFR **§** 600.810).

The Project area encompasses the impacts resulting from the proposed WFA, OECRC, IECRC, and onshore cable route corridor footprints. Potential adverse effects on EFH may include noise, water quality, alterations to substrates used by EFH-designated species during specific life stages, and impairments to pelagic or benthic organisms and their habitat. If a Project component is likely to result in a short-term (less than 2 years), long-term (2 years to < life of Project), or permanent (life of Project) impairment of designated EFH or HAPC for a managed species and life stage, this would constitute an adverse effect on EFH.

The following sections summarize potential impacts of the Proposed Action on EFH during construction, O&M, and decommissioning of the proposed Project. Temporal classifications of impacts include short-term (less than 2 years), long-term (2 years to < life of the Project), or permanent (life of the Project) effects.

5.1 Construction and Operation Activities

Project construction would generate short-term and long-term direct and indirect effects on EFH through vessel activity, pile driving, seabed preparation, and installation of scour protection. noise; crushing, burial, and entrainment effects; and suspended sediments and turbidity from bed disturbance. These effects would occur intermittently and at varying locations in the Project area over the duration of Project construction. Thus, the suitability of EFH for managed species may be reduced depending on the nature, duration, and magnitude of each effect. Impacts of Project activities on EFH and EFH species are discussed below.

5.1.1 Installation of WTG/OSS Structures and Foundations

5.1.1.1 Vessel Activity

5.1.1.1.1 Habitat Loss/Conversion

During installation of the 98 WTG and three OSS structures and associated foundations, it is anticipated that 120 simultaneous construction vessels would be necessary (Ocean Wind 2022a). Vessels may require anchoring to facilitate construction activities. Certain construction vessels such as jack-up vessels or hotel vessels would require stabilization spuds. These activities would occur intermittently during installation of WTG and OSS foundation installation. Anticipated benthic habitat disturbing activities during WTG and OSS installation include anchor placement, anchor chain sweep, and spud placement. These activities would take place within a 4,735.51-acre (1,916.39-hectare) area, comprised of all three of the NOAA Habitat Complexity Categories (cross-walked with benthic habitat types in Table 3-1). Vessels that utilize anchors (rather than spud cans) to hold position generally have a greater potential to disturb the seabed and result in crushing or burial impacts and habitat loss or conversion. Aside from monopile installation activities, vessels within the WFA would primarily use dynamic positioning systems to hold position and would not result in such impacts.

Benthic habitat types within the WFA that are subject to disturbance from vessel activities mentioned above include approximately 4,030.03 acres (1,630.90 hectares) of soft bottom, 651.32 acres (263.58 hectares) of complex bottom, and 54.2 acres (21.93 hectares) of heterogenous complex bottom (Inspire 2022a). The areal extent of the direct, short-term, localized impacts from anchor placement and retrieval, anchor chain sweep, and spud placement during installation of WTGs and OSS structures would be approximately 14 acres [5.7 hectares] (Table 2-1), though the breakdown by specific habitat type for that number is not known.

Anchor placement and retrieval, anchor chain sweep, and spud placement could cause habitat loss or conversion by disturbing or crushing habitat in the immediate area where anchors, chains, and spuds meet the seafloor, resulting in short-term to long-term direct impacts to EFH for sessile benthic/epibenthic species. Recovery of EFH in soft-bottom habitats would likely recover in the short term, but impacts to complex hard-bottom habitats such as cobble and boulders could include disturbance of epifaunal communities, which could take much longer to recover. Within the Barnegat Bay portion of the Oyster Creek IECRC, anchor placement and retrieval could cause short-term to permanent impacts to SAV beds in the Project area. While anchor placement and chain sweep may damage seagrass blades which could recover in the short term, anchor drag and retrieval are likely to damage or uproot seagrass rhizomes, which may take years to recover (Orth et al. 2017), resulting in long-term to permanent impacts to SAV. To minimize anchoring impacts and reduce impacts to EFH and EFH species, Ocean Wind has committed to an applicant proposed measures (APMs) to avoid anchoring on sensitive habitat during construction activities (Section 6.1.1).

Anchoring activities could also result in the crushing and burial of sessile or slow-moving benthic/epibenthic EFH species and/or life stages, resulting in direct, permanent (lethal), localized impacts to these species. Recovery of the benthic/epibenthic community in soft-bottom habitat would be recoverable in the short-term, while the benthic/epibenthic community in complex habitat would undergo short-term to long-term recovery. Anchor placement and retrieval, anchor chain sweep, and spud placement could cause mobile benthic and pelagic EFH species, as well as benthic and pelagic prey species, to avoid the area of impact, resulting in direct, short-term, localized impacts on these species. Sessile or slow-moving prey species could be crushed or buried as a result of anchoring activities, resulting in indirect short-term effects on pelagic and mobile benthic EFH species and/or life stages that feed on those species.

Effects on EFH and EFH species:

- Direct
  - Short-term loss/conversion of EFH (APM for avoidance of sensitive habitat when anchoring): EFH for Sessile Benthic/Epibenthic – Soft Bottom, Mobile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex; Mobile Benthic/Epibenthic – Complex; Pelagic species groups; Prey Species – Benthic; Prey Species – Pelagic, Summer Flounder HAPC; Summer Flounder HAPC.
  - Permanent, localized crushing and burial of EFH species: Sessile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex; Prey –Benthic/Epibenthic species groups.
  - Short-term avoidance of anchoring activities by EFH species: Mobile Epibenthic/Benthic – Soft Bottom; Mobile Epibenthic/Benthic – Complex; Pelagic; Prey Species – Benthic and Prey Species – Pelagic species groups.
- Indirect
  - Short-term loss of benthic prey items: Mobile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Complex.

5.1.1.1.2 Sediment Suspension

Only certain Project vessel activities, such as those associated with anchoring (e.g., anchor placement and retrieval, chain sweep, and/or spud placement) would likely result in sediment suspension, a concomitant increase in turbidity in the water column, and sedimentation.

Sediments within the WFA are generally medium- to coarse-grained with areas of gravelly sand and gravel deposits near the WFA. Based on the grain sizes evaluated for similar projects in Massachusetts, Rhode Island, and Virginia, the medium- to coarse-grained sand deposits near the WFA are likely to settle to the bottom of the water column quickly, so an increase in turbidity would be short-term and local, and sedimentation would be local. Finer sediments within the export cable route, closer to shore, and in back-bay areas would stay suspended longer and potentially be transported farther depending on local currents. Impacts from sediment resuspension, turbidity, and sedimentation would likely be greater in soft-bottom habitat with finer sediment than in complex hard-bottom habitat.

SAV occurs in soft sediments in Barnegat Bay and would be subject to increases in sediment suspension and deposition. However, seagrasses have vertical structure that can accommodate a degree of burial greater than would be expected from the one-time resuspension and settling of dredged material (Lewis and Erftemeijer 2006). Ocean Wind has committed to an APM to avoid anchoring in sensitive habitats would also reduce impacts to SAV (Section 6.1.1), although some sedimentation could still occur due to anchoring in nearby areas.

Sessile benthic/epibenthic EFH species have a range of susceptibility to sediment suspension, turbidity, and sedimentation based on life stage, mobility, and feeding mechanisms. Increases in sediment suspension and deposition may cause short-term adverse impacts to EFH due to a decrease in habitat quality for benthic species and life stage, with small sessile or slow-moving benthic EFH species and life stages (e.g., benthic eggs and larvae) experiencing greater impacts from deposition than larger, mobile species or life stages. Filter-feeding invertebrates could experience a reduction in feeding ability and food quality. Benthic prey species could experience sedimentation, such as clams in shellfish beds in Barnegat Bay, could experience short-term increases in turbidity and sedimentation, but would be expected to recover. Resuspended sediment in the water column would reduce the quality of EFH for mobile benthic/epibenthic and pelagic EFH species, but water column EFH would be expected to recover quickly following sedimentation. Short-term loss of foraging opportunities and displacement of mobile benthic/epibenthic and pelagic EFH species and pelagic prey species due to increased turbidity could also occur, but recovery would be expected following settlement of sediments.

Effects

- Direct
  - Short-term decrease in quality of EFH due to suspended sediments and increased turbidity: EFH for Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; and Pelagic species groups; Summer Flounder HAPC.
  - Short-term, local impacts due to sedimentation: Sessile Benthic/Epibenthic – Soft Bottom; Prey Species – Benthic.
- Indirect
  - Short-term loss of foraging opportunities: Mobile Epibenthic/Benthic – Soft Bottom; and Pelagic species groups.
  - Short-term decrease in quality of EFH in areas adjacent to Project activities for: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Summer Flounder HAPC; Prey Species – Benthic.

5.1.1.1.3 Vessel Noise

Vessel noise may interfere with feeding and breeding, alter schooling behaviors and migration patterns (Buerkle 1973; Olsen et al. 1983; Schwarz and Greer 1984; Soria et al. 1996; Vabø et al. 2002; Mitson and Knudsen 2003; Ona et al. 2007; Sarà et al. 2007), mask important environmental auditory cues (CBD 2012; Barber 2017), and induce endocrine stress response (Wysocki et al. 2006). Fish communication is mainly in the low-frequency (<1,000 hertz [Hz]) range (Ladich and Myrberg 2006; Myrberg and Lugli 2006) so masking is a particular concern because many fish species have unique vocalizations that allow for inter- and intra-species identification, and because fish vocalizations are generally not loud, usually approximately 120 decibels (dB) sound pressure level (SPL) with the loudest sounds reaching 160 dB SPL (Normandeau Associates 2012). Behavioral responses in fishes differ depending on species and life stage, with younger, less mobile age classes being the most vulnerable to vessel noise impacts (Popper and Hastings 2009; Gedamke et al. 2016).

Underwater sound from vessels can cause avoidance behavior, which has been observed for Atlantic herring (*Clupea harengus*) and Atlantic cod (*Gadus morhua*) and is a likely behavior of other species as well (Vabø et al. 2002; Handegard et al. 2003). Fish may respond to approaching vessels by diving toward the seafloor or by moving horizontally out of the vessel's path, with reactions often initiated well before the vessel reaches the fish (Ona et al. 2007; Berthe and Lecchini 2016). The avoidance of vessels by fish has been linked to high levels of infrasonic and low-frequency sound (approximately 10 to 1,000 Hz) emitted by vessels. Accordingly, it was thought that quieter vessels would result in less avoidance (and consequently quieter vessels would have a higher chance of encountering fish) (De Robertis et al. 2010). By comparing the effects of a quieted and conventional research vessel on schooling herring, it was found that the avoidance reaction initiated by the quieter vessel was stronger and more prolonged than the one initiated by the conventional vessel (Ona et al. 2007). In a comment to this publication, Sand et al. (2008) pointed out that fish are sensitive to particle acceleration and that the cue in this case may have been low-frequency particle acceleration caused by displacement of water by the moving hull. This could explain the stronger response to the larger, noise-reduced vessel in the study by Ona et al. (2007), which would have displaced more water as it approached.

Nedelec et al. (2016) investigated the response of reef-associated fish by exposing them in their natural environment to playback of vessel engine sounds. They found that juvenile fish increased hiding and ventilation rate after a short-term vessel sound playback, but responses diminished after long-term playback, indicating habituation to sound exposure over longer durations. These results were corroborated by Holmes et al. (2017) who also observed short-term behavioral changes in juvenile reef fish after exposure to vessel noise as well as desensitization over longer exposure periods. While sounds emitted by vessel activity are unlikely to injure fish, vessel sound has been documented to cause short-term behavioral responses (Holmes et al. 2017). Project-related vessel noise on nearby artificial reefs, discussed in Section 3.3, would be intermittent and of short duration, therefore, impacts to reef-associated fish are expected to be low.

Analysis of vessel noise related to the Cape Wind Energy Project found that noise levels from construction vessels at 10 feet (3 meters) were loud enough to elicit an avoidance response, but not loud enough to do physical harm (MMS 2008). Pelagic species and life stages and prey species that occur high in the water column (e.g., Atlantic butterfish, Atlantic herring, Atlantic mackerel, bluefish, and some highly migratory pelagic species) would be the most likely affected species by vessel and construction noise, although the behavioral avoidance impacts would be short-term. However, in inshore, shallow waters benthic species and life stages could also be affected. Additionally, although sandbar shark HAPC is not within the Project area, it is possible that transiting Project vessels could pass near or within the sandbar shark HAPC that occurs near the Project area, thereby reducing habitat quality. Sandbar sharks typically occur lower in the water column, so vessel noise likely would not disturb them except in shallow water. Any disturbance they did experience would result in a short-term impact of avoidance of vessel noise. Demersal and benthic invertebrates would not be anticipated to be affected as a result of increased noise from vessels associated with construction of the proposed Project. Therefore, EFH-designated fish within the WFA may initially exhibit a negative behavioral response to vessel activity; however, as vessel traffic increases throughout the previously discussed Project timeline, habituation to vessel noise by EFH-designated species are likely to occur. Project-related vessel noise would be intermittent and of short duration, so the overall impacts to fish are expected to be low.

Vessel and pile driving noise effects on specific hearing categories for EFH-designated species are combined and detailed further in Section 5.1.1.2.

Effects

- Direct
    - Short-term, local avoidance responses due to vessel noise: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex Habitat; Mobile Benthic/Epibenthic – Complex Habitat; Pelagic; Prey Species – Benthic/Epibenthic; Prey Species – Pelagic.
- Indirect
    - Reduction in habitat quality for sandbar shark HAPC.

5.1.1.1.4 Potential Introduction of Exotic/Invasive Species

Invasive species can be accidentally released in the discharge of ballast water and bilge water during vessel activities. Increasing vessel traffic throughout the construction duration of the Project would increase the risk of accidental releases of invasive species. Vessels are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including U.S. Coast Guard ballast discharge regulations (33 CFR 151.2025) and U.S. Environmental Protection Agency National Pollutant Discharge Elimination System Vessel General Permit standards, both of which aim at least in part to prevent the release and movement of invasive species. Adherence to these regulations would reduce the likelihood of discharge of ballast or bilge water contaminated with invasive species. Although the likelihood of invasive species becoming established due to Project-related activities is low, the impacts of invasive species could be strongly adverse, widespread, and permanent if the species were to become established and out-compete native fauna. Indirect impacts could result from competition with invasive species for food or habitat, and/or loss of foraging opportunities if preferred prey is no longer available due to competition with invasive species.

Effects

- Direct
    - Extremely low likelihood, but potentially long-term and widespread impacts to any or all EFH and EFH species: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex Habitat; Mobile Benthic/Epibenthic – Complex Habitat; Pelagic; Prey Species – Benthic/Epibenthic; Prey Species – Pelagic.
- Indirect
    - Extremely low likelihood of competition with invasive species, loss of foraging opportunities: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex Habitat; Mobile Benthic/Epibenthic – Complex Habitat; Pelagic; Prey Species – Benthic/Epibenthic; Prey Species – Pelagic.

5.1.1.2 Pile Driving

5.1.1.2.1 Underwater Sound

Acoustic impacts from construction of the proposed Project would result primarily from pile driving activities related to installing the WTGs and OSS foundations. The assessment of acoustic impacts provided in the following section emphasizes direct acoustic effects on EFH-designated species and their life stages. These results are also applicable to prey resources used by EFH-designated species. Accordingly, short-term acoustic impacts that reduce prey availability constitutes an adverse effect on EFH.

Underwater sounds are composed of both pressure and particle motion components and are perceived by fish 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 ($m\ s^{-2}$); however, there is not an internationally accepted standard unit for particle motion (Nedelec et al. 2016). 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.

All fish and many invertebrates perceive the particle motion component of sound. Fish have sensory structures in the inner ear that function to detect particle motion (Popper and Hawkins 2018; Nedelec et al. 2016, Nedelec et al 2021). Detectable particle motion is limited to a range of a few hundred hertz), at high intensities and limits the distance over which sounds are detectable. (Ladich and Schulz-Mirbach, 2016). Limited studies have been conducted on particle motion detection within marine species, however the following provides a summary of some of the studies conducted:

- Due to a lack of air-filled spaces and compressible tissue, crustaceans are responsive to vibration reception. The Norway lobster (*Nephrops norcegicus*) responded to vibrational stimuli of 20-80 Hz within 1 m away in the form of postural changes.
- According to Fay and Simmons (1998) (as cited in Roberts and Elliot 2017), the sensitivity of receptor systems on fish appears to be 10^5 times higher than crustaceans.
- Decapods have been observed to have three types of mechanoreceptors; superficial surface receptors, internal statocyst receptors and chordotonal organs that detect water flow and turbulence as well as vibrational stimuli (Breithaupt and Tautz 1998, as cited in Roberts and Elliott 2017).

Particle motion is an important part of a fish’s ability to orient itself in its environment and perceive biologically relevant sounds of prey, predators, and other environmental cues (Popper and Hawkins 2018). Alternatively, most marine mammals and limited fish species interpret noise via sound pressure components of sound waves. Fish with a swim bladder or other air-containing organ can detect the pressure component of sound as the pressure wave causes the compression and vibration of the air-filled swim bladder. The extent to which the pressure component contributes to a fish’s ability to hear varies from species to species and is related to the structures in the fish’s auditory system, ability to process the signal from the swim bladder, the size of the swim bladder, and its location relative to the inner ear.

Impacts from sound vary based on the intensity of the noise and the method of sound detection used by the animal. Behavioral reactions, including short-term displacement or disruption of normal activities such as feeding or movement, could occur. Severe impacts could include physiological reactions such as ruptured capillaries in fins, hemorrhaging of major organs, or burst swim bladders (Popper et al. 2014), which could lead to mortality. Acoustic impacts on fish and invertebrates due to pile driving would vary depending on the ability of the organism to detect sound pressure and whether the air bladder and auditory system are linked, making the species more sensitive to sound impacts (Popper et al. 2014). Fish hearing categories from least sensitive to most sensitive are: organisms without swim bladders (invertebrates, flatfish, some tunas, sharks and rays), fish with swim bladders not involved in hearing (sturgeons, striped bass, yellowfin and bluefin tuna), and fish with swim bladders involved in hearing (some tuna species, gadids, herring; Popper et al. 2014). These categories are shown in Table 5-1.

Assessment of the potential for underwater noise to injure or disturb a fish or invertebrate requires acoustic thresholds against which received sound levels can be compared. The most conservative available acoustic thresholds for fish were developed for impulsive sources (e.g., impact pile driving) by the Fisheries Hydroacoustic Working Group (2008) and Popper et al. (2014). Behavioral thresholds were developed by Andersson et al. (2007), Wysocki et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011). These threshold values are provided in Table 5-2 for pile driving Impulsive criteria include dual metrics which are used to assess the effects to fish exposed to high levels of accumulated energy ($L_{e,24\,hr}$) for repeated impulsive sounds and a single strike at high peak levels (L_{pk}). The criteria include a maximum accumulated SEL for lower-level signals and a maximum L_{pk} for a single pile-driving strike or explosive event (FHWG 2008).

Noise thresholds for adult invertebrates have not been developed because of a lack of available data. In general, mollusks and crustaceans are less sensitive to noise-related injury than many fish because they lack internal air spaces and are less over-expansion or rupturing of internal organs, the typical cause of lethal noise related injury in vertebrates (Popper et al. 2001). Current research suggests that some invertebrate species groups, such as cephalopods (e.g., octopus, squid), crustaceans (e.g., crabs, shrimp), and some bivalves (e.g., scallops, ocean quahog) are capable of sensing sound through particle motion (Carroll et al. 2016; Edmonds et al. 2016; Hawkins and Popper 2014). Particle motion effects dissipate rapidly and are highly localized around the noise source. Studies of the effects of intense noise sources on invertebrates, similar in magnitude to those expected from Project construction, found little or no measurable effects even in test subjects within 3.3 feet (1 meter) of the source (Edmonds et al. 2016; Payne et al. 2007). Jones et al. (2020, 2021) evaluated squid sensitivity to high-intensity impulsive sound comparable to monopile installation. They observed that squid displayed behavioral responses to particle motion effects within 6.6 feet (2 meters) of high-intensity impulsive noise. They further theorized that squid in proximity to the seabed might be able to detect particle motion from impact pile driving imparted through sediments “several hundred meters” from the source, eliciting short-term behavioral responses lasting for several minutes. Other researchers have found evidence of cephalopod sensitivity to continuous low frequency sound exposure comparable to sound sources like vibratory pile driving (Andre et al. 2011).

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, lack of evidence for any source due to extreme difficulty of measuring particle motion and determining fish sensitivity to particle motion renders establishing of any guidelines or thresholds for particle motion exposure currently not possible (Popper et al. 2014; Popper and Hawkins 2018).

Table 5-1 Fish and Invertebrates Categorized by Hearing and Susceptibility to Sound Pressure

Category	Description	Examples	Hearing and Susceptibility to Sound Pressure
1	Fish without swim bladder or hearing associated gas chamber, invertebrates (shellfish, cephalopods), fish eggs and larvae	Flatfish, monkfish, sharks, rays, some tunas, cephalopods, clams	Species are less susceptible to barotrauma. Detect particle motion but not sound pressure, but some barotrauma may result from exposure to sound pressure. Invertebrate species have no air bladder or associated gas chamber for hearing. Invertebrate susceptibility to noise impacts is likely similar to fish with no swim bladder.
2	Fish with swim bladder that does not affect hearing	Bluefish, butterfish, scup, some tunas	Species have a swim bladder, but hearing is not connected to it or other associated gas chamber. Species detect only particle motion but are susceptible to barotrauma.
3	Fish with swim bladder or gas chamber associated with hearing (hearing generalist)	Atlantic herring, black sea bass, gadids	Hearing connected to swim bladder or other associated gas chamber. Species detect sound pressure as well as particle motion and are most susceptible to barotrauma.

Source: Popper et al. 2014

Table 5-2 Acoustic Thresholds for Fish for Impact Pile Driving

Fish Type	Physiological Effects		Behavioral Disturbance[c]
	L_{pk} (dB re 1 μPa)	L_e, 24 hr (dB re 1 μPa²s)	L_p (dB re 1 μPa)
	Impulsive	Impulsive	Impulsive/Non-Impulsive
Fish (≥ 2 grams)[a]	206	187	150
Fish (< 2 grams)[a]	206	183	150
Fish without swim bladder[b]	213	216	150
Fish with swim bladder not involved in hearing[b]	207	203	150
Fish with swim bladder involved in hearing[b]	207	203	150

Notes: [a] FHWG 2008; [b] Popper et al. 2014; [c] Andersson et al. 2007, Wysocki et al. 2007, Mueller-Blenkle et al. 2010, Purser and Radford 2011
> = greater than; < less than; dB re 1 μPa = decibels relative to 1 micropascal; dB re 1 μPa²s = decibels relative to 1 micropascal squared second
L_{pk} = peak sound pressure level; $L_{E,24h}$ = cumulative sound exposure level over 24 hours L_p = sound pressure level

Noise from impact pile driving for the installation of WTGs and OSS foundations would occur intermittently during the installation of offshore structures. A total of 98 WTGs are anticipated for the Proposed Action. Each WTG requires one monopile and each pile requires 4 to 6 hours of driving to install. This would occur over a maximum-case scenario of a total of 98 days over 2 years. Acoustic propagation modeling of the impact pile-driving activities for the Proposed Action was undertaken by JASCO Applied Sciences to determine distances to the established injury and disturbance thresholds for fish (Küsel et al. 2022). Two types of piles were modeled: a tapered 8/11 monopile (26 feet [8 meters] diameter at the waterline and 37 feet [11 meters] diameter at the mudline) and a 2.44-meter pin pile used in jacket foundations. 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. For all impact pile driving, a single noise-abatement system[5] (e.g., one or multiple bubble curtain[s]) with a 10 dB-per-hammer-strike noise attenuation will be used (APM, see Table 6-1). This attenuation is considered achievable with currently available technologies (Bellmann et al. 2020). Soft starts during impact pile driving is an additional mitigation technique that involves the gradual increase in hammer blow energy to allow marine life to leave the area, and is a Project APM (see Table 6-1). Soft starts would include at least 20 minutes of 4-6 strikes per minute at 10 to 20% of the maximum hammer energy (HDR 2022).

Although some fish may move during pile driving, they were considered static receivers for the purposes of the modeling study (Küsel et al. 2022). Acoustic distances where sound levels could exceed fish thresholds were determined using a maximum-over-depth approach and finding the distance that encompasses at least 95% of the horizontal area that would be exposed to sound at or above the specified level (Appendix A in Küsel et al. 2022). The calculated acoustic distances for fish to the physiological and behavioral thresholds with 10 dB attenuation are shown in Table 5-2. These values represent worse-case scenarios of installation of two monopiles or three pin piles in one day during winter.

Sound fields from the 8/11-meter monopiles were modeled at one representative location in the offshore Project area using IHC S-4000 (monopile) and IHC S-2500 (pin pile) impact hammers. Monopiles were modeled for maximum potential impact for an installation of two monopiles per 24 hours, while pin piles were modeled at 3 pin piles per 24 hours, both during winter. Acoustic modeling incorporated 10 dB attenuation, as described above. The resulting values represent a radius extending around each pile where potential injurious-level or behavioral effects could occur (Table 5-3). The single-strike (or peak sound pressure level [L_{pk}) injury distance represents how close a fish would have to be to the source to be instantly injured by a single pile strike. The cumulative injury distance ($L_{E,24h}$) considers total estimated daily exposure, meaning a fish would have to remain within that threshold distance over an entire day of exposure to experience injury. The exposure distance for behavioral effects is an instantaneous value (L_{rms}), meaning that any animal within the effect radius is assumed to have experienced behavioral effects. The likelihood of injury from monopile installation depends on proximity to the noise source, intensity of the source, effectiveness of noise-attenuation measures, and duration of noise exposure. Results from the modeling are shown in Table 5-3. Injury from a single strike on a monopile would range from 20 meters from the monopile for fish without a swim bladder to 70 meters from a monopile for all other fish categories and sizes. Pin pile installation would result in injury from a single strike ranging from 10 meters for fish without a swim bladder to 50 meters for fish with a swim bladder (either not involved or involved in hearing). Fish of both size categories would experience injury within 60 meters of installation of a pin pile. Injury from prolonged cumulative exposure (over 24 hours) within 430 meters of monopile installation could occur for fish without a swim bladder or within 2.38 km for fish with a swim bladder (either not involved or involved in hearing). The injury from cumulative exposure to monopile installation could occur from 8.66 km for fish greater than 2 grams to 11.59 km for fish less than 2 grams. Pin pile installation would produce lower impact levels, with cumulative exposure resulting in impacts within 60 to 64 meters for fish of each swim bladder group, and up to 5.69 km for fish less than 2 grams.

[5] Note that the noise-abatement system implemented must be chosen, tailored, and optimized for site-specific conditions.

Table 5-3 includes modeled impacts for behavioral effects from monopile and pin pile installation. Behavioral impacts from monopile installation could occur up to 7.54 km from the sound source for all fish sizes, and up to 5.32 kms from pin pile installation. Within these areas, 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). Behavioral disturbance to fish from pile driving noise is therefore considered short term for the duration of the activity. To mitigate impacts to the extent practicable, the Project would employ either a double big bubble curtain or a single big bubble curtain in combination with a hydrodamper to achieve a minimum of 10 dB noise reduction (acoustic ranges in Table 5-3 are modeled with 10 dB attenuation. Additionally, the Project would employ soft starts during impact piling, allowing a gradual increase of hammer blow energy, thus allowing mobile marine life to leave the area. Soft starts would be employed on the Project such that prior to the commencement of any impact pile driving (and any time following a cessation of 30 minutes or more), soft-start techniques would be implemented and would include at least 20 minutes of 4 to 6 strikes per minute at between 10 to 20% of the maximum hammer energy.

Table 5-3 Acoustic Ranges to Fish Thresholds for Monopile and Pin Pile Foundation Installation with 10 dB Attenuation (Two Monopiles/24 Hours or Three Pin Piles/24 Hours)

Faunal Group	Metric	Threshold	Monopiles - $R_{95\%}$ (km)[a]	Pin Piles - $R_{95\%}$ (km)[b]
Fish ≥ 2 grams	$L_{E,24h}$	187	8.66	4.05
	L_{pk}	206	0.07	0.06
	L_{rms}	150	7.54	5.32
Fish < 2 grams	$L_{E,24h}$	183	11.59	5.69
	L_{pk}	206	0.07	0.06
	L_{rms}	150	7.54	5.32
Fish without swim bladder	$L_{E,24h}$	216	0.43	0.06
	L_{pk}	213	0.02	0.01
Fish with swim bladder not involved in hearing	$L_{E,24h}$	203	2.38	0.64
	L_{pk}	207	0.07	0.05
Fish with swim bladder involved in hearing	$L_{E,24h}$	203	2.38	0.64
	L_{pk}	207	0.07	0.05

Source: Küsel et al. 2022, Tables 27 and 29

[a] Maximum $R_{95\%}$ (km): hammer energy 4000kJ, penetration depth 50 meters. Monopile foundations have 8- to 11-meter diameter. Assumes two monopiles per 24 hours. Results presented are for location G10 (Küsel et al. 2022).

[b] Maximum $R_{95\%}$ (km): hammer energy 2500kJ, penetration depth 60 meters, winter scenario. Jacket foundations have 2.44-meter diameter. Assumes 3 pin piles per 24 hours.

dB = decibels; kJ = kilojoules; km = kilometers; $R_{95\%}$ = maximum acoustic range at which the sound level was encountered after the 5% farthest points were excluded; $L_{E,24h)}$ = cumulative sound exposure level over 24 hours; L_{pk} = peak sound pressure level; L_{rms} = sound pressure level root mean squared

Noise from pile driving would cause short-term stress and behavioral changes to some EFH-designated species. Sound transmission depends on many environmental parameters, such as the sound speed in the water and substrates. It also depends on the sound production parameters of a pile and how it is driven, including the pile material, size (length, diameter, and thickness), and the make and energy of the hammer (Küsel et al. 2022). Fish response would be highest near impact pile driving (within tens of meters), moderate at intermediate distances (within hundreds of meters), and low at further distances from the pile (within thousands of meters) (Küsel et al. 2022). During active pile driving activities, 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. The soft start mitigation measure would minimize impacts by inducing fish to leave the immediate vicinity of the pile driving activity. Affected areas would likely be recolonized by finfish in the short-term following completion of pile driving activity. Early sessile life stages of finfish, including eggs and larvae, could experience mortality or developmental issues as a result of noise; however, thresholds of exposure for these life stages are not well studied (Weilgart 2018).

Species occurring in the WFA that are most sensitive to noise associated with pile driving activities would be fishes that have a swim bladder involved with hearing (Category 3, i.e., Atlantic herring, gadids). (Küsel et al. 2022). Studies conducted by California Department of Transportation (2001) resulted in some mortality for several different fish species exposed to driving of steel piles 8 feet (2.4 meters) in diameter, whereas Ruggerone et al. (2008) found no mortality to caged yearling coho salmon (*Oncorhynchus kisutch*) placed as close as 2.0 feet (0.6 meters) from a 1.5-foot- (0.45-meter-) diameter pile and exposed to more than 1,600 strikes.

A number of species with an air bladder not involved in hearing have designated EFH in the WFA, Category 2 (i.e., yellowfin tuna, bluefin tuna). Included in this category are fish eggs and larvae. While eggs and larvae may be less vulnerable to the impacts of sound pressure, their inability to escape would likely subject those within the radial distance to injury and mortality.

The least-affected species with EFH designated in the WFA include those species in Category 1, including invertebrates, sharks, rays, flounders, and some tunas. These species do not have an air bladder and rely on particle motion for hearing, reducing any damage induced by sound pressure (Popper et al. 2014). Included in this group are sessile species (Atlantic surfclam and ocean quahog). Although these species are less sensitive to sound pressure, they are similar to eggs and larvae in that they cannot avoid or retreat from potentially damaging sound pressure and would be subject to injury and mortality when sound pressure occurs within a certain radial distance from pile driving.

Noise effects on EFH-designated species and life stages are based on auditory categories previously described in Table 5-1. The following subsections detail various impact mechanisms associated with the construction and installation of WTG and OSS foundations.

5.1.1.2.2 Impact Pile Driving

Hearing Categories: Impact pile driving would produce acoustic impacts that would adversely affect EFH for Hearing Category 1, Hearing Category 2, and Hearing Category 3 (Table 5-2). Species in these groups could exhibit physiological and behavioral impacts depending on intensity and duration of the acoustic impact, distance from the sound source, and hearing sensitivity. Hearing Category 1 includes those species and life stages least sensitive to acoustic stressors so would have the least impacts; Hearing Category 2 would exhibit moderate impacts, and Hearing Category 3 would be affected the greatest. The noise levels would temporarily make the habitat less suitable and cause individuals to vacate the area of Project activities. Pile driving during site preparation activities is anticipated to cause adverse impacts to EFH for both pelagic and demersal life stages; however, this impact would be short-term and EFH is expected to return to pre-pile driving conditions.

Effects

- Direct
  - Short-term, direct effects on EFH and EFH species and life stages for all Hearing Categories, with greatest impacts to Hearing Category 3 species and life stages.
  - Short-term, direct effects on EFH of all Species Groups: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex

Habitat; Mobile Benthic/Epibenthic – Complex Habitat; Pelagic; Prey Species – Benthic/Epibenthic; Prey Species – Pelagic.

5.1.1.2.3 Habitat Loss/Conversion

Development of the WFA would include installation of 98 WTGs and their foundations, and three OSSs and their foundations. The installation of the WTGs and OSSs would permanently alter benthic habitat by introducing new hard surfaces to the seabed. Additionally, these vertical structures, extending from the seabed to the water surface would alter the character of pelagic habitats used by many EFH-designated species and their prey and foraging resources. Over time, these new hard structures would become colonized by sessile organisms, creating complex habitats that effectively serve as artificial reefs within the WFA.

5.1.1.2.3.1 Benthic Effects of WTG and OSS Foundations

Impact footprints for WTG and OSS foundations intersect all three of the NOAA Habitat Complexity Categories cross-walked to benthic habitat types (i.e., complex, heterogenous complex, and soft bottom). WTG foundation footprints would permanently impact all three habitat types, with each 37-foot (11-meter) turbine foundation footprint permanently altering approximately 0.0247 acre (95.03 m^2) of benthic substrate, for a total of 2.34 acres (0.95 hectare) of benthic impacts. OSS foundation footprints would permanently alter approximately 1.22 acres (0.49 hectare) for each OSS, resulting in 3.67 acres (1.49 hectares) of benthic substrate impacts for the three OSSs.

The WTG and OSS foundations would displace approximately 1.6 acres (0.65 hectare) of complex habitat, 0.05 acre (0.02 hectare) of heterogenous complex habitat, and 4.35 acres (1.76 hectares) of soft-bottom habitat. These habitats would no longer be available to EFH species such as gadids, flatfish, and skates for the entire life of the Project through decommissioning when the foundations are removed.

An estimated 6.2 acres (2.50 hectares) of complex habitat, 0.7 acre (0.28 hectare) of heterogenous complex habitat, and 29.72 acres (12.02 hectares) of soft-bottom habitat would be modified by placement of scour protection around the WTG and OSS foundations. These natural habitats would no longer be available to EFH species for the entire life of the Project and could potentially be permanent if scour protection is not retrieved from benthic habitat after Project decommissioning.

If concrete mattresses are used for scour protection, it may take 3 to 12 months to fully cure after placement. Curing concrete can have surface pH levels as high as 11 or 12, rendering the surfaces of these structures toxic to sessile eggs, larvae, and invertebrates (Lukens and Selberg 2004). As such, the installation of these Project features would result in a diminishing short-term adverse effect on EFH. These features may or may not be removed when the Project is decommissioned, depending on the habitat value they provide.

To minimize direct impacts to EFH and EFH species due to habitat conversion, Ocean Wind has committed to several APMs, including to avoid areas that would require extensive seabed alterations to the extent practicable (Section 6.1.1).

Potential effects to the food web from the loss or modification of benthic habitat would be limited to increases in biomass and slight shifts in community composition. Stable isotope analysis of colonizing organisms on wind turbines in the Belgian North Sea suggests that the trophic structure is differentiated by depth, likely associated with different food sources (Mavraki 2020; Mavraki et al. 2020). Around the base of the monopiles, colonizing organisms on the surface of the pile would likely enhance food availability and food web complexity through an accumulation of organic matter (Degraer et al. 2020; Mavraki et al. 2020). This accumulation could lead to an increased importance of the detritus-based food web but is unlikely to result in significant broad scale changes to the local trophic structure (Raoux et al.

2017). Modification of benthic habitat is not expected to significantly impact the food web for EFH species.

Pelagic Effects of WTG and OSS Foundations

The artificial reef effect created by offshore structures like WTGs is well documented and can have an attractive effect on many marine species (Langhamer 2012; Peterson and Malm 2006; Ruebens et al 2013; Wilhelmsson et al. 2006). This 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, however (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 (De Mesel et al. 2015; Gill 2005; Roux 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 on the mid-Atlantic OCS. 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 in Section 5.1.3.3. 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 permanent alteration of pelagic habitats by the WTG and OSS 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.

Effects

- Direct
    - Permanent adverse effects to EFH and EFH species/life stages due to decrease in preferred habitat for: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Prey Species – Benthic/Epibenthic species groups.
    - Permanent beneficial effect to EFH and EFH species/life stages due to increase in preferred habitat: Sessile Benthic/Epibenthic – Complex Habitat; Mobile Benthic/Epibenthic – Complex Habitat; Pelagic; Prey Species – Benthic/Epibenthic; Prey Species – Pelagic.

- Indirect
  - Permanent adverse effects to EFH and EFH species due to potential increased predation risk associated with aggregation effect: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex Habitat; Mobile Benthic/Epibenthic – Complex Habitat; Pelagic; Prey Species – Pelagic; Prey Species – Benthic/Epibenthic species groups.
  - Permanent beneficial effects to EFH and EFH species.

5.1.1.3 Seabed Preparation

5.1.1.3.1 Habitat Loss/Conversion

Foundation preparation activities may be required depending on the seabed and the foundation type. Foundation preparation, if required, may include levelling and removal of surface or subsurface debris such as boulder and sandwaves, or in situ UXO/MEC disposal. Each 37-foot (11-meter) turbine foundation footprint would permanently alter approximately 0.0247 acre (95.03 m^2) of benthic substrate, for a total of 2.34 acres (0.95 hectare) of benthic impacts. OSS foundation footprints would permanently alter approximately 1.22 acres (0.49 hectare) for each OSS, resulting in 3.67 acres (1.49 hectares) of benthic substrate impacts for the three OSSs. Prior to installation of WTG and OSS foundations, seabed surface preparation may be required. The design envelope or COP Volume III, Appendix E, does not currently list impact footprint specifics related to seabed surface preparation for WTG and OSS foundations. Per the previous foundation information listed above, it can be assumed that approximately 2.34 acres (0.93 hectare) and 3.67 acres (1.48 hectares) of benthic substrate may require seabed surface preparation for WTG and OSS foundation installation, respectively. As previously discussed, impact footprint due to seabed surface preparation within the WFA for WTG and OSS foundation installation would take place within an approximately 4,735.51-acre (1,916.39-hectare) area. Currently, no specific benthic impact calculations exist for sandwave leveling and seabed debris removal prior to WTG and OSS foundation installation. Boulders constitute complex habitat, so approximately 254 acres (103 hectares) of seabed within the WFA could potentially be affected by boulder relocation (Inspire 2022a).

In order to prepare the seabed prior to installation, excavation may be required where debris is buried or partially buried. To minimize direct impacts to EFH and EFH species due to habitat conversion, Ocean Wind has committed to several APMs, including to avoid areas that would require extensive seabed alterations to the extent practicable (Section 6.1.1).

Sand and Muddy Sand was the primary habitat type mapped within the WFA (46,691 acres; approximately 85% of the area); Coarse Sediment was also mapped within the WFA (8,088 acres; approximately 15% of the area) (Table 3-1, Inspire 2022a). Nearly all of the benthic habitats mapped within the WFA were highly dynamic and mobile with over 52,500 acres (approximately 95% of the area) described further using the Mobile modifier (Table 3-1, Inspire 2022a). Ripples observed within these areas were dynamic over relatively short temporal scales with the direction of the ripples varying widely. Habitats without ripples were relatively small in spatial extent and were distributed mostly in the eastern and southeastern portions of the WFA (Figure 3-10, Inspire 2022a). The majority of the WFA was classified as Sand and Muddy Sand – Mobile and very small to large patches of Coarse Sediment – Mobile were interspersed throughout the area. Bare mobile granules and pebbles often were observed within these Coarse Sediment – Mobile areas within the troughs of sand ripples or overlaying sandy sediments. Sand and Muddy Sand with Low Density Boulder Field habitats were observed in a few discrete areas, across the center of the WFA.

The occurrence of boulders on the Mid-Atlantic OCS is often an indicator of the presence of glacial moraine. The CMECS size definition of boulders was utilized during benthic habitat surveys as gravel larger than 256 mm. Boulders within proximity to each monopile and the inter-array cable centerline would need to be relocated to prepare the seabed for pile installation and jet plow. Foundation preparation activities prior to installation of WTG and OSS foundations may be required depending on the seabed and the foundation type. In addition to boulder removal, other foundation preparation activities include leveling of sandwaves and removal of surface or subsurface debris. Excavation may be required where debris is buried or partially buried. Areal extent of short-term seafloor disturbance would be up to approximately 4,735.51 acres (1,916.39 hectares), comprised of 651.32 acres of complex habitat, 54.2 acres of heterogenous complex habitat, and 4,030.03 acres of soft-bottom habitat. Currently, no specific benthic impact calculations exist for sandwave leveling and seabed debris removal prior to WTG and OSS foundation installation. Boulders constitute complex habitat, so approximately 254 acres (103 hectares) of seabed within the WFA could potentially be affected by boulder relocation (Inspire 2022a). Sensitive taxa and attached fauna are often associated with boulders. Boulder relocation would potentially alter the composition of both the original and relocated habitat. Over time, the relocated boulders would be recolonized, contributing to the habitat function provided by existing complex benthic habitat of relocated boulders. Benthic sessile or slow-moving organisms, such bivalves, eggs, or larvae that are within the area of impact would experience direct impacts from burial or removal. Benthic habitat that is not directly buried by WTGs and OSS foundations is expected to recover quickly. Long-term to permanent impacts of artificial structures associated with the Project, as well as affected species are discussed further in Section 5.1.3.1.

The affected areas would be rendered temporarily unsuitable for EFH species associated with complex, heterogenous complex, and soft-bottom benthic habitats during one or more life stages. Neighboring benthic communities that have similar habitats and assemblages would recolonize disturbed areas. Impacts and recovery times would vary depending on habitat types, which can generally be separated into the high-energy oceanic environment versus the low-energy estuarine environment. Recovery of the benthic species would likely require several months to a year or more (Lewis et al. 2002; Dernie et al. 2003). Recovery to a pre-construction state may take 2 to 4 years or more (Van Dalfsen and Essink 2001; Boyd et al. 2005). Benthic meiofauna are known to recover from sediment disturbances more rapidly than the macrobenthos; recolonization up to pre-disturbance densities has occurred within weeks or less, and entire assemblages have recovered within 90 days (MMS 2009).

Array cables, interconnection cables, and offshore export cable installation would therefore result in a short-term adverse effect on EFH lasting through surface preparation activities and installation, but would be expected to recover shortly after installation.

Effects

- Direct
    - Short-term
    - Long-term localized adverse effects to EFH and EFH species/life stages due to decrease in preferred habitat for: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Prey Species – Benthic/Epibenthic species groups.
    - Long-term localized adverse effects to EFH and EFH species/life stages due to decrease in preferred habitat for: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Prey Species – Benthic/Epibenthic species groups.

5.1.1.3.2 Sediment Suspension

Seabed preparation activities (e.g., removal of debris or seabed leveling) would results in short-term and localized resuspension and sedimentation of finer grain sediments. Medium-to-course grained sediments within the WFA are likely to settle to the bottom of the water column quickly, with sand redeposition being short-term and localized. These effects would occur intermittently at varying locations in the Project area over the duration of Project construction but are not expected to cause permanent effects on EFH quality. Depending on the nature, extent, and severity of each effect, this may temporarily reduce the suitability of EFH for managed species, which would result in short-term adverse effects on EFH for those species. Indirect impacts to EFH could occur as a result of sediment suspension, temporarily decreasing foraging success due to increased turbidity. It would be expected that normal foraging behavior would resume following completion of installation and settlement of suspended sediments.

The Atlantic City reef, Great Egg reef, Ocean City reef, and Deepwater reef are all located within 10 miles of the WFA or within 330 feet of an export cable. Given their proximity to this activity, there is the potential for indirect impacts to these resources from sediment transport during cable installation.

Low order (deflagration) or high order (detonation) in situ disposal of UXO/MEC has the potential to affect benthic resources. UXO/MEC disposal has the potential to cause disturbances to the seafloor (sediment suspension and deposition) as well as noise. Impacts are expected to be short term and direct, with the potential to cause injury or mortality to benthic species within the direct vicinity of the disposal activities.

Changes to the Project design and additional impacts that were not considered in the EFH assessment could occur in the unlikely event that UXO/MEC are discovered in the Project footprint and are not disposed of in situ. These changes could include additional micrositing of monopile foundations and cable routes to avoid UXO/MEC hazards, and/or the removal and relocation of UXO/MEC to other locations on the seabed where avoidance is not practicable. The relocation of Project features would result in the same type of short-term construction-related and long-term operational impacts as those described in the EFH assessment, but the location, extent, and distribution of those impacts by habitat type may vary. These changes could, in theory, limit the ability to avoid impacts to complex benthic habitat in specific circumstances. The removal and relocation of UXO/MEC would result in suspended sediment effects from mechanical disturbance of the seabed as those described for Project construction in the EFH assessment, but the extent of those impacts would marginally increase as a result of UXO/MEC relocation.

Regardless of mitigation strategy, any change in impact area resulting from potential MEC/UXO risk avoidance is unknown but is likely to be small relative to the effects of Project construction. Those effects would be similar in nature to the short-term crushing and burial effects considered in the EFH assessment and would not alter the effect determination in the EFH assessment for any EFH species. Further coordination with the appropriate federal agencies (e.g., NMFS) would occur as appropriate if MEC/UXO mitigation requires action that was not considered in this consultation. Detailed information on UXO/MEC are provided in *Technical Memorandum: Underwater Acoustic Modeling of Detonation of Unexploded Ordnance (UXO) for Ørsted Wind Farm Construction, US East Coast* (Hannay and Zykov 2022).

5.1.1.3.3 Underwater Sound (UXO/MEC Detonation)

Ocean 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, as discussed above, some may need to be removed by explosive detonation. Underwater explosions of this type generate high pressure levels that could kill, injure, or disturb fish. Ocean Wind conducted modeling of acoustic fields for UXO detonations and ranges to physiological injury were calculated (Hannay and Zykov 2022). Table 5-4 summarizes the maximum ranges to physiological injury per charge weight for fish in all hearing groups.

Table 5-4 Maximum Ranges to Onset of Potential Mortal Injury and Mortality for Fish for UXO Charge Sizes with 10 dB Mitigation

Fish Hearing Group	Threshold	All sites: Maximum (m)				
		E4 (2.3 kg)	E6 (9.1 kg)	E8 (45.5 kg)	E10 (227 kg)	E12 (454 kg)
All Fish Hearing Groups	$L_{pk, 0\text{-}pk, flat}$: 229 dB	49	80	135	230	290

Source: Hannay and Zykov 2022.
Note: Water Depth 50 m.
*Minimum threshold (Popper et al. 2014)
dB = decibels; dB re 1 μPa = decibels relative to 1 micropascal; kg = kilograms; L_{pk} = peak sound pressure level

Modeling indicates that the distance for a UXO detonation to result in potential mortal injury and mortality for all fish hearing groups ranges between 49 m and 290 m (depending on charge weight). Fish in proximity to the UXO could be exposed to a detonation, potentially resulting in behavioral changes, physiological effects, potential mortal injury, or mortality. An APM of a dual noise-mitigation system with a 10 dB attenuation will be implemented during all detonation events (Table 6-1). Distances in Table 5-4 were modeled with 10 dB mitigation, This APM, coupled with the unlikely detonation of UXO, the conservative approach to modeling distances (see Hannay and Zykov 2022), and the low number of potential detonations required for the Project (unknown, but modeled for no more than 10), reduces the potential for impacts.

For fish species that use swim bladders for hearing, Popper et al. (2014) suggest a high likelihood of temporary threshold shift (TTS) and recoverable injury at near and intermediate distances, where near refers to within a few tens of meters and intermediate refers to a few hundreds of meters. For fish species with swim bladders not used for hearing, the guidelines indicate high likelihood of recoverable impairment at near and intermediate distances but low levels of TTS at intermediate distances. For fish without swim bladders the guidelines indicate low likelihood of recoverable injury at intermediate distances and moderate likelihood of TTS at intermediate distances, and low levels of both effects at far distances of a few kilometers (Hannay and Zykov 2022).

Hearing Categories: Impact pile driving would produce acoustic impacts that would adversely affect EFH for Hearing Category 1, Hearing Category 2, and Hearing Category 3 (Table 5-2). Species in these groups could exhibit physiological impacts depending on size of the UXO, distance from the sound source, and hearing sensitivity. Hearing Category 1 includes those species and life stages least sensitive to acoustic stressors so would have the least impacts; Hearing Category 2 would exhibit moderate impacts, and Hearing Category 3 would be affected the greatest. The noise levels would temporarily make the habitat less suitable and cause individuals to vacate the area of Project activities. UXO demolition during site preparation activities is anticipated to cause adverse impacts to EFH for both pelagic and demersal life stages; however, this impact would be short-term and EFH exposed to acoustic impacts from UXOs is expected to return to pre-demolition conditions.

Effects

- Direct
  - Short-term, direct effects on EFH and EFH species and life stages for all Hearing Categories, with greatest impacts to Hearing Category 3 species and life stages.
  - Short-term, direct effects on EFH of all Species Groups: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex Habitat; Mobile Benthic/Epibenthic – Complex Habitat; Pelagic; Prey Species – Benthic/Epibenthic; Prey Species – Pelagic.

5.1.1.3.4 Underwater Sound (Vessels)

The impacts and direct and indirect effects to EFH and EFH species due to underwater sound from vessels associated with seabed preparation would be similar to those impacts analyzed in Section 5.1.1.1 Vessel Activity.

5.1.1.4 Installation of Scour Protection

5.1.1.4.1 Habitat Conversion

The WTGs would extend up to 906 feet (276 meters) above MLLW, with a spacing of 1.15 by 0.9 miles (1 by 0.8 nm, 1.9 by 1.5 km) between WTGs in a southeast-northwest orientation within the 68,450-acre (277 km^2) WFA. Ocean Wind would mount the WTGs on monopile foundations, and OSSs would be placed on either monopile or piled jacket foundations. The WTG foundations would have a maximum seabed penetration of 164 feet (50 meters). Where required, scour protection would be placed around foundations to stabilize the seabed near the foundations, as well as the foundations themselves. The scour protection would be a maximum of 8.2 feet (2.5 meters) in height and would extend away from the foundation as far as 73.5 feet (22.4 meters). Each WTG would contain approximately 1,585 gallons (6,000 liters) of transformer oil and 146 gallons (553 liters) of general oil (for hydraulics and gearboxes). Other chemicals used would include diesel fuel, coolants/ refrigerants, grease, paints, and sulfur hexafluoride.

Development of the WFA would include installation of 98 WTGs and their foundations, and three OSSs and their foundations. The installation of 98 37-foot (11-meter) monopile foundations would permanently alter 2.34 acres (0.95 hectares) of benthic habitat by introducing new hard surfaces to the seabed and water column. These vertical structures would extend from the seabed to the water surface and would alter the character of pelagic habitats used by many EFH-designated species and their prey and foraging resources. Over time, these new hard structures would become colonized by sessile organisms, creating complex habitats that effectively serve as artificial reefs within the WFA. Moreover, scour protection for WTGs and OSSs would permanently alter 36.57 acres (14.80 hectares) of benthic habitat. The scour protection would extend out 73.5 feet (22.4 meters) from the foundations and have a layered thickness of 8.2 feet (2.5 meters).

In general, impacts from seabed disturbance would be localized and short-term with the exception of habitat conversion and/or loss due to the installation of the WTGs and OSSs and associated scour protection, where required. It is anticipated that mobile life stages would move out of the area to avoid potential impacts. Demersal non-mobile life stages would be affected due to the placement of foundations and scour protection in the immediate area of installation. Most juvenile and adult finfish would actively avoid all construction activities. However, immobile finfish life stages such as demersal eggs and larvae, and sessile organisms could experience mortality as a result of being crushed or buried by the foundations, scour protection, and vessel anchors within the WFA footprint. EFH-designated species that would likely be affected by crushing and burial effects of installation of scour protection are similar to those listed in Section 5.1.1.1.

Effects

- Direct
  - Permanent adverse effects to EFH and EFH species/life stages due to decrease in preferred habitat for: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Prey Species – Benthic/Epibenthic species groups.

    - Permanent beneficial effect to EFH and EFH species/life stages due to increase in preferred habitat: Sessile Benthic/Epibenthic – Complex Habitat; Mobile Benthic/Epibenthic – Complex Habitat; Pelagic; Prey Species – Benthic/Epibenthic; Prey Species – Pelagic.
- Indirect
    - Permanent adverse effects to EFH and EFH species due to potential increased predation risk associated with aggregation effect: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex Habitat; Mobile Benthic/Epibenthic – Complex Habitat; Pelagic; Prey Species – Pelagic; Prey Species – Benthic/Epibenthic species groups.
    - Permanent beneficial effects to EFH and EFH species

5.1.1.4.2 Sediment Suspension

Installation of the WTGs and substations would disrupt approximately 6.01 acres (2.43 hectares) of benthic habitat, and scour protection would disrupt approximately 36.57 acres (14.80 hectares) of benthic habitat. Methods of installation may include side stone dumping, fall pipe, or crane placement. Placement of scour protection may temporarily increase suspended sediments due to resuspension of bottom sediments. These benthic disturbances would increase turbidity and suspend sediment in the water column. Impacts to benthic habitat would occur locally and temporarily at each of the proposed WTG and substation locations due to the predominantly sandy composition of the upper sediments in the Project area. EFH-designated species that would likely be affected sediment suspension due to the of scour protection are similar to those listed in Section 5.1.1.1.

Effects

- Direct
    - Short-term decrease in quality of EFH due to suspended sediments and increased turbidity: EFH for Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; and Pelagic species groups; Summer Flounder HAPC
    - Short-term, local impacts due to sedimentation: Sessile Benthic/Epibenthic – Soft Bottom; Prey Species – Benthic.
- Indirect
    - Short-term loss of foraging opportunities: Mobile Epibenthic/Benthic – Soft Bottom; and Pelagic species groups.
    - Short-term decrease in quality of EFH in areas adjacent to Project activities for: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Summer Flounder HAPC; Prey Species – Benthic.

5.1.2 Inter-Array, OSS Link, and Export Cable Installation

Array, OSS link, and substation interconnection cable impact footprints intersect all three of the previously discussed NOAA Habitat Complexity Categories cross-walked to benthic habitat types. Cable impact footprints include areas that may be affected by seafloor preparation activities, cable installation, and cable protection. Impact footprints were calculated along indicative cable centerlines. Short-term disturbance activities to prepare the seafloor and lay the inter-array cables may potentially impact approximately 1,410.67 acres, primarily categorized as soft bottom (85%), with some area categorized as complex (15%) and heterogeneous complex (0.4%) (Appendix 10.2.7, Table 10.2-7). Short-term disturbance activities to prepare the seafloor and lay the OSS Link cables may potentially impact approximately 42.72 acres, primarily categorized as soft bottom (94%), with some area categorized as complex (6%) (Appendix 10.2.7, Table 10.2-7).

Cable protection may be required for up to 10% of the route, with the Project design envelope allowing for up to 77 acres for the array cables and 8 acres for the substation interconnection cables, but the locations where cable protection would be required are not known and the exact habitats that could be affected cannot be determined at this time. The majority of the area that may be affected by cable protection for the inter-array cables is classified as soft-bottom habitat (84.9%), with some area categorized as complex (15.01%) and a very small area (0.4%) categorized as heterogeneous complex. The composition of habitats that may be affected by the array, OSS Link, and substation interconnection cables (Table 3-6 and Figure 3-17, Inspire 2022a) is very similar to the composition observed within the WFA (Table 3-5 and Figure 3-21-15, Inspire 2022a). The soft-bottom habitats that would potentially be affected were generally mapped as Sand and Muddy Sand – Mobile and the habitats categorized as complex were generally mapped as Coarse Sediment – Mobile (Table 3-4 and Figure 3-10, Inspire 2022a). Sand and Muddy Sand with Low Density Boulder Field habitats were categorized as heterogeneous complex (Table 3-4 and Figure 3-10, Inspire 2022a).

The impact footprints associated with the BL England Offshore Export Cable to be laid within the BL England OECRC intersect the two NOAA Habitat Complexity Categories cross-walked to benthic habitat types mapped within this area (Inspire 2022a). Impact footprints include those for seabed preparation activities, cable installation, installation of cable protection, and anchoring and sediment excavation associated with HDD at landfall. These footprints were calculated along an indicative cable centerline and assuming the 35th Street Landfall as an indicative landfall. Short-term disturbance activities to prepare the seafloor and lay the cable may potentially impact 200.36 acres of the seafloor, primarily soft-bottom habitat (99%), with the remainder classified as complex (1%) (Appendix 10.2.7, Table 10.2-7). This area of the full corridor of seafloor disturbance (up to 320 acres; Ocean Wind 2022a) 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. Cable protection may be required for up to 10% of the route, or up to 16 acres, but the locations where cable protection would be required are not known and the exact habitats to be affected cannot be determined (Ocean Wind 2022a). The majority of the area that may be affected by cable protection was classified as soft bottom (99%) (Appendix 10.2.7, Table 10.2-7). Cofferdam and HDD activities, including anchoring, to support the landfall at 35th St. would include 23.77 acres of short-term disturbance, including 0.57 acre of sediment excavation for the HDD exit (Appendix 10.2.7, Table 10.2-7). The composition of habitats that may be affected by the BL England Offshore Export Cable and the 35th St Landfall (Inspire 2022a) is very similar to the composition observed within the BL England OECRC (Table 3-5 and Figure 3-22, Inspire 2022a). The soft-bottom habitats that would potentially be affected were generally mapped as Sand and Muddy Sand and the habitats categorized as complex were generally mapped as Coarse Sediment – Mobile (Table 3-4 and Figure 3-17, Inspire 2022a). Comparable data for the other potential BL England landfalls (13th Street, 5th Street) can be found in Table 10.2-7.

The impact footprints associated with the two cables to be laid within the Oyster Creek OECRC and IECRC intersect two of the three NOAA Habitat Complexity Categories cross-walked to benthic habitat types mapped within this project area (Appendix 10.2.7, Table 10.2-7). Impact footprints include those for seabed preparation activities, cable installation, installation of cable protection, and anchoring and sediment excavation associated with HDD activities. These footprints were calculated along two indicative cable centerlines and assuming HDD on both the Atlantic and Barnegat Bay sides of Island Beach State Park and an open cut landing at The Farm Landfall as an indicative landfall (using the same footprint parameters as used along the cable routes). The impact footprints do not intersect the Mud and Sandy Mud with Low Density Boulder Field habitat categorized as heterogeneous complex that occupies two acres within the Oyster Creek IECRC (Appendix 10.2.7, Table 10.2-7). Short-term disturbance activities for installation of the Oyster Creek offshore export cable may potentially impact a maximum of approximately 1,115.53 acres, with 52% categorized as soft bottom and 48% categorized as complex (Appendix 10.2.7, Table 10.2-7). Short-term disturbance activities for installation of the Oyster Creek inshore export cable may potentially impact a maximum of approximately 113.06 acres, with 86% categorized as soft bottom and 14% categorized as complex (Appendix 10.2.7, Table 10.2-7, IECRC - Base Case to The Farm). Comparable data for all other potential Oyster Creek IECRC landfall locations can be found in Table 10.2-7.

This area of the full corridor of seafloor disturbance (up to 1,430 acres; Ocean Wind 2022a) 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. As with the other cables, cable protection may be required for up to 10% of the route with the Project design envelope allowing for up to 70 acres, but the locations where cable protection would be required are not known and the exact habitats to be affected cannot be determined (Ocean Wind 2022a). Cofferdam and HDD activities to support the transition at IBSP would include 28.9 acres of short-term disturbance, including 1.14 acres of sediment excavation (Appendix 10.2.7, Table 10.2-7). The composition of habitats that could be affected by the Oyster Creek OECRC and IECRC is similar between the two cable corridors (Inspire 2022a). The soft-bottom habitats that would potentially be affected in the Oyster Creek OECRC were generally mapped as Sand and Muddy Sand, while those within the Oyster Creek IECRC were generally mapped as Mud and Sandy Mud (Appendix 10.2.7, Table 10.2-6). The habitats categorized as complex in the Oyster Creek OECRC were generally mapped as Coarse Sediment – Mobile, while those within the Oyster Creek IECRC Corridor were mapped as sand and mud habitats with recent or historical SAV presence (Appendix 10.2.7, Table 10.2-6). Impacts from installation of the export cable would result from direct disturbance of benthic habitats, the resuspension and nearby deposition of sediments, and emplacement of cable protection resulting in habitat conversion. Direct disturbance could result in the injury or mortality of organisms within the footprint of the export cable, primarily sessile or slow-moving benthic invertebrates such as hard clam and bay scallop, or non-motile early life stages such as the demersal, adhesive eggs of winter flounder and skates. It could also damage SAV habitat which is present along both the eastern and western shorelines of Barnegat Bay. Monitoring benthic habitats around cable installations is included in the benthic monitoring plan (GEN-06; COP Volume II Table 1.1-2; Ocean Wind 2022a).

5.1.2.1 Vessel Activity

5.1.2.1.1 Habitat Disturbance

During installation of the inter-array up to 18 simultaneous construction vessels could be necessary, and up to 24 simultaneous construction vessels could be necessary for the BL England OECRC and Oyster Creek OECRC/IECRC (Ocean Wind 2022a). Simultaneous vessels necessary for installation of the substation interconnection cables are included in the vessel counts for inter-array, OECRC, and IECRC installation. Vessels involved in cable installation would include main laying vessels, burial vessels, and support vessels. Vessels may require anchoring and/or spudding to facilitate construction activities.

As indicated in the COP for the proposed Project, maximum total inter-array cable length would be approximately 190 miles (305.77 km). Maximum total substation interconnection cable length would be approximately 19 miles (30.57 km). Maximum total offshore export cable length would be approximately 32 miles (51.49 km) for BL England and approximately 143 miles (230.136 km) for Oyster Creek. Comparable data for each Oyster Creek OECRC/IECRC landfall option can be found in Table 2-1. Anchoring would occur every 1,640 feet (499.87 meters) along the cable routes. Array and substation interconnection cable footprints intersect all three of the NOAA Habitat Complexity Categories cross-walked to benthic habitat types (Table 3-1). Short-term disturbance activities to prepare the seafloor and lay the inter-array cables, including anchoring, may potentially impact up to approximately 1,410.67 acres, primarily categorized as soft bottom (85%), with some area categorized as complex (15%) and heterogeneous complex (0.4%) (Appendix 10.2.7, Table 10.2-7). Please refer to Section 5.1.1.1.1. Short-term disturbance activities to prepare the seafloor and lay the OSS Link cables may potentially impact approximately 42.72 acres, primarily categorized as soft bottom (94%), with some area categorized as complex (6%) (Appendix 10.2.7, Table 10.2-7).

Within the BL England offshore export cable corridor HDD locations, short-term impacts from vessel anchoring and excavation could occur within an area of 23.77 acres (9.62 hectares) of soft-bottom habitat. Comparable data for the other potential BL England landfalls (13^{th} Street, 5^{th} Street) can be found in Table 10.2-7. Approximately 20% of the total area is anticipated to be affected by anchoring and spudding activities. No impacts to complex or heterogenous complex habitat is expected. Impacts to EFH are expected to be similar to those listed in Section 5.1.1.1. Within the Oyster Creek inshore export cable corridor, short-term impacts from vessel anchoring could occur in a range of 26.92 acres (10.89 hectares) to complex habitat and 28.1 acres (hectares) to soft-bottom habitat. Comparable data for all other potential Oyster Creek IECRC landfall locations can be found in Table 10.2-7. Approximately 20% of the total area is anticipated to be affected by anchoring and spudding activities. No impacts to heterogenous complex habitat are expected. Impacts to EFH are expected to be similar to those listed in Section 5.1.1.1.

Potential impacts of dredging the Oyster Creek Federal Channel include physical seabed/land disturbance, water quality impacts such as sediment suspension and deposition and turbidity, potential release of contaminants, and impingement and/or entrainment of organisms. Dredging the federal channel for vessel access would result in physical disturbance to the bay and/or channel bottom would be similar to that described for cable installation. The open water area around Oyster Creek is reportedly 600 to 1,000 feet wide, adequate to maintain fish passage during dredging operations. Hydraulic and/or closed clamshell dredging may be used for dredging (Table 2-1) and impacts to the bay bottom may include crushing, burial, or impingement/entrainment effects on EFH species and their prey. However, overall mortality of fish entrained during dredging is considered to be low (Wenger et al. 2016). Mortality rate of estuarine fish entrained during a hopper dredging event was found to be 38% (Armstrong et al. 1982). Impingement/entrainment is unlikely as most marine species will avoid the dredge and the draghead is not activated until it is resting directly on the bottom. Dredging and transfer of dredged materials to an upland disposal facility via a pipeline system, barge, or scow, along with vessel anchoring, could also result in crushing, burial and entrainment effects. The dredges have grid screens on the draghead water intake to reduce/prevent impingement/entrainment of marine species into the dredge. Potential avoidance and the less than 100 percent mortality rate indicate that the dredging effects to EFH would likely have a minor effect on EFH species. Benthic community structure is expected to recover rapidly, within a few months of the activity, and activities have been sited to avoid and minimize impacts to SAV.

Oyster Creek is a component of the upstream limit of the authorized Barnegat Inlet navigation channel that has been maintained by the Philadelphia District USACE since 1940 (USACE 2020). In nearshore areas with finer grained sediments, suspended sediments would extend above the dredged trench and take longer to settle to the seabed. These impacts for finer sediments are anticipated to be localized adjacent to the trench and temporary in nature. Dredging impacts would include a localized change in seabed topography and removal of sediments. Sediment resuspension and deposition would be localized and short-term due to existing sediment types. However, due to local hydrodynamics, sediment would settle and fill in interstitial areas and cover the additional protection material. Turbidity created by the dredging operation will dissipate quickly due to the strong currents that pass through the inlet. Impacts may take several years to over a decade to revert to original seabed elevations (BOEM n.d.). These activities would not permanently impact or change hydrodynamics or sediment movement in the area.

Barnegat Bay is subject to tidal and wind-generated waves that can result in high turbidity so that turbidity generated by dredging operations is not expected to have more than short term and localized impacts. The USACE EA (2020) for Oyster Creek, based on contaminant analysis of dredged material, found sediments from Oyster Creek were “clean sand, free of contamination.” Therefore, no direct, indirect or cumulative adverse effects on water quality would occur due to the release of contaminants.

This would result in short-term negligible direct effects on water quality associated with a temporary and localized increase in turbidity at the dredging and placement areas.

Pipelines used to transport materials from the dredges to a disposal site also have the potential to impact EFH. Pipelines transport dredged sediment, either by pumping from a hopper dredge, a cutterhead dredge to a disposal location such as a beach, spoil area, or upland disposal site, or hydraulic offloading out of a barge. Dredge material transport pipelines can either float on the water surface or be submerged and rest on the bottom of the water body.

Flexible floating dredge pipe has been used to improve the efficiency of typical dredging operations and implemented by USACE Districts since 2000 (USACE undated). Floating pipelines are supported at regular intervals by buoyancy units/material and are flexible enough to accommodate waves and currents. Floating pipelines are anchored to the sea floor and may require booster pumps if the pipeline is too long for the dredge to push the material to the placement location. Floating pipelines can interfere with vessel traffic, although spacing and flexibility can help to avoid conflicts with marine vessels. However, floating pipelines provide a means of avoiding impacts to benthic habitats such as SAV and shellfish, and in the South Atlantic, their use has been required, where possible, to avoid listed SAV species and corals during dredging activities (NMFS SARBO 2020).

Submerged pipelines are floated into place, full of air and then sunk in the desired location. Submerged pipelines are less likely to interfere with marine traffic but could result in conflicts with fishing gear and activities. Submerged pipelines would temporarily disturb ocean bottom habitats and could result in injury and/or mortality due to crushing or displacement. Movement of submerged pipelines due to waves and currents may increase the extent of the potential physical damage to benthic habitats.

Structural failure in either type of pipeline could result in an unexpected blowout of sand. The temporary placement of equipment and the transportation of materials by pipeline, hopper dredge, barge, or scowl, may temporarily also have temporary impacts on water quality, transparency, and stable unconsolidated sediments. Pipeline monitoring would avoid unanticipated movement of submerged pipelines and support structures for floating pipelines placed near or over hardbottom and for discharge of slurry/leaks along the length of a submerged pipeline near hardbottom or floating pipeline placed over hardbottom.

The Final EA for Dredging of the Oyster Creek Channel Barnegat Inlet FNC (USACE 2020) concluded that any effects associated with equipment placement in functioning critical habitat would be insignificant because of the temporary and limited in geographic extent, and the critical habitat would remain fully functional upon removal.

Localized impacts on sessile and or slow-moving benthic resources would occur in these areas. Early life stages such as eggs and larvae as well as sessile and slow-moving benthic invertebrates such as hard clams and bay scallops would be subject to mortality from these activities. Mobile benthic organisms would be temporarily displaced by the anchors. Certain construction vessels such as jack-up vessels or hotel vessels would require stabilization spuds. The spuds would cause some localized direct impacts where they meet the sediment. Impacts to SAV are anticipated to be minimal as anchoring and spudding would avoid these areas to the extent practicable. The potential for crushing and burial impacts associated with vessel anchoring and spudding would be short-term and localized as previously described in Section 5.1.1.1.

Vessels may also have a direct impact via organism entrainment while taking on ballast water, withdrawing water for engine cooling, hoteling, and operating on-board reverse osmosis systems (USDOE 2012). Impacts from increased vessel traffic and construction activities would be short-term and localized in nature.

Benthic or epibenthic EFH species and/or life stages would be the primary groups affected, with secondary effects on EFH species and/or life stages that prey on benthic and epibenthic organisms. Pelagic species and/or life stages would not be at risk for lethal crushing or burial impacts but could be subject to entrainment effects. Only those life stages likely to be directly exposed to crushing and burial or associated effects on benthic prey species are addressed in this section. Crushing and burial exposure and associated effects on benthic prey organisms represent a short-term reduction in habitat suitability for EFH species.

Inter-array cable installation would occur during Q3 of 2024 to Q2 of 2025, and offshore export cable installation would occur during Q2 of 2024 to Q1 of 2025. Vessel activities previously discussed would occur during cable installation activities. Thus, crushing and burial effects would be limited in duration but could occur throughout the anticipated construction window. Construction and burial impacts during cable installation would be similar to those associated with WTG and OSS foundation installation discussed in Section 5.1.1.1.

5.1.2.1.2 Sediment Suspension and Deposition

In general, vessel activities (i.e., anchoring and/or spudding) associated with cable installation would cause short-term impacts to water quality intermittently throughout Project construction. These benthic disturbances would increase turbidity and suspend sediment in the water column. Impacts to benthic habitat would occur locally and temporarily within the specified cable routes. The potential impacts to water quality, and by extension, EFH and EFH-designated species, such as resuspension of sediments, would be short-term and localized, and would be similar to those discussed in Section 5.1.1.1.

5.1.2.1.3 Vessel Noise

Impacts from vessel noise would be similar to those discussed in Section 5.1.1.1.

5.1.2.1.4 Potential Introduction of Exotic/Invasive Species Via Ballast

Impacts from potential introduction of invasive species from vessel activity would be similar to those discussed in Section 5.1.1.1.

5.1.2.2 Seabed Preparation

5.1.2.2.1 Habitat Alteration

Seabed preparation may be required prior to installation of inter-array and offshore export cables, and may include seabed levelling and removal of surface or subsurface debris such as boulders, lost fishing gear, or lost anchors. Excavation may be required where debris is buried or partially buried. Array and substation interconnection cable impact footprints intersect all three of the NOAA Habitat Complexity Categories cross-walked to benthic habitat types described in Section 3. Short-term disturbance activities to prepare the seafloor and lay the inter-array cables may potentially impact approximately 1,410.67 acres, primarily categorized as soft bottom (1,192.74 acres [482.68 hectares]), with some area categorized as complex (211.68 acres [85.66 hectares]) and heterogeneous complex (6.25 acres [2.53 hectares]) (Appendix 10.2.7, Table 10.2-7). Short-term disturbance activities to prepare the seafloor and lay the OSS Link cables may potentially impact approximately 42.72 acres (Appendix 10.2.7, Table 10.2-7).

The impact footprints associated with the BL England Offshore Export Cable to be laid within the BL England OECRC intersect two NOAA Habitat Complexity Categories cross-walked to benthic habitat types mapped within this area (previously described in Section 3). Impact footprints include those for seabed preparation activities. Short-term disturbance activities to prepare the seafloor may potentially impact approximately 200.36 acres (81.08 hectares) of the seafloor, primarily soft-bottom habitat (198.05 acres [80.15 hectares]), with the remainder classified as heterogenous complex (2.3 acres [0.93 hectare]).

The impact footprints associated with the Oyster Creek Offshore and Inshore Export Cable Route Corridor intersect two of the three NOAA Habitat Complex Categories (previously described in Section 3). Impact footprints include those for seabed preparation activities. These footprints were calculated along two indicative cable centerlines and assuming HDD on both the Atlantic and Barnegat Bay sides of Island Beach State Park and an open cut landing at The Farm Landfall as an indicative landfall (using the same footprint parameters as used along the cable routes). For the Oyster Creek OECRC, short-term disturbance activities may potentially impact a maximum of approximately 1,144,4 acres (4,631.22 hectares), with benthic substrate comprised of 605.68 acres (245,11 hectares) of soft-bottom habitat and 538.36 acres (217.87 hectares) of complex habitat. Cofferdam and HDD activities to support the transition at IBSP account for 28.90 acres (11.7 hectares) of short-term disturbance. For the Oyster Creek IECRC, short-term disturbance activities may potentially impact a maximum of approximately 140 acres (56.66 hectares), with benthic substrate comprised of 96.79 acres (39.17 hectares) of soft-bottom habitat and 43.20 acres (17.48 hectares) of complex habitat. Impacts to summer flounder HAPC associated with the Oyster Creek Export Cable Corridor are further broken down by impact type in Appendix 10.2.7, Table 10.2-8.

Boulder relocation would potentially alter the composition of both the original and relocated habitat. Over time, the relocated boulders would be recolonized, contributing to the habitat function provided by existing complex benthic habitat of relocated boulders. Long-term to permanent impacts of artificial structures associated with the Project, as well as affected species are discussed further in Section 5.1.3.1.

The affected areas would be rendered temporarily unsuitable for EFH species associated with complex, heterogenous complex, and soft-bottom benthic habitats during one or more life stages. Array cables, interconnection cables, and offshore export cable installation would therefore result in a short-term adverse effect on EFH lasting through surface preparation activities and installation but would be expected to recover shortly after installation.

Effects

- Direct
    - Short-term loss/conversion of EFH: EFH for Sessile Benthic/Epibenthic – Soft Bottom, Mobile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex; Mobile Benthic/Epibenthic – Complex; Pelagic species groups; Prey Species – Benthic; Prey Species – Pelagic, Summer Flounder HAPC; Summer Flounder HAPC
    - Permanent, localized crushing and burial of EFH species: Sessile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex; Prey –Benthic/Epibenthic species groups
    - Short-term avoidance of anchoring activities by EFH species: Mobile Epibenthic/Benthic – Soft Bottom; Mobile Epibenthic/Benthic – Complex; Pelagic; Prey Species – Benthic and Prey Species – Pelagic species groups
- Indirect
    - Short-term loss of benthic prey items: Mobile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Complex

5.1.2.2.2 Sediment Suspension and Deposition

Seabed preparation and subsequent sediment suspension prior to installation of inter-array cables and export cables would take place in addition to seabed preparation activities associated with WTG and the OSS foundation installations. Similar impacts to EFH species are expected to occur. As discussed in

Section 5.1.1, grain sizes within the WFA and along the OECRC are generally medium to coarse grained, which are likely to settle to the bottom of the water column quickly. Sand redeposition would be minimal and close in vicinity to the trench centerline, minimizing impacts to demersal fish eggs such as those of ocean pout.

In inshore areas (i.e., back bays), sediments are comprised of fine to medium grains. Therefore, suspension and settlement of sediments is expected. As noted in Section 2.1.2.2, the finer sediments in these areas would become suspended and extend above the trench and take longer to settle to the seabed than in areas of sand or coarser-grained sediments. These impacts to water quality for finer sediments are anticipated to be short-term in nature. Winter flounder eggs have the potential to be affected by seabed preparation activities along the IECRC. Winter flounder lay demersal, adhesive eggs on the bottom of Barnegat Bay, which can be crushed or destroyed via trenching and dredging. Additionally, winter flounder egg hatching success can be greatly reduced with as little as 2 to 3 mm of sediment via sedimentation.

Direct impacts to foraging habitat are expected to be localized to the width of the trench and short-term as benthic organisms would recolonize the area. Impacts to summer flounder HAPC associated with the Oyster Creek IECRC are further broken down by impact type in Appendix 10.2.7, Table 10.2-8.

Effects

- Direct
  - Short-term decrease in quality of EFH due to suspended sediments and increased turbidity: EFH for Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; and Pelagic species groups; Summer Flounder HAPC
  - Short-term, local impacts due to sedimentation: Sessile Benthic/Epibenthic – Soft Bottom; Prey Species – Benthic
- Indirect
  - Short-term loss of foraging opportunities: Mobile Epibenthic/Benthic – Soft Bottom; and Pelagic species groups
  - Short-term decrease in quality of EFH in areas adjacent to Project activities for: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Summer Flounder HAPC; Prey Species – Benthic

5.1.2.2.3 Entrainment

Some types of seabed preparation equipment (e.g. hydraulic dredges) use water withdrawals, which can entrain planktonic larvae of benthic fauna (e.g., larval polychaetes, mollusks, crustaceans) with assumed 100% mortality of entrained individuals (COP Volume II, Section 2.2.5.2.1; Ocean Wind 2022a). Due to the surface-oriented intake, water withdrawal could entrain pelagic eggs and larvae, but would not affect resources on the seafloor. However, the rate of egg and larval survival to adulthood for many species is very low (MMS 2009). Due to the limited volume of water withdrawn, BOEM does not expect population-level impacts on any given species.

Effects

- Direct
  - Loss of EFH and EFH species due to water intake for eggs, larvae, and small juveniles of within the Pelagic and Prey Species – Pelagic species groups.
- Indirect

- Loss of food sources for planktivorous species, including filter-feeding invertebrates: Sessile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex Habitat; Pelagic; Prey Species – Benthic/Epibenthic; Prey Species – Pelagic.

5.1.2.2.4 Underwater Sound

As previously discussed in section 5.1.1., underwater sound associated with construction activities from seabed preparation is expected to be short-term and localized to the area of impact. Maximum total impacts for array cables includes boulder clearance (2,220 acres [898.40 hectares]) and sandwave clearance (222 acres [89.84 hectares]). The acreage of impacts for boulder clearance assumes a 98-foot (29.87 meter) wide corridor over 100% of the route, while the acreage of impacts for sandwave clearance assumes a 98-foot (29.87 meter) wide corridor over 1% of the route. Maximum total impacts for substation interconnection cables includes boulder clearance (222 acres [89.84 hectares]) and sandwave clearance (2 acres [8.98 hectares]). These acreage of impact values for boulder clearance assumes a 98-foot- (29.87-meter-) wide corridor over 100% of the route, while the acreage of impacts for sandwave clearance assumes a 98-foot (29.87 meter) wide corridor over 1% of the route. Maximum total impacts for the Oyster Creek portion of the offshore export cables includes boulder clearance (1,710 acres [692.01 hectares]) and sandwave clearance (17 acres [6.87 hectares]). Maximum total impacts for the BL England portion of the offshore export cables includes boulder clearance (400 acres [161.87 hectares]) and sandwave clearance (4 acres [1.62 hectares]). These acreage of impact values assume a 98-foot- (29.87-meter-) wide corridor over 100% of the route for boulder clearance and a 98-foot (29.87 meter) wide corridor over 1% of the route for sandwave clearance.

Effects

- Direct
  - Short-term, direct effects on EFH and EFH species and life stages for all Hearing Categories, with greatest impacts to Hearing Category 3 species and life stages.
  - Short-term, direct effects on EFH of all Species Groups: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex Habitat; Mobile Benthic/Epibenthic – Complex Habitat; Pelagic; Prey Species – Benthic/Epibenthic; Prey Species – Pelagic.

5.1.2.2.5 Underwater Sound (UXO)

The impacts and direct and indirect effects to EFH and EFH species due to underwater sound from UXO demolition associated with seabed preparation for inter-array and export cable installation would be similar to UXO sound impacts analyzed in Section 5.1.1.3 Seabed Preparation.

5.1.2.3 Trenching/Cable Installation

5.1.2.3.1 Habitat Loss/Conversion

The installation of array cables between WTGs and substation foundations (interconnection cables) would take place within areas that were previously disturbed during the seabed preparation activities and foundation installation. The maximum total installed array cable length is 190 miles (300 km), and the maximum installed substation interconnection cable length is 19 miles (30.58). Array cable installation would be completed via hydroplow wherever possible with alternative methods that include surface lay, trenching, jetting, plowing and pre-plowing, vertical injection, and control flow excavation as necessary. Direct impacts to EFH due to habitat disturbance are expected within the designated 82-foot-wide array cable and substation interconnection cable disturbance corridors along the entire length of each corridor (Ocean Wind 2022a). As indicated in the COP, a maximum 1,850 acres (748.67 hectares) of short-term benthic disturbance is anticipated during the array cable installation process, and a maximum 185 acres (74.87 hectares) of short-term benthic habitat disturbance is anticipated during substation interconnection cable installation. It is anticipated that pelagic species and motile life stages would avoid construction activities based on typical installation speeds, and direct impacts are not anticipated. Direct impacts to foraging habitat are expected to be localized to the width of the trench and short-term as benthic organisms would recolonize the area. Indirect impacts to EFH could occur as a result of sediment suspension, temporarily decreasing foraging success due to increased turbidity. It would be expected that normal foraging behavior would resume following completion of installation and settlement of suspended sediments. Sediment suspension impacts are discussed further below. Indirect impacts from sediment deposition in adjacent areas could occur, potentially smothering sessile organisms and burying existing sediments. Sediment dispersion modeling conducted for three other offshore wind projects (the Vineyard Wind 1 Project in Massachusetts, the Block Island Wind Farm in Rhode Island, and the Virginia Offshore Wind Technology Advancement Project of Virginia) were reviewed and evaluated, and general sediment conditions and hydrodynamics are similar to those in the Project area (see COP Volume II, Section 2.1.2.2.1 for detailed descriptions; Ocean Wind 2022a). The sediments within each project area were predominantly sands and current velocities were within similar ranges, indicating that the results of each modeling effort would be expected to be representative of the Project site. Turbidity concentrations greater than 10 mg/L would be short in duration up to 6 hours and limited to within approximately 50 to 200 meters of the trench in the offshore area. BOEM anticipates that offshore wind projects would use dredging only when necessary and rely on other cable laying methods for reduced impacts (such as jet plow or mechanical plow) where feasible. Another offshore wind project (Vinhateriro et al. 2018) analyzed sediments similar to those found in the Ocean Wind 1 Project area. The modeling indicated that the maximum predicted depth of sediment deposition for inter-array cable installation would be less than 1.2 inches (30 mm), with burial effects limited to within 29.5 to 98.4 feet (9 to 30 meters) of the cable path, and that burial depths would be generally limited to less than 3.4 inches (1 cm) in the immediate vicinity of the cable path. This analysis is being utilized to assess potential impacts to adjacent benthic habitats for the Ocean Wind Project.

Offshore export cables would be placed by the same methods listed above for array cables, depending on site conditions. The maximum total cable length is 143 miles (230 km) for the Oyster Creek portion of the OECRC and 32 miles (51 km) for the BL England portion of the OECRC. Direct impacts to EFH due to habitat disturbance are expected within the designated 82-foot-wide cable disturbance corridor for both BL England and Oyster Creek export cables along the entire length of each corridor (Ocean Wind 2022a). As indicated in the COP, a maximum 1,430 acres (578.70 hectares) of short-term benthic disturbance is anticipated during the Oyster Creek offshore export cable installation process. Impacts are expected to be similar to those of the array and substation interconnection cables. Indirect impacts associated with sediment deposition are anticipated to be similar to those of the array substation interconnection cables, as was found in modeling conducted for South Fork Wind Farm (Vinhateriro et al. 2018) and interpreted by BOEM.

The IECRC would be affected by cable installation within backbay areas behind the barrier island in Barnegat Bay. Export cables across Barnegat Bay would be placed by similar methods as listed above for the offshore export cables. Cables at landfall areas may be installed by HDD, with sheet piling installed for intertidal cofferdams for the HDD exit pits. Open cut trenching is being considered for landfalls not under the USACE beach nourishment program, including the west side of Island Beach State Park (Prior Channel Route) and at the Holtec landfall. Open cut trenches would be temporarily supported by sheet piling that would be temporarily installed to support open cut trenches and as intertidal cofferdams for HDD exit pits. Open cut installation would entail excavation of up to a 10-foot-wide trench that would extend up to approximately 300 feet waterward from the shoreline using a land-based or barge-mounted excavator, positioning and securing the cable, burial and backfill to restore pre-existing construction contours, and revegetation.

The IECRC and inshore/intertidal areas associated with the landfalls in Barnegat Bay have a more diverse fish assemblage than is seen in the WFA. Species that inhabit estuarine waters utilize the unique inshore habitats such as tidal wetlands, shellfish and SAV beds and shoreline structures for shelter, feeding, and spawning. Cable installation would result in short-term benthic disturbance, and habitat alteration would likely cause adult and juvenile fish to relocate temporarily. Summer flounder, whose HAPC exists within SAV beds in its EFH range, would be an example of a species that could be affected by the loss of SAV habitat during construction. Sessile and slow-moving benthic organisms such as bivalves and the adhesive, demersal eggs of winter flounder would be vulnerable to direct benthic impacts. Table 5-5 details maximum estuarine EFH and HAPC impacts from the inshore export cable. Table 5-6 summarizes tidal wetland impacts along the estuarine portion of the BL England and Oyster Creek cable routes.

HAPC for juvenile and adult summer flounder is likely to be subject to short-term, long-term, and/or permanent effects from Project activities that disrupt the SAV in Barnegat Bay, such as installation of the export cable. Summer flounder are expected to be able to recolonize most areas once construction is complete. Impacts to HAPC would be minimized by the use of trenchless technologies such as HDD or direct pipe, as practicable, which can be used to install the cable beneath overlying sediments and SAV without direct physical disturbance. Open cut trenching at the Prior Channel Route and/or Holtec landfall could result in short-term, long-term, or permanent impacts to summer flounder HAPC. Ocean Wind has developed a Submerged Aquatic Vegetation (SAV) Monitoring Plan (Inspire 2022c) to document baseline delineations and conditions of SAV beds, assess potential impacts to these SAV beds as a result of the construction and operations of the inshore export cable(s) associated with the Project, and track recovery of these SAV beds over time to inform potential mitigation strategies. The proposed SAV Mitigation Plan (Ocean Wind 2022d) outlines Ocean Wind’s proposed process to ensure that any impacts on SAV incurred during construction and installation activities of the Ocean Wind 1 export cable, and which cannot be avoided and/or minimized, are adequately mitigated. Refer to Section 6.2, Submerged Aquatic Vegetation (Summer Flounder HAPC) Avoidance, Minimization, and Mitigation for additional information.

Table 5-5 Maximum OECRC/IECRC Route Impacts to Estuarine EFH and HAPC

Export Cable Route	Total Benthic Disturbance within Shellfish Habitat		Total Benthic Disturbance within SAV	
	Acres	Hectares	Acres	Hectares
Oyster Creek	121	48.97	20	8.09
BL England	1	00.40	-	-
Total	122	49.37	20	8.09

Source: COP, Volume II, Table 2.2.5-6 (Ocean Wind 2022a)
COP = Construction and Operations Plan; EFH = Essential Fish Habitat; HAPC = habitat area of particular concern; OECRC = Offshore Export Cable Route Corridor; SAV = submerged aquatic vegetation

Table 5-6 Summary of Tidal Wetland Impacts along Indicative Onshore Export Cable Routes by NJDEP Wetland Community Type within the Project Area

Onshore Export Cable Route	Wetland Community Type	Acres of Short-term Impact
BL England	*Phragmites*-dominated coastal wetlands	0.35
	Saline marsh (low marsh)	0.18
Oyster Creek	Saline marsh (high marsh)	2.54
	Saline marsh (low marsh)	2.72
	Phragmites-dominated coastal wetlands	4.37
	Disturbed tidal wetlands	0.05

Modified from COP, Volume II, Table 2.2.1-5 (Ocean Wind 2022a)
COP = Construction and Operations Plan; NJDEP = New Jersey Department of Environmental Protection

A maximum of approximately 20 acres (8.1 hectares) of summer flounder HAPC within SAV could be disturbed as a result of the installation of the cable along the indicative Oyster Creek offshore export cable route. Impacts to summer flounder HAPC associated with the Oyster Creek Export Cable Corridor are further broken down by impact type in Appendix 10.2.7, Table 10.2-8. All impacts to HAPC would be short-term and limited to the duration of construction. Based on SAV mapping, a maximum of 20 acres (8.1 hectares) of SAV could be temporarily affected in Barnegat Bay from indicative cable installation.

Based on the July 2022 underwater video SAV data collected in Barnegat Bay at four landing areas (Inspire 2022a), the area of SAV in the area of potential influence would depend on the specific landing area. The area of potential influence was defined as a 500-ft buffer on either side of the cable route options at the landfall areas out to either the potential HDD transition location (western landfall areas) or to the distance at which the 2019 mapped SAV beds ended (IBSP landfall). Across the three western landfall survey areas, the Farm had the least acreage of SAV observed (0 acres) and the smallest project area of potential influence on SAV (18.4 acres). The Marina cable route option at the Lighthouse Drive landfall had the next lowest acreage of SAV observed (9.5 acres), but the project area of potential influence on SAV was similar to or slightly higher than the other western cable route options. The greatest SAV area and project area of potential influence on SAV were documented at the IBSP landfall, 59.9 and 91.7 acres, respectively. Cable installation through the prior channel where sparse SAV was observed would limit direct impacts on the complete and patchy SAV habitat at the IBSP landfall.

The Atlantic City Reef, Great Egg Reef, Ocean City Reef, and Deepwater Reef are all located within 10 miles of the WFA or within 330 feet of an export cable. Given their proximity to this activity, there is the potential for indirect impacts to those reefs within 330 feet of an export cable from sediment transport during cable installation, as discussed above, based upon sediment transport modeling conducted for another offshore wind project (Vinhateriro et al. 2018).

The southernmost point of the Great Bay/Little Egg Harbor sandbar shark HAPC is located 3.9 miles from the BL England OECRC. Given the distance between this HAPC and this activity, it is unlikely that there would be indirect impacts to sandbar shark HAPC from sediment transport during cable installation, as based on sediment transport modeling from another offshore wind project (Vinhateriro 2018), sedimentation from export cable installation would only occur within 330 feet of the cable.

Shellfish beds are found throughout Barnegat Bay. The proposed indicative cable route avoids moderate to high density shellfish beds mapped by the NJDEP to the extent practicable, as well as crossing previously disturbed areas. Direct impacts would be minimized via routing and use of trenchless technology options. Potential indirect impacts to shellfish beds include resuspension of sediments and potential burial. However, would avoid the highest densities of shellfish to the extent practicable and because shellfish such as the hardclam (*Mercenaria mercenaria*) have the ability to vertically migrate through sediment and survive burial events (Maurer et al. 1986) while others such as the bay scallop are mobile.

Installation of the array cable, substation interconnection cable, and the offshore export cables could result direct impacts such as crushing and burial, of slow-moving or sessile organisms and life stages. The sea-to-shore transition would occur where the onshore segment of the OECRC meets the offshore segment of the OECRC. Cofferdam installation, open cut trenching, dredging and sidecast, and vessel anchoring could result in crushing and burial effects. Direct mortality of benthic life stages and sessile organisms could also result from fluidizing the sediments along the cable corridors during cable burial. The effects of crushing and burial impacts on EFH resulting from cable installation would vary depending on how benthic and near-bottom habitats exposed to these impacts are used by EFH-designated species. Benthic and epibenthic life stages would be the primary groups affected, with secondary effects on EFH-designated species and life stages that prey upon benthic and epibenthic organisms. Mobile organisms such as juvenile and adult finfish may be temporarily displaced by cable installation but would be able to avoid direct impacts related to these activities. Use of the jet plow would cause lethal impacts to non-motile pelagic life stages due to the surface-oriented water intake.

Effects

- Direct
  - Short-term loss/conversion of EFH (APM for avoidance of sensitive habitat when anchoring): EFH for Sessile Benthic/Epibenthic – Soft Bottom, Mobile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex; Mobile Benthic/Epibenthic – Complex; Pelagic species groups; Prey Species – Benthic; Prey Species – Pelagic, Summer Flounder HAPC; Summer Flounder HAPC
  - Permanent, localized crushing and burial of EFH species: Sessile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex; Prey – Benthic/Epibenthic species groups
  - Short-term avoidance of anchoring activities by EFH species: Mobile Epibenthic/Benthic – Soft Bottom; Mobile Epibenthic/Benthic – Complex; Pelagic; Prey Species – Benthic and Prey Species – Pelagic species groups
- Indirect
  - Short-term loss of benthic prey items: Mobile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Complex;
  - Sediment transport to adjacent areas

5.1.2.3.2 Sediment Suspension and Deposition

Cable installation activities would generate localized plumes of suspended sediments within the immediate proximity of the trench excavation and reburial. Sediment dispersion modeling conducted for three other offshore wind projects (the Vineyard Wind Project in Massachusetts, the Block Island Wind Farm in Rhode Island and the Virginia Offshore Wind Technology Advancement Project of Virginia), and two underwater cable projects (the Seacoast Reliability Project in Little Bay, New Hampshire and the Silver Run Electric Project in the Delaware River estuary), were reviewed and evaluated, as general sediment conditions and hydrodynamics are similar to the Project Area. The sediments within each project area were predominantly sands and current velocities were within similar ranges indicating that the results of each modeling effort would be expected to be representative of the Ocean Wind Project site. The conditions at each project site are compared in Table 2.1.2-13 of COP, Volume II. Most of the sediments within the WFA are likely to be medium to coarse grains, and resuspended sediment would therefore be expected to resettle quickly (COP Volume II, Section 2.1.2.2; Ocean Wind 2022a).

Vinhateiro et al. (2018) modeled cumulative TSS concentrations and sediment plume dispersal from hydroplow excavation and reburial of a 61.1-linear-mile (98.3 km, 53.1 nm) section of the South Fork Export Cable Beach Lane alternative route which traverses a diversity of substrates, including two segments dominated by silt and mud sediments. These silt and mud segments resulted in the estimated TSS concentrations as high as 1,347 mg/L within 8.2 feet of the seabed. Across the range of sediments modeled, deposition of 0.1 inches could occur up to 115 feet from the cable path and deposition of 0.4 inches could occur up to 29.5 feet from the cable path. The study estimated that sediment plumes would resettle and TSS concentrations would return to background levels within 0.3 to 0.4 hours of disturbance.

A sediment dispersal modeling study was also conducted for the Vineyard Wind project to assess expected sediment disturbing construction activities (Epsilon 2018). The model assumed a fine sand- and silt-dominated seafloor across the entire disturbed area and assessed installation of array and export cables as well as dredging of sandwaves. Modeling of the inter-array cable installation in the Wind Development Area was run for a typical installation (expected 90%) and maximum installation (expected 10%). Vertically, the sediment suspension was limited to the bottom 10 feet (3 meters) of the water column with 85% modeled to remain in the bottom meter (Epsilon 2018). For typical installation, TSS more than 10 mg/L above the baseline levels in the Wind Development Area are expected to extend as far as 1.9 miles (3.1 km) from the centerline with concentration in excess of 50 mg/L extending to 525 feet (160 m) from the centerline. Maximum modeled impacts due to installation indicated the 10 mg/L plume could extend up to 7.5 km from the center line while plumes of 50 mg/L and 100 mg/L would extend up to 1.2 miles (2 km) and 0.53 miles (0.86 km) from the centerline respectively.

The Vineyard Wind project also modeled impacts from dredging with a trailing hopper suction dredge in regions where sandwaves needed to be removed to bury the cable in stable seafloor. Vertically, the resulting sediment plume can impact the entire water column. TSS more than 10 mg/L above baseline were modeled to extend up to 10 miles (16 km) from the centerline while plumes of 750 mg/L and 1,000 mg/L higher than the baseline could extend 3.2 miles (5 km) and 1.2 miles (2 km) respectively. Overall, TSS are expected to remain in the water column for less than 3 hours.

Inter-array cable installation would occur during Q3 of 2024 to Q2 of 2025 and offshore export cable installation, including IECRC installation, would occur during Q2 of 2024 to Q1 of 2025. Sediment-producing activities would occur intermittently during the cable installation process.

In inshore areas (i.e., back bays), sediments are comprised of fine to medium grains. Therefore, suspension and settlement of sediments is expected from potential cable installation activities such as jetting, plowing, open cut trenching, cutting, and control flow excavation. As noted in Section 2.1.2.2, the finer sediments in these areas would become suspended and extend above the trench and take longer to settle to the seabed than in areas of sand or coarser-grained sediments. These impacts to water quality for finer sediments are anticipated to be short-term in nature. Direct impacts are associated with early life stages of demersal species such as the eggs of the winter flounder. Immediately following installation, indirect impacts from suspended sediments can potentially cause mortality to demersal fish eggs due to burial and reduced hatching success (Berry et al. 2011). However, across many different USACE dredging projects in New York Harbor, even when dredging sediments with high percentage of fine grain particles, plumes dissipated rapidly over distance (within 650 feet [200 meters] in the upper water column and 2,000 feet [600 meters] in the lower water column) to levels not detectable against background conditions. Active swimmers would be able to easily avoid plumes, and passive drifters would only be exposed over short distances (USACE 2015). Therefore, no potential impacts on adult and juvenile EFH-designated species are expected. Impacts to demersal life stages and sessile organisms due to burial via sediment deposition may occur, but are expected to be localized and short-term.

Effects

- Direct
  - Short-term decrease in quality of EFH due to suspended sediments and increased turbidity: EFH for Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; and Pelagic species groups; Summer Flounder HAPC
  - Short-term, local impacts due to sedimentation: Sessile Benthic/Epibenthic – Soft Bottom; Prey Species – Benthic.
- Indirect
  - Short-term loss of foraging opportunities: Mobile Epibenthic/Benthic – Soft Bottom; and Pelagic species groups.
  - Short-term decrease in quality of EFH in areas adjacent to Project activities for: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Summer Flounder HAPC; Prey Species – Benthic.

5.1.2.3.3 Horizontal Directional Drilling (HDD) or Open Cut Trenching

During installation of the estuarine portion of the OECRC, impacts to SAV would be minimized, where practicable, by the use of trenchless installation methods which install the cable beneath overlying sediments and SAV without direct physical disturbance (if possible, after consideration of engineering design and feasibility analysis). HDD installation at the Island Beach State Park/Base Case would be limited by engineering constraints to a length of approximately 1,181 feet (360 meters) into Barnegat Bay. As a result, the HDD exit pits would be located within intact SAV beds. HDD installation of the export cables in the Prior Channel would require a 50-meter (164-foot) separation of the cables to provide adequate spacing for the drills from a constructability perspective, and to reduce risk of inadvertent returns of drilling fluids. This 50-meter (164-foot) cable separation would extend beyond the limits of the prior channel and would require disturbances into adjacent SAV beds for cable installation and vessel access for the marine HDD spread. Additionally, HDD would require a set back to the east in the parking lot of the adjacent personnel building to achieve the required burial depth under the channel/shoreline and reduce the risk of inadvertent return of drilling fluids which is highest at the shoreline (Ocean Wind 2022a).

During HDD, a sediment mix including drilling mud (i.e., bentonite) is used. During drilling, reaming, or pulling events, some drilling mud may be released from the end of the bore hole. Therefore, each HDD would have an exit pit to receive the drilling mud. Bentonite is heavier than water, so it would remain in the exit pit and then be removed through a vacuum or suction dredge. HDD conduits would be drilled for landfall. An HDD entry pit would be required for each cable duct. Trenchless installation (e.g., HDD) has the potential for impact in the event of inadvertent return of drilling fluids, thus causing adverse impacts to water quality through increases in turbidity, as well as hazardous chemical impacts to EFH and EFH-designated species. Best management practices, such as monitoring of the drilling mud volumes, pressures, and pump rates and returns, would be followed to determine if drill mud loss occurs in amounts that signal a possible inadvertent return. An Inadvertent Return Plan would be developed and implemented to prevent and minimize impacts (COP, Volume II, Table 1.1-2).

Open cut trenching is being considered for landfalls not under the USACE beach nourishment program, including the west side of Island Beach State Park (Prior Channel Route) and at the Holtec landfall due to elevated risks of inadvertent returns of drilling mud occurring during HDD. Ocean Wind has conducted a hydrofracture evaluation and determined that the required drilling fluid pressure is estimated to be greater than the theoretical strength of the overlying soils for most of the HDD installation, which would suggest high risk of prolonged and repeated drilling fluid losses to surrounding environment. Open cut trenching for the Prior Channel option allows for reduced cable separation (66 feet [20 meters]), which minimizes impacts to the intact SAV beds to the north and south of the prior channel (Ocean Wind 2022a). Table 5-7 presents a comparison of short-term SAV impacts for HDD and open cut trenching for Oyster Creek IECRC landfall options.

Table 5-7 Short-Term SAV Impacts by Installation Method for Oyster Creek IECRC Landfall Options[1]

Data	IBSP-Base Case (Acres		IBSP – Prior Channel (Acres)		Holtec/The Farm (Acres)		Bay Parkway One Shot (Acres)		Bay Parkway (Acres)		Nautilus (Acres)		Lighthouse (Acres)		Marina (Acres)	
	HDD[2]	Open Cut[3]	HDD[4]	Open Cut	HDD	Open Cut	HDD	Open Cut	HDD	Open Cut	HDD	Open Cut	HDD	Open Cut	HDD	Open Cut
1979 Data	15.25	-	-	0.89	0	1.49	0.09	1.19	0	1.49	0	0.20	0	1.19	0	2.09
1985–1987 Data	13.17	-	-	14.01	0	0	0.87	1.99	0.57	2.39	0	1.29	0.25	1.49	0.15	2.98
2009 Data	11.78	-	-	1.80	0	1.59	1.86	2.98	0.22	2.09	0	0.99	0	0.80	0	0.50
Ocean Wind Survey Data	13.86	-	-	8.35	0	1.89	0.32	0.89	0	0.99	0	0.70	0	0.90	0	0.30

[1] Assumes 82-foot disturbance corridor width for open cut trenching installation method and cable installation and seafloor preparation
[2] HDD area calculated using boundary of HDD pit trench
[3] Open cut trenching installation not proposed for IBSP Base Case option.
[4] HDD installation not proposed for IBSP Prior Channel option.

SAV habitat would be avoided wherever possible, and impacts minimized should the cable need to traverse a unique habitat (e.g., complying with seasonal work windows and other best management practices). Affected species would likely relocate to surrounding similar habitat during and immediately following construction. Following construction, the areas of cable burial would be restored to previous elevations and impacted SAV would be restored, reestablishing the HAPC areas. Post-cable installation restoration activities would include backfill and grading to restore the pre-construction shoreline contours. The recontoured area would be replanted with native wetland vegetation and would be monitored for a minimum of 5 years of post-construction to confirm shoreline stabilization and adequate vegetative cover.

Impacts from seabed disturbance due to open cut trenching and HDD are anticipated to be localized and short-term due to their temporary nature. Mobile life stages would move out of the area to avoid potential impacts. However, demersal non-mobile life stages would be affected due to removal of the sediment on which they occur. Most juvenile and adult finfish would actively avoid all construction activities. Immobile finfish life stages such as demersal eggs and larvae, and sessile organisms may also experience mortality as a result of being crushed or buried during trenching or HDD. EFH-designated species that would likely be affected by open cut trenching and HDD are similar to those listed in Section 5.1.2.3.1.

The fine sediments of backbays are more susceptible to suspension and settlement of sediments during cable installation activities such as open cut trenching and HDD. As noted in Section 2.1.2.2, the finer sediments in these areas would become suspended and extend above the trench and take longer to settle to the seabed than in areas of sand or coarser-grained sediments. These impacts are anticipated to be short-term in nature. Direct impacts are associated with early life stages of demersal species such as the eggs of the winter flounder. Immediately following installation, indirect impacts from suspended sediments can potentially cause mortality to demersal fish eggs due to burial and reduced hatching success (Berry et al. 2011). However, for many different USACE dredging projects in New York Harbor, even when dredging sediments with high percentage of fine grain particles, plumes dissipated rapidly over distance (within 650 feet [200 meters] in the upper water column and 2,000 feet [600 meters] in the lower water column) to levels not detectable against background conditions. Active swimmers would be able to easily avoid plumes, and passive drifters would only be exposed over short distances (USACE 2015). Therefore, no potential impacts on adult and juvenile EFH-designated species are expected. Impacts to demersal life stages and sessile organisms due to burial via sediment deposition may occur, but are expected to be localized and short-term, similar to impacts described in Section 5.1.2.3.2 Sediment Suspension and Deposition.

Excavation or water removal activities that support open cut trenching and HDD may also result in entrainment of planktonic larvae of benthic fauna (e.g., larval polychaetes, mollusks, crustaceans) with assumed 100% mortality of entrained individuals (COP Volume II, Section 2.2.5.2.1; Ocean Wind 2022a). Due to the surface-oriented intake, water withdrawal could entrain pelagic eggs and larvae, but would not affect resources on the seafloor. Due to the limited volume of water withdrawn, BOEM does not expect population-level impacts on any given species. Impacts would be similar to those described in 5.1.2.2.3 Entrainment.

Underwater noise from open cut trenching and HDD may also affect EFH-designated species, as described earlier in this section for vessels and for sheetpile driving. The vibratory noise is more likely to result in behavioral responses in exposed fish, but injury is also possible for fish that are close by. Noise impacts of sheet pile driving are similar to those described for pile driving with respect the impacts of vibratory noise, but would be much less due to lower frequency, less intensity, and number of locations. Vessel noise can also adversely affect species with designated EFH. For example, analysis of vessel noise related to the Cape Wind Energy Project found that noise levels from construction vessels at 10 feet (3 meters) were loud enough to elicit an avoidance response, but not loud enough to do physical harm (MMS 2008). Demersal and benthic invertebrates would not be anticipated to be affected as a result of increased noise from vessels associated with construction of the proposed Project. Therefore, EFH-designated species in the vicinity of open cut trenching or HDD may initially exhibit a negative behavioral response to vessel activity; however, as vessel traffic increases and then declines over the Project timeline, habituation to vessel noise by EFH-designated species are likely to occur. Project-related vessel noise is expected to result in a direct minor to moderate adverse impact to EFH for both pelagic and demersal life stages, but this impact will be short-term and once construction is completed, the habitat suitability is expected to return to trenching conditions.

Effects

- Direct
  - Short-term loss/conversion of EFH: EFH for Sessile Benthic/Epibenthic – Soft Bottom, Mobile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex; Mobile Benthic/Epibenthic – Complex; Pelagic species groups; Prey Species – Benthic; Prey Species – Pelagic, Summer Flounder HAPC
  - Permanent, localized crushing and burial of EFH species: Sessile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex; Prey –Benthic/Epibenthic species groups
  - Short-term avoidance of cable installation activities by EFH species: Mobile Epibenthic/Benthic – Soft Bottom; Mobile Epibenthic/Benthic – Complex; Pelagic; Prey Species – Benthic and Prey Species – Pelagic species groups
  - Short-term decrease in quality of EFH due to suspended sediments and increased turbidity: EFH for Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; and Pelagic species groups; Summer Flounder HAPC
- Indirect
  - Short-term loss of benthic prey items: Mobile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Complex
  - Sediment transport to adjacent areas
  - Short-term loss of foraging opportunities: Mobile Epibenthic/Benthic – Soft Bottom; and Pelagic species groups
  - Short-term decrease in quality of EFH in areas adjacent to Project activities for: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Summer Flounder HAPC; Prey Species – Benthic.

5.1.2.3.4 Underwater Sound

Sound from trenching equipment for placement of new or expanded submarine cables and pipelines is likely to occur within the Project area. Noise impacts associated with installation of Project cable installation would be short-term and localized and extend only a short distance beyond the emplacement corridor. Impacts from noise would be lower than impacts from the trenching and disturbance to the seafloor; regardless, the most prominent noise-producing activities would be related to trenching and seafloor excavation. Noise from trenching could result in injury or mortality for finfish in the immediate vicinity of the activity and would likely result in short-term behavioral changes in a broader area. These impacts would be short term, and finfish would be expected to return to the areas of impact following any cable or pipeline activities.

Sheet piling would be temporarily installed to support open cut trenches and as intertidal cofferdams for HDD exit pits. For cofferdams (for HDD) and open cut trenches installed using sheet pile, a vibratory hammer would be used to drive the sidewalls and endwalls into the seabed to a depth of approximately 6 feet (1.8 m); sections of the shoreside endwall will be driven to a depth of up to 30 feet to facilitate the HDD entering underneath the endwall. Adverse impacts to EFH associated with sheet piling installation would include disturbance and temporary loss of benthic habitat and injury and/or mortality due to habitat disturbance and noise (vibratory). These impacts are expected to be short term and would end once the cofferdam is removed and the disturbance would be in a relatively small area, and therefore a small portion of the available EFH. Recolonization of sediments by epifaunal and infaunal species and the return of mobile fish and invertebrate species will allow this area to continue to serve as foraging habitat for EFH species. Underwater noise generated by vibratory hammering during installation of sheetpiles can have direct impacts on finfish species, particularly those with swim bladders (see discussion in 5.1.1, above). The vibratory noise is more likely to result in behavioral responses in exposed fish, but injury is also possible for fish that are close by. Noise impacts of sheet pile driving are similar to those described for turbine pile driving with respect the impacts of vibratory noise, but would be much less due to lower frequency, less intensity, and number of locations. Noise may cause fish to be temporarily stunned, which might make them more susceptible to predation. In general, sheet pile driving is expected to have an adverse impact to EFH for species that are mobile and can detect sound. It is possible, but not likely, that elevated noise may interrupt migration patterns of finfish through the area because they may avoid elevated noise levels. Impact pile driving is expected to result in a direct minor to moderate adverse impact to EFH for both pelagic and demersal life stages, but this impact will be short-term as once pile driving is completed, the habitat suitability is expected to return to pre-pile driving conditions.

Vibratory pile driving, which requires the use of a vibratory hammer, is associated with installation and removal of the cofferdam, noise associated with some HRG surveys, vessel noise, aircraft operations, cable laying and trenching, and WTG operations were considered Project-generated non-impulsive underwater noise and subsequently evaluated. If required, temporary cofferdams may be installed either as sheet pile structures into the seafloor or a gravity cell structure placed on the floor using ballast weight. Selection of a preferred design for cofferdams and landfall works is pending additional design and coordination. Ocean Wind anticipates that impacts relating to cofferdam installation and removal would eclipse any potential impacts of alternative methods and, therefore, presented here.

The extent of potential underwater noise effects as a result of vibratory driving of sheet piles was modeled for marine fish, as detailed in the Ocean Wind BA (October 2022), using a loss model developed within the GARFO Acoustics Tool (NOAA 2020). Based on the GARFO modeling conducted, peak injury threshold for physiological injury would be exceeded at < 3.3 feet (1 meter) from the source. At this small distance in which these effects could occur, impacts are considered extremely unlikely and were considered discountable in the BA. Cumulative injury thresholds are also not expected to be exceeded, therefore there is no effect.

The extent of potential behavioral effects and results indicated behavioral thresholds for fish would be exceeded up to 328 feet (100 meters) from the source and would only occur for brief periods (vibratory pile driving is only expected to occur over a 4-day period). Marine fish would be able to divert away from the noise and therefore, only minor effects would be anticipated.

With the relatively small areas in which behavioral disturbance is expected to occur and the short duration of the activity, the potential for behavioral exposure to the Atlantic sturgeon (the only ESA-listed fish in the Project area) is reduced; Atlantic sturgeon may divert away from the area, and any effects to this brief exposure would be so small that they could not be measured, detected, or evaluated and are therefore insignificant, as reported in the BA.

Effects

- Direct
  - Short-term, direct effects on EFH and EFH species and life stages for all Hearing Categories, with greatest impacts to Hearing Category 3 species and life stages.

- Short-term, direct effects on EFH of all Species Groups: Sessile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex Habitat; Mobile Benthic/Epibenthic – Complex Habitat; Pelagic; Prey Species – Benthic/Epibenthic; Prey Species – Pelagic.

5.1.2.4 Cable Protection

Cable protection may be required where burial cannot occur, sufficient depth cannot be achieved, or protection is required due to crossing other cables or pipelines. Rock placement, mattresses, frond mattresses, rock bags, or seabed spacers may be used to protect the cable (see Section 2.2.2.4).

Approximately 10% of the cable route may require cable protection (Ocean Wind 2022a). Installation of cable protection would cause long-term and localized habitat conversion and short-term and localized sediment suspension which would adversely affect EFH and EFH-designated species.

5.1.2.4.1 Habitat Loss/Conversion

Array and substation interconnection cable construction area potentially requiring cable protection is comprised of 148.04 acres (59.91 hectares) of soft-bottom habitat, 0.75 acre (0.30 hectare) of heterogenous complex habitat, and 25.79 acres (10.44 hectares) of complex habitat. Cable protection may be required for up to 10% of the route, with the Project design envelope allowing for up to 77 acres (31.16 hectares) for the array cables and 8 acres (3.24 hectares) for the substation interconnection cables, but the locations where cable protection would be required are not known and the exact habitats to be affected cannot be determined at this time. The majority of the area that may be affected by cable protection is classified as soft-bottom habitat (85%) (Appendix 10.2.7, Table 10.2-7). Most of the remaining area (15%) intersects habitats categorized as complex and a very small area (0.43%) categorized as heterogeneous complex (Appendix 10.2.7, Table 10.2-7). The soft-bottom habitats that would potentially be affected were generally mapped as Sand and Muddy Sand – Mobile and the habitats categorized as complex were generally mapped as Coarse Sediment – Mobile (Appendix 10.2.7, Table 10.2-6). Sand and Muddy Sand with Low Density Boulder Field habitats were categorized as heterogeneous complex (Table 3-4, Inspire 2022a).

The BL England offshore export cable construction area that could potentially require cable protection is comprised of 23.67 acres (9.58 hectares) of soft-bottom habitat, with no heterogenous complex habitat or complex habitat. Cable protection may be required for up to 10% of the route, with the Project design envelope allowing for up to 16 acres (6.47 hectares) of cable protection. The locations where cable protection would be required are not known and the exact habitats to be affected cannot be determined at this time.

The Oyster Creek offshore export cable construction area that could potentially require cable protection is comprised of 69.05 acres (27.94 hectares) of soft-bottom habitat, zero acres of heterogenous complex habitat, and 64.41 acres (26.07 hectares) of complex habitat. The Oyster Creek inshore export cable construction area that could potentially require cable protection is comprised of 11.56 acres (4.68 hectares) of soft-bottom habitat, zero acres of heterogenous complex habitat, and 1.95 acre (0.79 hectares) of complex habitat. Cable protection may be required for up to 10% of the route, with the Project design envelope allowing for up to 70 acres (28.33 hectares) of cable protection. The locations where cable protection would be required are not known and the exact habitats to be affected cannot be determined at this time.

Impact calculation above are based on an assumed 9.81 foot (2.99 meter) wide strip, inclusive of cable installation width. In general, impacts from seabed disturbance would be localized and short-term with the exception of habitat conversion and/or loss due to the installation of the WTGs and OSSs and associated scour protection, where required. It is anticipated that mobile life stages would move out of the area to avoid potential impacts. Demersal non-mobile life stages would be affected due to the placement of foundations and scour protection in the immediate area of installation. Most juvenile and adult finfish would actively avoid all construction activities. However, immobile finfish life stages such as demersal eggs and larvae, and sessile organisms could experience mortality as a result of being crushed or buried by the foundations, scour protection, and vessel anchors within the WFA footprint. EFH-designated species that would likely be affected by crushing and burial effects of installation of scour protection are similar to those listed in Section 5.1.1.1.

5.1.2.4.2 Benthic Effects from Cable Protection for the BL England OECRC

5.1.2.4.2.1 Complex Benthic Habitat

Placement of physical structures such as concrete mattresses, frond mattresses, rock bags, rock placement, and seabed spacers as protection for protection of exposed segments of the BL England OECRC would result in the intermediate- to long-term modification of complex benthic habitat. A maximum potential impact of approximately 0.02 acre (0.008 hectare) of complex benthic habitat would be permanently altered by placement of protective structures. If concrete mattresses were to be used, placement in complex benthic habitat would permanently reduce the natural suitability of the affected habitat. Mattresses would likely be removed during decommissioning, the effects of which would be addressed under future EFH consultation.

The nearshore terminus (estuarine portion) of the BL England OECRC route overlaps areas of complex habitat that may be within designated HAPC for summer flounder if they support macroalgae or seagrasses. While such areas would be avoided to the extent practicable during construction, any impacts on macroalgae or aquatic vegetation would constitute a short-term to long-term adverse effect on HAPC for this species. EFH for gadid juveniles and adults, demersal egg, larvae, juvenile, and adult fishes, various juvenile and adult skates and sharks, and demersal invertebrate life stages be adversely affected in the short-term to long-term by alteration of natural habitat and the placement of protective structures associated with the BL England OECRC.

5.1.2.4.2.2 Non-complex (Soft Bottom) Benthic Habitat

The placement of concrete mattresses and other protective structures to exposed segments of the BL England OECRC would result in long-term conversion of soft-bottom habitat to complex benthic habitat. A maximum potential impact of approximately 23.67 acres (9.58 hectares) of soft-bottom habitat would be converted to complex benthic habitat by placement of protective structures.

The affected areas would be rendered unsuitable for EFH-designated species associated with non-complex benthic habitats during one or more life stages. The BL England OECRC installation would therefore result in long-term adverse effects on EFH lasting for the life of the Project. The concrete mattresses would likely be removed during decommissioning, restoring the affected area to non-complex benthic habitat (the effects of mattress removal would be addressed under a separate future EFH consultation for Project decommissioning). Mattress placement in soft-bottom habitat would convert benthic habitat to more complex benthic habitat and would provide similar artificial reef benefits as previously discussed.

EFH for demersal organisms and life stages would be adversely affected in the short-term to long-term by alteration of natural habitat and the placement of protective structures associated with the BL England OECRC.

5.1.2.4.3 Benthic Effects from Cable Protection for the Oyster Creek OECRC and IECRC

5.1.2.4.3.1 Complex Benthic Habitat

Placement of physical structures such as concrete mattresses, frond mattresses, rock bags, rock placement, and seabed spacers as protection for protection of exposed segments of the Oyster Creek OECRC/IECRC would result in the intermediate- to long-term modification of complex benthic habitat. The total area of maximum potential impacts is 64.41 acres (26.07 hectares) of complex benthic habitat would be permanently altered by placement of protective structures for the OECRC. The total area of maximum potential impacts is 1.95 acres (0.79 hectares) of complex benthic habitat would be permanently altered by placement of protective structures for the IECRC. If concrete mattresses were to be used, placement in complex benthic habitat would permanently reduce the natural suitability of the affected habitat. Mattresses would likely be removed during decommissioning, the effects of which would be addressed under future EFH consultation.

The nearshore terminus (estuarine portion) of the Oyster Creek IECRC route overlaps areas of complex habitat that may be within designated HAPC for summer flounder if they support macroalgae or seagrasses. While such areas would be avoided to the extent practicable during construction, any impacts on macroalgae or aquatic vegetation would constitute a short-term to long-term adverse effect on HAPC for this species.

EFH for demersal organisms and life stages would be adversely affected in the short-term to long-term by alteration of natural habitat and the placement of protective structures associated with the Oyster Creek OECRC.

5.1.2.4.3.2 Non-complex (Soft Bottom) Benthic Habitat

The placement of concrete mattresses and other protective structures to exposed segments of the Oyster Creek OECRC would result in long-term conversion of a maximum of 69.05 acres (27.94 hectares) of soft-bottom habitat to complex benthic habitat. The placement of concrete mattresses and other protective structures to exposed segments of the Oyster Creek IECRC would result in long-term conversion of a maximum of 11.56 acres (4.68 hectares) of soft-bottom habitat to complex benthic habitat. The affected areas would be rendered unsuitable for EFH-designated species associated with non-complex benthic habitats during one or more life stages. The Oyster Creek OECRC/IECRC installation would therefore result in long-term adverse effects on EFH lasting for the life of the Project. The concrete mattresses would likely be removed during decommissioning, restoring the affected area to non-complex benthic habitat (the effects of mattress removal would be addressed under a separate future EFH consultation for Project decommissioning). Mattress placement in soft-bottom habitat would convert benthic habitat to more complex benthic habitat and would provide similar artificial reef benefits as previously discussed.

EFH for demersal organisms and life stages would be adversely affected in the short-term to long-term by alteration of natural habitat and the placement of protective structures associated with the Oyster Creek OECRC/IECRC.

5.1.2.4.4 Sediment Suspension

Installation of cable protection through the above-mentioned methods disturb benthic habitat. Placement of cable protection may temporarily increase suspended sediments due to resuspension of bottom sediments. These benthic disturbances would increase turbidity and suspend sediment in the water column. Impacts to benthic habitat would occur locally and temporarily within each previously discussed cable corridor. These seabed disturbances could result in short-term suspended sediment/sedimentation and direct mortality of sessile or slow-moving organisms due to burial upon sediment deposition. EFH-designated species that would likely be affected by suspended sediment are similar to those listed in Section 5.1.1.1.

5.1.3 Operation/Presence of Structures

5.1.3.1 Artificial Substrate

5.1.3.1.1 Community Structure Changes/Invasive Species

Development of the WFA would include installation of 98 WTGs and their foundations, and three OSSs and their foundations. The installation of the WTGs and OSSs would permanently alter benthic habitat by introducing new hard surfaces to the seabed. Additionally, these vertical structures, extending from the seabed to the water surface would alter the character of pelagic habitats used by many EFH-designated species and their prey and foraging resources. Over time, these new hard structures would become colonized by sessile organisms, creating complex habitats that effectively serve as artificial reefs within the WFA.

5.1.3.1.1.1 Underwater Sound

The operation of the WFA would produce underwater noise from the following sources:

- Effectively continuous, non-impulsive, low-frequency underwater noise and particle motion effects from WTG operations
- O&M vessel operations

The effects of these underwater noise sources on habitat suitability for EFH species are described by Project component in the following sections. The operation of the OECRCs would not generate underwater noise or particle motion effects and would not require planned maintenance. Therefore, there are no operational noise effects on EFH associated with this Project feature.

5.1.3.1.2 WFA

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 in the Underwater Acoustic and Exposure Modeling Survey (Küsel et al. 2022). Studies indicate that operating turbines (e.g., both older-generation, geared turbine designs and quieter, modern, direct-drive systems like those proposed for the WFA) produce underwater noise on the order of 110 to 125 dB relative to 1 micropascal root-mean-square sound pressure level (SPL_{RMS}) at a reference distance of 50 meters, occasionally reaching as high as 128 dB relative to 1 µPa SPL_{RMS}, in the 10-Hz to 8-kilohertz range (Tougaard et al. 2020). It is important to note that the Tougaard et al. (2020) study is based on turbines 6.15 MW and below; the Project WTGs are expected to be larger than 10 MW. Additionally, the turbines used in the Tougaard et al. (2020) study use gear box drives, which are louder than direct drives, which will be used for the Project. When compared to injury thresholds for fish, no physiological effects on fish as a result of WTG operational noise is anticipated. Based on Tougaard et al. (2020) inputs. It is important to note that, more recently, Stöber and Thomsen (2021) attempted to estimate operational noise from larger current-generation, direct-drive WTGs. They found that these designs could generate higher operational noise levels than those reported in earlier research; however, these findings have not yet been validated.

Some degree of habituation to these operational noise and particle motion effects is to be anticipated. Bedjer et al. (2009) argue that habituation of organisms to ongoing low-level disturbance is not necessarily a neutral or benign process. For example, 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. However, several reports have noted that offshore wind farms attract fish and invertebrate species as a result of providing an artificial reef effect (Russel et al. 2014; Degraer et al. 2020). As a result, adverse behavioral effects from operation of WTGs are not considered likely.

Collectively, these findings suggest that the WFA 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. Applying the sensitivity thresholds detailed in Section 5.1.1.2, potential adverse effects on habitat suitability for squid and fish belonging to the hearing specialist group are estimated to extend up to 164 feet (50 meters) from each foundation. This equates to adverse effects on habitat suitability over 46 acres (18.6 hectares) for the 37-foot (11-meter) monopile for EFH.

5.1.3.1.3 Offshore Export Cables and Array Cables

The offshore export cables and array cables would produce no operational noise effects and would therefore have no associated effects on EFH or EFH-designated species.

5.1.3.1.4 Vessel Noise

Vessel noise during O&M procedures is expected to have similar impact magnitude, and impact the same EFH-designated species as those previously discussed in Section 5.1.1.1.

5.1.3.2 Hydrodynamic Effects

Placement of monopiles and WTGs has the potential to influence local hydrodynamics. By adding vertical structure that spans the water column, there is potential for alteration to vertical and horizontal water velocity and circulation. The WFA is considered seasonally stratified, with warmer waters and higher salinity leading to strong stratification in the late summer and early fall. Storms and upwelling in the fall result in increased mixing and deterioration of the stratified layers. Presence of the monopiles in the water column can introduce small-scale mixing and turbulence that also results in some loss of stratification (Carpenter et al. 2016; Floeter et al. 2017; Schultze et al. 2020). In strongly stratified locations, the mixing seen at monopiles is often masked by processes forcing toward stratification (Schultze et al. 2020), but the introduction of nutrients from depth into the surface mixed layer can lead to a local increase in primary production (Floeter et al. 2017). 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 each monopile 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 toward stabilization (Schultze et al. 2020).

Monopiles can also influence current speed and direction. Monopile wakes have been observed and modeled at the kilometer scale (Cazenave et al. 2016; Vanhellemont and Ruddick 2014). While impacts to current speed and direction decrease rapidly around monopiles, there is evidence of hydrodynamic effects out to a kilometer away from a monopile (Li et al. 2014). However, other work suggests the influence of a monopile is primarily limited to within 328 to 656 feet (100 to 200 meters) of the pile (Schultze et al. 2020). The discrepancy likely relates to local conditions, wind farm scale, and sensitivity of the analysis.

NOAA consensus on other projects in the region is that effects would be limited to within a few hundred meters of the monopile (NOAA 2019). Here, the conservative assumption is made that effects could occur within 656 to 1,312.3 feet (200 to 400 meters) downstream of each monopile. Because the WTGs would be spaced 1 nm by 0.8 nm (1.9 by 1.5 km), which is greater than the downstream extent of individual hydrodynamic effects, the hydrodynamic effects of one monopile are not expected to influence the effects of another. Thus, there are no anticipated hydrodynamic effects of the monopile array, simply local effects of each individual monopile.

5.1.3.2.1 Affected Species

The 98 WTGs are likely to create individual localized hydrodynamic 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 WFA footprint.

Pelagic juveniles and adults with EFH-designated species utilizing water column habitat may experience localized hydrodynamic effects down current of each WFA monopile. These effects may be limited to decreased current speeds but could also include minor changes to seasonal stratification regimes. Adults and juveniles are 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. EFH-designated species with pelagic juvenile and adult life stages that are likely to occur within the WFA area.

There are no hydrodynamic effects associated with OECRC and IECRC footprints during O&M.

5.1.4 Operation/Presence of Inter-Array and Offshore Export Cables

5.1.4.1 Power Transmission (EMF, Heat)

The WFA inter-array cable and the OECRC would generate intermittent induced magnetic and electrical field effects and substrate heating effects whenever they are under power through the life of the Project. These effects would be present whenever winds speeds within the WFA are sufficient to turn WTGs. As such, these effects are anticipated to be continuous, with intermittent interruptions during periods of no wind.

EFH is divided into the following components for the purpose of this assessment:

- Benthic habitats used by EFH fish and invertebrate species having benthic or epibenthic eggs and larvae. Minimum physiological effect thresholds are defined as follows (Brouard et al. 1996):
  - Magnetic field : 1,000 milligauss (mG) (observed developmental delay)
  - Electrical field: >500 millivolts per meter (mV/m)
- Bottom habitats used by benthic or epibenthic life stages of EFH finfish species. Minimum physiological effect thresholds are defined as follows (Armstrong et al. 2015; Basov 1999; Bevelhimer et al. 2013; Orpwood et al. 2015):
  - Magnetic field: > 1,000 mG
  - Electrical field: 20 mV/m
- Demersal habitats (from 3.3 to 26.2 feet [1 to 8 meters] off the seabed) used by pelagic life stages of EFH finfish and invertebrates:

- Finfish: Same thresholds as above.
- Squid: > 800 mG (Love et al. 2015)

- Bottom habitats used by benthic and epibenthic life stages of EFH shark and skate species. Minimum effect thresholds are defined as follows (Bedore and Kajiura 2013; Hutchinson et al. 2020; Kempster et al. 2013):
  - Magnetic field: Detection, unknown; behavioral, 250-1,000 mG (species-specific)
  - Electrical field: Detection, 20-50 µV/cm (2-5 mV/m) for fields < 20 Hz, no response to electrical fields above 20 Hz
- Benthic and infaunal habitats used by EFH shellfish species, and benthic invertebrate prey organisms for EFH species

Discussed below are the electromagnetic field (EMF) and heating effects of each construction footprint area by taxonomic grouping and life stage.

5.1.4.1.1 WFA

The EMF and substrate heating effects of the inter-array cable on EFH would vary depending on the respective cable voltage, the position of the cable on the seabed, and how EFH is used by different life stages of EFH-designated species. Specifically, EFH-designated species with life stages that are surface-oriented or use pelagic habitats would not be exposed to EMF effects and would experience no effects on this habitat component. In contrast, EFH-designated species that use bottom or near-bottom habitats along the potential cable paths during one or more life stages may be exposed to EMF effects. The significance of these potential effects is dependent on habitat use (i.e., likelihood of exposure), and species-specific sensitivity to magnetic and electrical fields and heating effects.

The inter-array cable would generate intermittent induced magnetic and electrical field effects throughout the life of the Project, with the timing and duration of occurrence determined by wind speeds exceeding the operational kick-in threshold. The resulting effects on EFH would vary in intensity depending on the following factors:

- Position of the cable segment (i.e., buried to target depth or laid on the bed surface)
- Proximity of the affected habitat to the cable (i.e., benthic or epibenthic habitat within 3.3 feet (1 meter) of the seabed or surficial or mid-water pelagic habitats)
- Species-specific sensitivity to EMF effects

5.1.4.1.1.1 EMF Effects on Habitats Used by Benthic or Epibenthic Eggs and Larvae

Several EFH species and fish and invertebrates that provide prey for EFH-designates species have benthic eggs and larvae that could settle in areas along the inter-array cable path, including both buried and exposed cable segments. The maximum induced magnetic field and electrical field generated by the inter-array cable are 65.1 mG and 4.3 mV/m at the bed surface immediately adjacent to exposed cable segments, respectively. Induced electrical field effects on eggs and larvae would be insignificant based on heir small body size.

Species-specific data on egg and larval sensitivity to EMF effects is lacking. However, general research on fish sensitivity to magnetic and electrical fields suggests that the effects of EMF from the inter-array cable on benthic egg and larval EFH would be insignificant. For example, Cameron et al. (1985) determined that magnetic fields on the order of 1,000 mG are required to produce observable developmental delay on the eggs of euryhaline Japanese rice fish. Brouard et al. (1996) exposed rainbow trout embryos to electrical fields ranging as high as 5,000 mV/m and observed no evident effects on development or subsequent survival. These test exposures are orders of magnitude higher than the largest potential EMF effect on benthic habitats likely to result from inter-array cable operation. These findings indicate that the EMF effects of this Project component on benthic EFH for the eggs and larvae of the following species would be insignificant.

5.1.4.1.1.2 EMF Effects on Habitats Used by Benthic or Epibenthic Juvenile and Adult Finfish

Several EFH species and their fish prey species use benthic or epibenthic habitats within 3.3 feet (1 meter) of the seabed during their life cycle that overlap with the inter-array cable path, including both buried and exposed cable segments. This indicates that EFH species and their prey could be exposed to the following EMF effects:

- Induced magnetic field: 21 to 65.1 mG at seabed above buried and exposed cable segments, respectively
- Electrical field: 1.4 to 4.3 mV/m at seabed above buried and exposed cable segments, respectively
- Induced electrical fields:
    - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.4 mV/m
    - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 0.74 mV/m

As with eggs and larvae, species-specific research on the magnetic and electrical field sensitivity is generally lacking. However, the preponderance of available research on a variety of fish species (e.g., Armstrong et al. 2015; Bevelhimer et al. 2013; Orpwood et al. 2015) indicates that the minimum magnetic field exposure threshold for observable effects on behavior exceeds 1,000 mG for most fish species. The minimum threshold for observable detection of electrical fields in electrosensitive fish species is on the order of 20 mV/m (Basov 1999). Each of these thresholds is an order of magnitude or greater than the maximum potential EMF effect likely to result from inter-array cable operation. In a review of EMF effects produced by offshore wind energy, Copping et al. (2016) concluded that induced electrical fields on the order of those generated in fish in close proximity to the inter-array cable would have no observable effects on physiology or behavior.

On this basis, the EMF effects of inter-array cable operation on benthic and epibenthic habitats used by EFH finfish species and finfish prey organisms would be insignificant. The following EFH species use the affected habitat during juvenile, adult, and/or spawning life stages.

5.1.4.1.1.3 EMF Effects on Demersal Habitats Used by Pelagic Finfish Species

Several pelagic EFH species may periodically use demersal habitats at or near 3.3 feet (1 meter) of the seabed during their life cycle. This may include habitats overlapping buried and exposed segments of the inter-array cable. Prey organisms for pelagic fish species may also occur within this EMF exposure zone. This indicates that these species could be exposed to the following EMF effects:

- Induced magnetic field: 9 to 27.9 mG at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Electrical field: 0.9 to 2.8 mV/m at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Induced electrical fields at 3.3 feet (1 meter) above seabed:
    - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.19 mV/m
    - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 0.31 mV/m
    - Adults between 6 and 8.2 feet (1.8 and 2.5 meters) length: < 0.43 mV/m

Applying the effect thresholds and rationale presented in the previous section, the EMF effects of inter-array cable operation on near-bottom pelagic habitats used by EFH finfish species would be insignificant. The following EFH species may periodically use the affected habitat during juvenile, adult, and/or spawning life stages:

5.1.4.1.1.4 EMF Effects on Demersal Habitats Used by Pelagic Invertebrates

Two pelagic EFH invertebrate species, longfin squid and shortfin squid, may periodically use demersal habitats at or near 3.3 feet (1 meter) of the seabed during their life cycle. This may include habitats overlapping buried and exposed segments of the inter-array cable. Prey organisms within this zone would also experience EMF exposure. This indicates that these species could be exposed to the following EMF effects:

- Induced magnetic field: 9 to 27.9 mG at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Electrical field: 0.9 to 2.8 mV/m at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Induced electrical fields (body size dependent): Juveniles and adults less than 3.3 feet (1 meter) in length: < 0.25 mV/m

While directed studies are lacking, there is little evidence that cephalopods like squid are electromagnetically sensitive (Normandeau 2011; Williamson 1995). Anecdotal observations suggest that EMF from submarine power cables has no effect on cephalopod behavior. Love et al. (2015) observed no differences in octopus predation on caged crabs placed immediately adjacent to a powered HVAC electrical cable producing induced magnetic fields ranging from 450 to 800 mG, and at a control site adjacent to an unpowered cable. The lack of effects on predation behavior suggests that cephalopods are insensitive to EMF effects of this magnitude. Given that the largest projected magnetic field effects from the inter-array cable are 1 to 2 orders of magnitude lower than these values, it is reasonable to conclude that the EMF effects of this Project feature on EFH used by longfin squid would be insignificant.

5.1.4.1.1.5 EMF Effects on Demersal and Epibenthic Habitats Used by Skates and Sharks

Several EFH skate and shark species use demersal and epibenthic habitats overlapping the potential inter-array cable corridor during one or more life history stages. This indicates that these species may be exposed to the following EMF effects depending on their proximity to the seabed:

- Induced magnetic field:
    - 21 to 65.1 mG at seabed above buried and exposed cable segments, respectively
    - 9 to 27.9 mG at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Electrical field:
    - 1.4 to 4.3 mV/m at seabed above buried and exposed cable segments, respectively
    - 0.9 to 2.8 mV/m at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Induced electrical fields at seabed:
    - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.4 mV/m
    - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 0.74 mV/m
    - Adults between 6 and 8.2 feet (1.8 and 2.5 meters) length: < 1.02 mV/m
- Induced electrical fields at 1 meter above seabed

- Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.19 mV/m
- Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 0.31 mV/m
- Adults between 6 and 8.2 feet (1.8 and 2.5 meters) length: < 0.43 mV/m

Elasmobranchs are sensitive to EMFs, using specialized electrosensory organs to detect faint bioelectric signals emitted by prey. Sharks and rays demonstrate sensitivity to bioelectrical fields less than 1 mV/m (Adair et al. 1998; Ball et al. 2016; Bedore and Kajiura 2013; Kempster et al. 2013). However, it is important to recognize that most bioelectrical fields operate at frequencies on the order of 0.001 to 5 Hz, and fields with frequencies greater than 20 Hz are beyond the detection range of most electrosensitive organisms (Bedore and Kajiura 2013). For example, Kempster et al. (2013) observed behavioral responses in bamboo shark (*Chiloscyllium plagiosum*) embryos exposed to electrical fields of 0.004 to 0.02 mV/m at 0.1 to 1.0 Hz, emulating the bioelectric fields generated by predators, but no response to the same field strength at 20 Hz. These findings indicate that the 60-Hz electrical fields generated by the inter-array cable would not be detectable by elasmobranchs.

The evidence for magnetic field sensitivity in sharks and rays is more variable. Orr (2016) exposed the benthic draughts board shark (*Cephaloscyllium isabellum*) to a 50-Hz magnetic field operating at 14,300 mG and found no observable effects on foraging behavior. In contrast, Hutchinson et al. (2018; 2020) observed behavioral responses in little skate to induced magnetic fields on the order of 650 mG. The available research indicates that while the minimum magnet sensitivity of elasmobranchs is unknown, some species have exhibited observable behavioral responses to anthropogenic EMF at field strengths ranging between 250 and 1,000 mG (Hutchinson et al. 2018, 2020; Normandeau 2011). The induced electrical fields generated in even the largest individuals potentially exposed to these effects are less than those generated by muscular and nervous activity in living animals (approximately 10 mV/m) and are therefore likely indetectable (Adair et al. 1998)

Based on the above findings, it is reasonable to conclude that the EMF effects of the inter-array cable on EFH used by epibenthic and demersal pelagic skates and sharks would be insignificant. The 60-Hz electrical fields generated by the cable are above the known detection frequency limit of 20 Hz, while the maximum induced magnetic field and induced electrical field effects are orders of magnitude below the known or probable detection limits of these species. EFH for the following epibenthic and demersal pelagic shark and ray species would be exposed to insignificant EMF effects from the inter-array cable:

5.1.4.1.1.6 EMF Effects on Benthic Invertebrates

The inter-array cable corridor overlaps with EFH used by Atlantic sea scallop, Atlantic surf clam, and ocean quahog and these species are likely to be exposed to EMF and heat effects from inter-array cable operation. Similarly, the inshore segments of the export corridors may impact hard clams and bay scallops. Benthic infauna that provide prey resources for EFH-designated species would also be exposed to these effects. The potential for EMF effects on shellfish EFH and benthic infauna in general is of concern as these species are generally immobile or slow-moving and any exposures to measurable effects would be prolonged. The available information on invertebrate sensitivity to EMF effects is equivocal (Albert et al. 2020). For example, Ottoviani et al. (2002) and Malagoli et al. (2003, 2004) observed apparent disruption of cellular processes in mussels exposed to induced 50-Hz magnetic fields ranging from 3 to 10 mG for as little as 15 minutes, and Stankevičiūtė et al. (2019) observed apparent genotoxic and cytotoxic effects in infaunal clams and worms after 12 days of exposure to a 10 mG field at 50 Hz. In contrast, Bochert and Zettler (2006) observed no apparent effects on physiological condition or gonad development in mussels exposed to a 37 mG DC magnetic field for over 90 days. Cada et al. (2011) observed no effects on the behavior of clams exposed to 360 mG for 48 hours.

The preponderance of evidence suggests that the inter-array cable could produce sufficient EMF to have potentially adverse effects on bivalve physiology, but the specific sensitivity of EFH shellfish species likely to occur in the cable path remains unclear.

In addition to EMF effects, buried segments of the inter-array cable would generate sufficient heat to raise the temperature of the surrounding sediments by as much as 10 to 20 °C above ambient within 1.3 to 2 feet (0.4 to 0.6 meters) of buried cable segments. Substrate temperature changes of this magnitude could adversely affect habitat suitability for juvenile and adult life stages of Atlantic surf clam and ocean quahog (Acquafredda et al. 2019; Harding et al. 2008), as well as other benthic infauna species. However, because the inter-array cable would be buried to a minimum depth of 4 to 6 feet (1.2 to 1.8 meters) along the majority of its length, heat effects from buried cable segments on benthic infauna would likely be insignificant. Cable segments at the transitions between fully buried and exposed cable segments would be buried at shallower depths, potentially exposing quahog and surf clam habitat and infaunal prey species to adverse thermal effects. Where the cable is buried less than the 4 foot (1.2 meter) minimum target, it would require additional cable protection such as concrete mattresses or rock. This would adversely impact benthic habitat, basically rendering the thermal impact moot. Note however that suitability of these habitats for surf clam and quahog and benthic infauna in general would also be negatively affected by the overlying concrete mattresses so the areal extents of these two impacts are not additive.

The following bivalve species and life stages may be exposed to potentially adverse effects on EFH resulting from EMF and heat effects from inter-array cable operation:

5.1.4.1.2 OECRC

The EMF and substrate heating effects of the OECRC on EFH would vary depending on the respective cable voltage, the position of the cable on the seabed (i.e., buried to target depth or laid on bed surface), and how EFH is used by different life stages of EFH-designated species. The nature of these effects and the potential exposure of EFH used by fish and invertebrates occurring along the OECRC, and the rationale used to analyze these effects, are similar to those described for the inter-array cable.

5.1.4.1.2.1 EMF Effects on Habitats Used by Benthic and Epibenthic Eggs and Larvae

Several EFH species have benthic eggs and larvae that could settle in areas along the OECRC path, including both buried and exposed cable segments. The maximum induced magnetic field and electrical field generated by the inter-array cable are 76.6 mG and 5.4 mV/m at the bed surface immediately adjacent to exposed cable segments, respectively. Induced electrical field effects on eggs and larvae would be insignificant based on their small body size.

Applying the effect thresholds and rationale described for these life stages as described above, the maximum EMF exposure generated by the OECRC is orders of magnitude smaller than the lowest observed biological effect threshold in fish and shellfish eggs and larvae. On this basis, the EMF effects of the OECRC on EFH used by benthic and epibenthic eggs and larvae are likely to be insignificant. EFH species with habitats exposed to insignificant EMF effects from the OECRC are as follows:

5.1.4.1.2.2 EMF Effects on Habitats Used by Epibenthic Finfish and Flatfish

Several EFH species use benthic or epibenthic habitats within 3.3 feet (1 meter) of the seabed during their life cycle that overlap with the OECRC, including both buried and exposed cable segments. Epibenthic fish species that provide prey for EFH species also use these habitats. This indicates that these species could be exposed to the following EMF effects:

- Induced magnetic field: 30 to 76.6 mG at seabed above buried and exposed cable segments, respectively
- Electrical field: 2.1 to 5.4 mV/m at seabed above buried and exposed cable segments, respectively
- Induced electrical fields:
  - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.59 mV/m
  - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 1.05 mV/m

Applying the same thresholds described above, the largest potential EMF effects from the OECRC are orders of magnitude smaller than the lowest observed physiological and behavioral effects thresholds for EFH species and prey that use benthic and epibenthic habitats. On this basis, the EMF effects of inter-array cable operation on benthic and epibenthic habitats used by EFH finfish species would be insignificant. The following EFH species use the affected habitat during juvenile, adult, and/or spawning life stages:

5.1.4.1.2.3 EMF Effects on Demersal Habitats Used by Pelagic Finfish Species

Several pelagic fish species, including EFH species and their prey, may periodically use demersal habitats at or near 3.3 feet (1 meter) of the seabed during their respective life cycles. This may include habitats that overlap buried and exposed segments of the inter-array cable. This indicates that these species could be exposed to the following EMF effects:

- Induced magnetic field: 21 to 53.6 mG at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Electrical field: 1.4 to 3.6 mV/m at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Induced electrical fields at 3.3 feet (1 meter) above seabed:
  - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.25 mV/m
  - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 0.47 mV/m
  - Adults between 6 and 8.2 feet (1.8 and 2.5 meters) length: < 0.62 mV/m

Applying the effect thresholds and rationale presented in the previous section, the EMF effects of OECRC operation on near-bottom pelagic habitats used by EFH finfish species and their prey organisms would be insignificant. The following EFH species may periodically use the affected habitat during juvenile, adult, and/or spawning life stages:

5.1.4.1.2.4 EMF Effects on Demersal Habitats Used by Pelagic Invertebrates

One pelagic EFH invertebrate species, longfin squid, may periodically use demersal habitats at or near 3.3 feet (1 meter) of the seabed during its life cycle. This may include habitats overlapping buried and exposed segments of the inter-array cable. This indicates that this species could be exposed to the following EMF effects:

- Induced magnetic field: 21 to 53.6 mG at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Electrical field: 1.4 to 3.6 mV/m at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Induced electrical fields at 3.3 feet (1 meter) above seabed: Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.25 mV/m

Longfin squid prey on fish and other invertebrates within this same effect area, indicating that effects described for fish and invertebrates in previous and following sections would apply to prey species. Applying the effect thresholds and rationale presented in the previous section, the EMF effects of OECRC operation on near-bottom pelagic habitats used by squid and their prey would be insignificant. Longfin squid may periodically use the affected habitat during the designated juvenile and adult life stages.

5.1.4.1.2.5 EMF Effects on Demersal and Epibenthic Habitats Used by Skates and Sharks

Several EFH skate and shark species use demersal and epibenthic habitats overlapping the potential SFEC corridor alternatives during one or more life history stages. This indicates that these species may be exposed to the following EMF effects depending on their proximity to the seabed:

- Induced magnetic field:
  - 21 to 65.1 mG at seabed above buried and exposed cable segments, respectively
  - 9 to 27.9 mG at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Electrical field:
  - 1.4 to 4.3 mV/m at seabed above buried and exposed cable segments, respectively
  - 0.9 to 2.8 mV/m at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Induced electrical fields at seabed:
  - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.4 mV/m
  - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 0.74 mV/m
  - Adults between 6 and 8.2 feet (1.8 and 2.5 meters) length: < 1.02 mV/m
- Induced electrical fields at 3.3 feet (1 meter) above seabed
  - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.19 mV/m
  - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 0.31 mV/m
  - Adults between 6 and 8.2 feet (1.8 and 2.5) meters length: < 0.43 mV/m

Applying the effect thresholds and rationale presented in the previous section, the EMF effects of OECRC operation on demersal and epibenthic habitats used by EFH shark and skate species and their prey organisms would be insignificant. The following EFH species may periodically use the affected habitat during juvenile, adult, and/or spawning life stages:

5.1.4.1.2.6 EMF Effects Benthic Invertebrates

The SFEC route alternatives overlap with EFH used by Atlantic sea scallop, Atlantic surf clam, and ocean quahog, and these species are likely to be exposed to EMF and heat effects from OECRC operation. As described above, the preponderance of evidence suggests that the OECRC could produce sufficient EMF to have potentially adverse effects on invertebrate physiology, but the specific sensitivity of EFH shellfish species and benthic infaunal prey organisms that are likely to occur in the cable path remains unclear. The maximum induced magnetic field generated of 76.6 mG would attenuate to 1 mG within 32.8 feet (10 meters) of the cable.

Buried segments of the OECRC would generate sufficient heat to raise the temperature of the surrounding sediments by as much as 10 to 20 °C above ambient within 1.3 to 2 feet (0.4 to 0.6 meter) of buried cable segments. Temperature changes of this magnitude could adversely affect habitat suitability for juvenile and adult life stages of Atlantic surf clam and ocean quahog, and benthic infaunal prey species. However, because the SFEC would be buried to a minimum depth of 4 to 6 feet (1.2 to 1.8 meters) along the majority of its length, heat effects on juvenile and adult clams and other benthic infauna over buried cable segments would likely be insignificant. Cable segments at the transitions between fully buried and exposed cable segments would be buried at shallower depths, potentially exposing quahog and surf clam habitat and other benthic infauna to adverse thermal effects. As stated however, these areas would be covered by concrete mattresses and rendered unsuitable habitat for benthic infauna so the two effect areas are not additive.

The following bivalve species and life stages may be exposed to potentially adverse effects on EFH resulting from EMF and heat effects from inter-array cable operation:

- Atlantic sea scallop (egg, larvae, juvenile, adult)
- Atlantic surfclam (juvenile, adult)
- Ocean quahog (juvenile, adult)

5.1.4.2 Cable Protection

Community structure changes due to installation of cable protection is discussed in detail in Section 5.1.2.4.

5.1.4.3 Power Conversion

Ocean Wind is not utilizing High-voltage Direct Current offshore cables, so power conversion is not discussed.

5.2 Project Monitoring Activities

5.2.1 Passive Acoustic Monitoring

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 vehicle, or AUVs). Moored PAM systems include PAM buoys that would be anchored to the seabed using various types of anchors typically employed in a variety of marine research activities. Typical anchor types include small concrete blocks, steel rings, sandbags, or truck tires filled with cement. PAM systems are typically rigged with a surface float to allow for full retrieval of the buoy, rigging, and anchor system. These mooring systems would temporarily introduce new hard structures to the environment that could become colonized by benthic organisms, including invasive species. Encrusting organisms would be removed from the ecosystem upon removal of the PAM anchoring systems. Placement of the anchors would result in sediment disturbance and a short-term increase in suspended sediment near the anchors and would crush any organisms and habitat underneath the anchors. The effects of the anchors on EFH species and habitats would result in short-term and long-term impacts to EFH and managed species. The movement of autonomous PAM systems and the minimal sound they produce could disturb pelagic EFH and could affect pelagic and benthic managed species through collisions or by affecting behavior (e.g., inducing startle responses), but these impacts are very unlikely. Therefore, it is understood that PAM would not change the effects determination for EFH for any species in the EFH assessment.

5.2.2 Fisheries

5.2.2.1 Trawl Survey

The beam trawl survey would periodically disturb soft-bottom benthic habitat within a set of pre-selected tow tracks identified by experienced commercial fishers as suitable for this gear type. A total of 20 tows would be targeted seasonally within both the Lease Area and the control site, resulting in a target sample size of 160 tows per year (80 within the Lease Area and 80 within the control site). Trawl surveys are scheduled to occur throughout the year, including a winter survey, a spring survey, a summer survey, and a fall survey. The tracks surveyed during each event would be randomly selected from the available set for each site, modified as needed to avoid gear conflicts. The trawls 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. Target species include black sea bass, monkfish, summer flounder, scup, and Atlantic herring. This activity would directly affect EFH species and their prey through death 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 (Nilsson and Rosenberg 2003; Rosenberg et al. 2003). 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 whether or not the Fisheries Research Monitoring Plan (FRMP) is implemented.

Impacts to 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 (BOEM 2022).

5.2.2.2 eDNA Sampling

Ocean Wind is partnering with researchers from Monmouth University and St. Anselm’s College to carry out a comprehensive eDNA survey at the Lease Area. The eDNA sampling would occur synoptically with the trawl survey, enabling for a more holistic understanding of the relative abundance and composition of the species assemblage at the Ocean Wind Offshore Windfarm Project site. eDNA sampling is non-invasive and can be conducted without causing damage to the benthic habitat.

Two years of sampling (e.g., eight seasonal surveys) are planned prior the commencement of offshore construction. The eDNA survey would continue during the construction phase, and a minimum of 2 years of eDNA monitoring would be completed following offshore construction. eDNA sampling would be competed concurrently with trawl sampling. At each trawl survey sampling location in the Lease Area and the control area, an eDNA sample would also be collected. Therefore, during each seasonal sampling event, 40 samples would be targeted for collection in the Ocean Wind Offshore Windfarm Project impact area and the trawl survey control area.

Impacts to EFH species through eDNA collection would be non-invasive and is not expected to impact any individuals. BOEM therefore concludes that eDNA sampling would not change the effects determination for EFH for any species in the EFH assessment (BOEM 2022).

5.2.2.3 Multi-Method Survey for Structure-Associated Fishes

Target sampling dates would occur in January, April, July, and late September or early October. It is anticipated that 12-15 locations would be sampled over three days using each of the three methods. Locations would be located inside the Project area as well as at a nearby control site. At each location, chevron traps would be baited and placed in a group of six traps spaced 200 m apart and soak for 90 minutes. Each chevron trap would have a vertical buoy line. The BRUV method would occur concurrently at the same location as the chevron traps after the vessel anchors. The equipment used for BRUVs would include a weighted line attached to surface and subsurface buoys that would hold a stereo-camera system in the water column and a system at the seafloor. The BRUVs would be deployed for 60 minutes at each site. Simultaneously with the BRUV sampling, rod-and-reel sampling would be conducted from the stern using four to five rods with terminal tackle with baited hooks. Each angler would complete four to five 3-minute timed fishing “drops” at each sampling location, for a total of 16 to 25 drops at each location. Transits for the F/V Dana Christine II from its homeport in Barnegat Light, New Jersey to the Project area would be approximately one 90 nm round trip for each seasonal survey.

Fishing activity of the type described can damage benthic invertebrates on hard-bottom benthic habitat, resulting in long-term effects to community composition and complexity (Tamsett et al. 2010). However, hard-bottom benthic habitats within the WFA, including the survey area, are regularly targeted by commercial trap and pot fisheries. This indicates that habitat disturbance from trap and pot placement is routine within the WFA would continue to occur whether or not the FRMP is implemented. Moreover, the commercial fishing vessels contracted for the FRMP would likely be engaged in trap and pot fishing if not engaged in research. As such, trap and pot survey activities under the FRMP are not likely to measurably alter the extent or frequency of benthic habitat disturbance in the affected areas. Therefore, this activity is not likely to adversely alter the composition and complexity of EFH relative to the environmental baseline and any associated effects would be insignificant relative to those likely to result from the effects of WFA construction and operation. BOEM therefore concludes that these surveys would not change the effects determination for EFH for any species in the EFH assessment (BOEM 2022).

5.2.2.4 Clam Survey

A robust commercial ocean quahog and surfclam fishery currently exists within the WFA, therefore, similar dredging activities already regularly occur. The towed sampling dredge would cause localized and direct impacts to benthic EFH on both hard and soft-bottom habitat, resulting in potentially long-term effects on community composition. Soft-bottom impacts would be short-term and expected to recover quickly. BOEM therefore concludes that these surveys would not change the effects determination for EFH for any species in the EFH assessment (BOEM 2022).

5.2.2.5 Pelagic Fish Survey

The pelagic fish survey would employ two methods, towed BRUVs and autonomous gliders. One glider deployment would be conducted during each of the three Project phases: pre-construction, during construction, and post-construction. Glider deployment would occur in October, coinciding with one of the other vessel-based surveys, and span three to four weeks. The second survey method in the pelagic fish survey (BRUVs) would occur from all survey vessels of opportunity (e.g., trawl survey vessel, clam survey vessel, glider deployment vessel, structure-associated habitat survey vessel) while underway. This survey would not result in additional vessel traffic. The survey techniques themselves would not cause any impacts to EFH or EFH-designates species. BOEM therefore concludes that these surveys would not change the effects determination for EFH for any species in the EFH assessment (BOEM 2022).

5.2.2.5.1 Acoustic Telemetry

The acoustic telemetry survey would cover the Ocean Wind lease area and adjacent inshore areas. Tagging efforts would not increase vessel transits as they would occur aboard the trawl, trap, or hook and line sampling vessels. The sole increase to vessel traffic for this survey component would be the towing of the omni-directional hydrophone during the four trips per year by the 25 feet R/V Resilience. Transits for the R/V Resilience are unclear, as it is able to be driven on a trailer to a nearby boat ramp. This EFH assessment assumes a nearby boat ramp from Ocean City or Atlantic City would be chosen resulting in an approximately 42-46 nm round trip transit per survey event. BOEM therefore concludes that these surveys would not change the effects determination for EFH for any species in the EFH assessment (BOEM 2022).

5.2.3 Benthic Habitat

Benthic survey activities include the use of SPI/PV equipment and an ROV to produce video recordings. The SPI/PV system would penetrate soft-bottom habitat to collect a plan view image of the subsurface substrate composition, which could impact EFH by crushing benthic organisms, disturbing soft-bottom habitat, and creating a short-term increase in suspended sediment. The movement of the ROV through the water, sound and lights produced by the ROV, and lights produced by the SPI/PV system, could disturb pelagic EFH and could affect pelagic and benthic species through collisions or by affecting behavior (e.g., inducing startle responses), but these impacts are very unlikely. It is understood that benthic surveys would not change the effects determination for EFH for any species in the EFH assessment.

5.3 Decommissioning

A separate EFH consultation would be conducted for the decommissioning phase of the Project. Decommissioning of the Project would include removal of all structures above the seabed in a general reversal of the installation activities. Similar equipment and number of vessels to those used during construction would be used to remove infrastructure. The OSS would be decommissioned by dismantling and removing its topside and foundation (substructure). As with the turbine components, this operation would be a reverse installation process subject to the same constraints as the original construction phase. It is anticipated that monopole foundations would be cut below the seabed level in accordance with standard practices at the time of demolition, which may include mechanical cutting, water jet cutting, or other industry standing practices. Removal of structures during decommissioning as well as vessel anchoring could cause injury or mortality to fish and EFH-designated species. Removal of turbine foundations would mean loss of the unique hard substrate and vertical habitat that had established itself over the life of the Project.

The scour protection placed around the base of each monopile would be removed during decommissioning, according to the best practices applicable at the time of decommissioning.

Offshore cables would either be left in situ or removed, or a combination of both, depending on the regulatory requirements at the time of decommissioning. It is anticipated that the array cables would be removed using CFE or a grapnel to lift them from the seabed. Alternatively, depending on available technology, an ROV may be used to cut the cable so that it can be recovered to the vessel. The export cables would be left in situ or wholly/partially removed. Any cable ends would be weighed down and buried if the cables are to be left in situ to ensure that the ends are not exposed or have the potential to become exposed post-decommissioning. Cables may be left in situ in certain locations, such as pipeline crossings, to avoid unnecessary risk to the integrity of the third-party cable or pipeline. The removal of cables has the potential to result in short-term localized disturbance and resuspension of benthic sediments.

These impacts to fish and EFH-designated species are anticipated to be short term and localized due to the disturbance of a relatively small area and would not cause long-term impacts once decommissioning activities are completed. Pelagic fish species are anticipated to avoid the area during Project decommissioning activities. Benthic and pelagic finfish species are anticipated to move back into the area. However, benthic habitat that serves as forage area for bottom-dwelling species may take longer to recover to pre-impact conditions. Successional epifaunal and infaunal species are anticipated to recolonize the sediments, gradually providing the continuation of foraging habitat for fish and EFH-designated species. Fish and invertebrate communities would transition back to a sandy, soft-bottom community structure, recolonizing from the surrounding sandy bottom habitat.

There would be short-term increases in sediment suspension and deposition during bottom disturbance activities. These increases in sediment suspension and deposition may cause short-term adverse impacts to mobile fish and EFH-designated species because of decrease in habitat quality for benthic species. Less mobile egg and larval life stages may experience injury or loss of individuals similar to that described for construction. Juveniles and adults are anticipated to vacate the habitat due to suspended sediment levels in the water column and avoid impact. Pelagic habitat quality and EFH is expected to quickly return to pre-disturbance levels.

Increased underwater noise during construction would primarily be associated with structure removal activities which may include mechanical cutting, water jet cutting, or other industry standing practices. The noise produced by the pile cutting activities is not expected to be impulsive and is therefore unlikely to produce noise levels with the potential for injury. The elevated noise levels may make the habitat temporarily less suitable and may cause fish and EFH-designated species to temporarily vacate the Project area during decommissioning activities. This impact is anticipated to be short-term and limited to the location of active pile removal which represents a small portion of the total available habitat. Further, short-term impacts to EFH-designated species are expected for mobile species that can detect sound associated with vessel or other decommissioning activity noises. These adverse impacts are anticipated to be similar and short-term in nature to the current noise levels of vessels that transit the area. Direct impacts to fish and EFH-designated species may result from a degradation of habitat for species that vacate the area during increased noise levels during Project decommissioning activities. Both pelagic and demersal life stages would experience a short-term impact from vessel and other decommissioning activity noise.

5.4 Cumulative and Synergistic Effects on EFH

The primary impact of the Project would be from 98 WTG foundations, which would be constructed in mostly sandy seafloor. New structures could affect migration through the area of species that prefer complex habitat by providing unique complex features (relative to the primarily sandy seafloor). This could lead to retention of those species and possibly impact spawning opportunities. However, it is also possible that the new structures would provide additional habitat benefit as a result of habitat conversion from non-complex habitat to complex habitat. Complex habitat and its associated fish communities is limited in the Mid-Atlantic, and it is possible that additional habitat would expand these fish communities. The structures would create an “artificial reef effect,” whereby more sessile and benthic organisms would likely colonize these structures over time (e.g., sponges, algae, mussels, shellfish, sea anemones). Higher densities of invertebrate colonizers would provide a food source and habitat to other invertebrates such as mobile crustaceans. With new foundations being added from additional offshore wind farms, EFH for fishes and invertebrates adapted to complex habitat would increase, but at the expense of EFH for soft-bottom fishes.

Construction and installation, O&M, and decommissioning of the Project would have short-term, long-term, and permanent direct and indirect impacts on EFH in the Project area. Project activities would extend over several years, and could result in extended periods, or multiple shorter sequential periods, when activities are being conducted in the same area, leading to the potential for cumulative and synergistic impacts.

6. Avoidance and Minimization Measures

This section outlines APMs proposed by Ocean Wind and additional environmental protection measures (EPMs) that BOEM could impose, which are intended to avoid and/or minimize potential impacts to EFH-designated species and EFH. Relevant APMs and mitigation measures, contributions to avoiding and/or minimizing adverse effects on EFH, and supporting rationale are summarized by Project component in Table 6-1. EPMs that BOEM could impose are included in Table 6-2. These measures are based on protocols and procedures that were successfully implemented for other offshore wind (OSW) projects, and align with existing BOEM recommended best management practices (BMPs).[6] BOEM may choose to incorporate one or more EPMs in the record of decision and adopt those measures as conditions of COP approval.

[6] Described in Attachment A of Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan (COP) (2016).

Table 6-1 APMs for Construction and Operation of the WFA, OECRC, and IECRC Project Components

APM No.*	Proposed APMs and Mitigation Measures to Avoid and Minimize Impacts	Project Components				Expected Effects
		WFA	OECRC	IECRC	Onshore Cable	
GEN-02	Site onshore, cable landfall and offshore facilities to avoid known locations of sensitive habitat (such as known nesting beaches) or species during sensitive periods (such as nesting season); important marine habitat (such as high density, high value fishing grounds as determined by fishing revenues estimate [BOEM Geographical Information System (GIS)]); and sensitive benthic habitat; to the extent practicable. Avoid hard-bottom habitats and seagrass communities, where practicable, and restore any damage to these communities.	X	X	X	X	Minimize impacts to sensitive and slow to recover habitats utilized by EFH-designated species. This measure limits impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, and Section 5.1.2 Inter-Array and Export Cable Installation.
GEN-03	Avoid areas that would require extensive seabed or onshore alterations to the extent practicable.	X	X	X	X	This measure limits impacts to EFH and EFH species by minimizing the extent of direct habitat impacts. This measure limits impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, and Section 5.1.2 Inter-Array and Export Cable Installation.
GEN-04	Bury onshore and offshore cables below the surface or seabed to the extent practicable and inspect offshore cable burial depth periodically during project operation, as described in the Project Description, to ensure that adequate coverage is maintained to avoid interference with fishing gear/activity.	X	X	X	X	This measure would protect the inter-array cables and offshore export cables from damage and further help to minimize impacts to EFH. This measure limits impacts discussed in Section 5.1.2 Inter-Array and Export Cable Installation.

APM No.*	Proposed APMs and Mitigation Measures to Avoid and Minimize Impacts	Project Components				Expected Effects
		WFA	OECRC	IECRC	Onshore Cable	
GEN-05	Use existing port and onshore operations and maintenance (office, warehouse, and workshop) facilities to the extent practicable and minimize impacts to seagrass by restricting vessel traffic to established traffic routes where these resources are present.	X	X	X	X	This measure limits direct and indirect vessel-related impacts to EFH and EFH species. This measure limits impacts discussed in Section 5.1.1.1 Vessel Activity and Section 5.1.2.1 Vessel Activity.
GEN-06	Develop and implement a site-specific monitoring program to ensure that environmental conditions are monitored during construction, operation, and decommissioning phases, designed to ensure environmental conditions are monitored and reasonable actions are taken to avoid and/or minimize seabed disturbance and sediment dispersion, consistent with permit conditions. The monitoring plan will be developed during the permitting process, in consultation with resource agencies.	X	X	X	X	This measure would minimize impacts on EFH and EFH species from turbidity and water quality reduction. This measure limits impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, Section 5.1.2 Inter-Array and Export Cable Installation, Section 5.1.3 Operation/Presence of Structures, and Section 5.1.4 Operation/Presence of Inter-Array Cables.
GEN-08	To the extent practicable, use appropriate installation technology designed to minimize disturbance to the seabed and sensitive habitat (such as beaches and dunes, wetlands and associated buffers, streams, hard-bottom habitats, seagrass beds, and the nearshore zone); avoid anchoring on sensitive habitat; and implement turbidity reduction measures to minimize impacts to sensitive habitat from construction activities.	X	X	X	X	Limits impacts to EFH and EFH species by minimizing the extent and duration of direct habitat impacts and reducing suspended sediment effects on EFH species. This measure would minimize the impact of vessel anchorage to EFH and EFH species. This measure limits impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, and Section 5.1.2 Inter-Array and Export Cable Installation.

APM No.*	Proposed APMs and Mitigation Measures to Avoid and Minimize Impacts	Project Components				Expected Effects
		WFA	OECRC	IECRC	Onshore Cable	
GEN-09	During pile-driving activities, use ramp up procedures as agreed with National Marine Fisheries Service (NMFS) for activities covered by Incidental Take Authorizations, allowing mobile resources to leave the area before full-intensity pile-driving begins.	X	-	-	-	The reduction in sound pressure levels (SPLs) would reduce the area of effects to EFH species and the prey they feed upon. This measure limits impacts discussed in Section 5.1.1.2 Pile Driving.
GEN-10	Prepare waste management plans and hazardous materials plans as appropriate for the Project.	X	X	X	X	Avoids adverse effects on EFH from impacts to water quality. This measure limits impacts discussed in Section 5.1.1.1 Vessel Activity and Section 5.1.2.1 Vessel Activity.
GEN-11	Establish and implement erosion and sedimentation control measures in a Stormwater Pollution Prevention Plan (SWPPP, authorized by the State), and Spill Prevention, Control, and Countermeasures (SPCC) Plan to minimize impacts to water quality signed/sealed by a New Jersey Professional Engineer and prepared in accordance with applicable regulations such as NJDEP Site Remediation Reform Act, Linear Construction Technical Guidance, and Spill Compensation and Control Act). Development and implementation of an Oil Spill Response Plan (OSRP, part of the SPCC plan) and SPCC plans for vessels.	X	X	X	X	Avoids adverse effects on EFH from impacts to water quality. This measure limits impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, and Section 5.1.2 Inter-Array and Export Cable Installation.

APM No.*	Proposed APMs and Mitigation Measures to Avoid and Minimize Impacts	Project Components				Expected Effects
		WFA	OECRC	IECRC	Onshore Cable	
GEN-12	Where HDD trenchless technology methods are used, develop, and implement an Inadvertent Return Plan that includes measures to prevent inadvertent returns of drilling fluid to the extent practicable and measures to be taken in the event of an inadvertent return.	-	-	X	X	Avoids adverse effects on EFH from impacts to water quality. This measure limits impacts discussed in Section 5.1.2.3 Trenching/Cable Installation.
GEN-13	Restore disturbance areas in the Onshore Project Area to pre-existing contours (maintaining natural surface drainage patterns) and allow vegetation to become reestablished once construction activities are completed, to the extent practicable.	-	-	-	X	Avoids adverse effects on EFH from impacts to water quality by maintaining existing movement patterns of water in the watershed.

APM No.*	Proposed APMs and Mitigation Measures to Avoid and Minimize Impacts	Project Components				Expected Effects
		WFA	OECRC	IECRC	Onshore Cable	
GEN-16	Prior to the start of operations, Ocean Wind will hold training to establish responsibilities of each involved party, define the chains of command, discuss communication procedures, provide an overview of monitoring procedures, and review operational procedures. This training will include all relevant personnel, crew members and protected species observers (PSO). New personnel must be trained as they join the work in progress. Vessel operators, crew members and protected species observers shall be required to undergo training on applicable vessel guidelines and the standard operating conditions. Ocean Wind will make a copy of the standard operating conditions available to each project-related vessel operator. Prior to the start of operations, Ocean Wind will implement a Navigational Safety and Training program that addresses navigational safety by providing eligible commercial, charter, and for-hire fishing vessels operating in and near the Wind Far Area with reimbursement for new radar equipment and/or training courses. Navigation equipment will include Pulse Compression Radar Systems and/or AIS transceivers. Professional training and experiential learning for fishermen may include: Captain course, license upgrade, radar course, or rules of the road refresher training.	X	X	X	-	This measure limits direct and indirect vessel-related impacts to EFH and EFH species. This measure limits impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, and Section 5.1.2 Inter-Array and Export Cable Installation.

APM No.*	Proposed APMs and Mitigation Measures to Avoid and Minimize Impacts	Project Components				Expected Effects
		WFA	OECRC	IECRC	Onshore Cable	
GEN-17	Implement Project and site-specific safety plans (Safety Management System).	X	X	X	X	This measure limits direct and indirect vessel-related impacts to EFH and EFH species.
GEO-01	Reduce scouring action by ocean currents around foundations and to seabed topography by taking reasonable measures and employing periodic routine inspections to ensure structural integrity.	X	-	-	-	This measure would minimize impacts on EFH and EFH species from turbidity and water quality reduction. This measure limits impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, and Section 5.1.3 Operation/Presence of Structures.
GEO-02	Take reasonable actions (use BMPs) to minimize seabed disturbance and sediment dispersion during cable installation and construction of project facilities.	X	X	X	-	This measure would minimize impacts on EFH and EFH species from turbidity and water quality reduction. This measure limits impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, and Section 5.1.2 Inter-Array and Export Cable Installation.
GEO-03	Conduct periodic and routine inspections to determine if non-routine maintenance is required.	X	X	X	X	This measure would minimize impacts on EFH and EFH species from turbidity and water quality reduction. This measure limits impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, Section 5.1.2 Inter-Array and Export Cable Installation, Section 5.1.3 Operation/Presence of Structures, and Section 5.1.4 Operation/Presence of Inter-Array Cables.

APM No.*	Proposed APMs and Mitigation Measures to Avoid and Minimize Impacts	Project Components				Expected Effects
		WFA	OECRC	IECRC	Onshore Cable	
GEO-04	In contaminated onshore areas, comply with State regulations requiring the hiring of a Licensed Site Remediation Professional (LSRP) to oversee the linear construction project and adherence to a Materials Management Plan (MMP). The MMP prepared for construction can also be followed as a best management practice when maintenance requires intrusive activities.	-	-	-	X	This measure would minimize impacts on EFH and EFH species from contamination
WQ-01	Implement turbidity reduction measures to minimize impacts to hard-bottom habitats, including seagrass communities, from construction activities, to the extent practicable.	X	X	X	-	This measure would minimize impacts on EFH and EFH species from turbidity and water quality reduction. This measure limits impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, and Section 5.1.2 Inter-Array and Export Cable Installation.
WQ-02	All vessels will be certified by the Project to conform to vessel operations and maintenance protocols designed to minimize the risk of fuel spills and leaks.	X	X	X	-	Avoids adverse effects on EFH from impacts to water quality. This measure limits impacts discussed in Section 5.1.1.1 Vessel Activity and Section 5.1.2.1 Vessel Activity.
TCHF-01	Coordinate with the New Jersey Department of Environmental Protection (NJDEP) and United States Fish and Wildlife Service (USFWS) to identify unique or protected habitat or known habitat for threatened or endangered and candidate species and avoid these areas to the extent practicable.	X	X	X	X	Consideration of benthic habitat would reduce impacts to sensitive habitats utilized by EFH species. This measure limits impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, and Section 5.1.2 Inter-Array and Export Cable Installation.

APM No.*	Proposed APMs and Mitigation Measures to Avoid and Minimize Impacts	Project Components				Expected Effects
		WFA	OECRC	IECRC	Onshore Cable	
TCHF-02	Conduct maintenance and repair activities in a manner to avoid or minimize impacts to sensitive species and habitat such as beaches, dunes, and the nearshore zone.	-	X	X	X	This measure would minimize the effects on EFH and EFH species from direct and indirect impacts related to project maintenance and repair activities. This measure limits impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, Section 5.1.2 Inter-Array and Export Cable Installation, Section 5.1.3 Operation/Presence of Structures, and Section 5.1.4 Operation/Presence of Inter-Array Cables.
TCHF-03	Wetland mitigation options are being coordinated with state and federal agencies and may include a mix of banking and onsite restoration, depending on agency preference and availability.			X	X	
BENTH-01	Ocean Wind is conducting appropriate pre-siting surveys to identify and characterize potentially sensitive seabed habitats and topographic features.	X	X	X	X	This measure would minimize the effects on EFH and EFH species from direct and indirect impacts related to project construction. This measure limits impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, and Section 5.1.2 Inter-Array and Export Cable Installation.
BENTH-02	Use standard underwater cables which have electrical shielding to control the intensity of electromagnetic fields (EMF). EMF will be further refined as part of the design or cable burial risk assessment.	X	X	X	X	This measure would minimize impacts to EFH and EFH species from EMF. This measure limits impacts discussed in Section 5.1.4 Operation/Presence of Inter-Array and Offshore Export Cables.

APM No.*	Proposed APMs and Mitigation Measures to Avoid and Minimize Impacts	Project Components				Expected Effects
		WFA	OECRC	IECRC	Onshore Cable	
BENTH-03	Conduct a submerged aquatic vegetation (SAV) survey of the proposed inshore export cable route	-	X	X	-	Consideration of benthic habitat would reduce impacts to sensitive habitats utilized by EFH species. This measure limits impacts discussed in Section 5.1.2 Inter-Array and Export Cable Installation.
FISH-01	Evaluate geotechnical and geophysical survey results to identify sensitive habitats (e.g., shellfish and SAV beds) and avoid these areas during construction, to the extent practicable.	X	X	X	-	Consideration of benthic habitat would reduce impacts to sensitive habitats utilized by EFH species. This measure limits impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, and Section 5.1.2 Inter-Array and Export Cable Installation.
FISH-02	Ocean Wind will coordinate with NJDEP, NMFS and USACE regarding time of year restrictions for winter flounder and river herring, as well as summer flounder habitat areas of particular concern (HAPC).	X	X	X	-	This measure could minimize the effects on EFH and EFH species from direct and indirect impacts related to project construction. This measure could limit impacts discussed in Section 5.1.1 Installation of WTG/OSS Structures and Foundations, and Section 5.1.2 Inter-Array and Export Cable Installation.
Impact Pile Driving **	The Project will use a dual noise mitigation (NMS) system for all impact piling events. The NMS will be a combination of two devices (e.g., bubble curtain, hydro-damper) to reduce noise propagation during pile driving. The Project is committed to achieving ranges associated with 10 dB during impact noise attenuation.	X	-	-	-	This measure would minimize impacts to EFH and EFH species from direct and indirect impacts by reducing the area of underwater noise effects during impact pile driving. This measure could minimize impacts from impact pile driving as discussed in Section 5.1.1.2.

APM No.*	Proposed APMs and Mitigation Measures to Avoid and Minimize Impacts	Project Components				Expected Effects
		WFA	OECRC	IECRC	Onshore Cable	
UXO**	For UXO detonations, Ocean Wind will use a noise mitigation system for all detonation events and is committed to achieving the modeled ranges associated with 10 dB of noise attenuation. Additionally, seasonal timing restriction from January through April, and post-detonation monitoring for injured and/or dead fish will be used for all UXO detonations.	X	X	-	-	These measures would minimize the impacts of UXO detonations discussed in Section 5.1.1.3 and 5.1.2.3 on EFH and EFH species from direct and indirect impacts related to site clearance activities for the WFA and OECRC.

Source: Modified from COP, Volume II, Table 1.1-2; Ocean Wind 2022a
* APM number corresponds with the APM numbers assigned in the COP, Volume II, Table 1.1-2.
**APM from Table H-1, Appendix H, Ocean Wind 1 Draft Environmental Impact Statement.
APM = applicant proposed measure; EFH = essential fish habitat; HDD = horizontal directional drill; HRG = high-resolution geophysical survey; IECRC = Inshore Export Cable Route Corridor; OECRC = Offshore Export Cable Route Corridor; WFA = Wind Farm Area

Table 6-2 Measures that BOEM could impose: General Avoidance/Minimization of Potential Impacts to EFH

Proposed EPMs and Mitigation Measures to Avoid and Minimize Impacts	Project Components				Expected Effects
	WFA	OECRC	IECRC	Onshore Cable	
Live and Hard Bottom Impact Monitoring – The Lessee would develop and implement a monitoring plan for live and hard-bottom features that may be affected by proposed activities. The monitoring plan would also include assessing the recovery time for these sensitive habitats. BOEM recommends that all monitoring reports classify substrate conditions following the Coastal and Marine Ecological Classification Standards (CMECS), including live bottoms (e.g., submerged aquatic vegetation and corals and topographic features. The plan would also include a means of recording observations of any increased coverage of invasive species in the affected hard-bottom areas.	X	X	X	-	This measure maximizes recovery of disturbed areas and protect EFH and EFH species from additional impacts.
Live and Hard Bottom Habitat Mapping and Avoidance – Vessel operators would be provided with maps of sensitive hard-bottom habitat in OSW project area, as well as a proposed anchoring plan that would avoid or minimize impacts on the hard-bottom habitat to the greatest extent practicable. These plans would be provided for all anchoring activity, including construction, maintenance, and decommissioning.	X	X	X	-	This measure limits direct and indirect vessel-related impacts to EFH and EFH species.

Proposed EPMs and Mitigation Measures to Avoid and Minimize Impacts	Project Components				Expected Effects
	WFA	OECRC	IECRC	Onshore Cable	
Intake Screens on Pump Intakes for In-shore Hydraulic Dredges – All hydraulic dredge intakes should be covered with a mesh screen or screening device that is properly installed and maintained to minimize potential for impingement or entrainment of fish species. The screening device on the dredge intake should prevent the passage of any material greater than 1.25" in diameter, with a maximum opening of 1.25"x 6". Water intakes should be positioned at an appropriate depth to avoid or minimize the entrainment of eggs and larvae. Intake velocity should be limited to less than 0.5 ft/sec.	-	-	X	-	This measure minimizes potential for impingement or entrainment of fish species.
Scour and Cable Protection – To the extent technically and economically feasible, the Lessee must ensure that all materials used for scour and cable protection consist of natural or engineered stone that does not inhibit epibenthic growth. The materials selected for protective purposes should mirror the natural environment and provide similar habitat functions.	X	X	X	-	Smaller long-term project footprint limits impacts to EFH and EFH species by minimizing the extent of direct habitat impacts.

EFH = essential fish habitat; EPM = environmental protection measure; HDD = horizontal directional drill; HRG = high-resolution geophysical survey; IECRC = Inshore Export Cable Route Corridor; OECRC = Offshore Export Cable Route Corridor; WFA = Wind Farm Area

6.1 UXO/MEC Mitigation

In the event that MEC/UXO are identified during pre-construction surveys. BOEM has determined that the likelihood of MEC/UXO encounter is very low, but the potential risk and the related contingency plan should be considered. Prior to seafloor preparation, cable routing, and micrositing planning, Ocean Wind would implement a MEC/UXO Risk Assessment with Risk Mitigation Strategy (RARMS) designed to evaluate and reduce risk in accordance with the As Low As Reasonably Practicable (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. Avoidance is proposed as the preferred approach for MEC/UXO mitigation; however, 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 micrositing. During Project construction, once the ALARP standard has been achieved, the likelihood of MEC/UXO encounter is very low. Ocean Wind would work with BOEM to identify appropriate response actions, which may include developing an emergency response plan, conducting MEC/UXO specific safety briefings, or retaining an on-call MEC/UXO consultant. In such situations, confirmed MEC/UXO may be removed through physical relocation to another suitable location on the seabed within the area of potential effect or previous designated disposal areas for wet storage using a "Lift and Shift" operation. Selection of a mitigation strategy 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. Demolition of up to 10 MEC/UXO may be necessary. Safety measures such as the use of guard vessels, enforcement of safety zones, and others would be identified in consultation with a MEC/UXO specialist and the appropriate agencies and implemented as directed.

The RARMS process would effectively avoid explosion-related risks to EFH in the unlikely event that MEC/UXO are discovered within the construction footprint. However, should MEC/UXO hazards be identified, the measures taken could lead to changes in the Project design and/or other effects on EFH that were not considered in this EFH assessment (BOEM 2021). Specifically, the discovery of MEC/UXO could lead to re-routing of cable routes and/or shifting the location of monopile foundations and scour protection, as avoidance is the preferred RARMS mitigation measure. There may be instances where avoidance of confirmed MEC/UXO hazards is not practicable due to a variety of factors. Should this occur, Ocean Wind would work with BOEM to identify appropriate response actions, which may include removal and relocation to a previously designated disposal site or other suitable location on the seabed. Selection of a mitigation strategy 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. If demolition is necessary, APMs including a dual noise-mitigation system with 10 dB attenuation, seasonal restrictions between January and April, and post-detonation monitoring for injured and/or dead fish would be implemented (see Table 6-1).

6.2 Submerged Aquatic Vegetation (Summer Flounder HAPC) Avoidance, Minimization, and Mitigation

The Project would avoid, minimize, and mitigate impacts to SAV (summer flounder HAPC), to the extent practicable, in the following ways:

- Inshore export cables installed partially via HDD would allow the Project to avoid areas of SAV during construction on the eastern and western shorelines of Barnegat Bay and in Peck Bay.

- The Project construction schedule includes in-water work within known SAV habitat scheduled to be conducted late fall through early spring, outside the SAV growing season.
- BMPs would be implemented for construction activities within 500 feet of SAV beds, and include measures such as: silt curtains along shallow areas to the maximum extent practicable (based on hydrodynamics and water depth); utilization of a closed environmental clamshell bucket equipped with sensors during dredging activities; adaptively managing installation speed/jetting pressure during cable lay to minimize sediment resuspension; and water quality (TSS and turbidity) monitoring.
- Ocean Wind would develop and implement a site-specific monitoring program to ensure that environmental conditions are monitored before and after construction to determine the amount of SAV restoration required. If required based on monitoring results, restoration may include the following: onsite in-kind restoration (e.g., transplanting or seed dispersion to restore the disturbed area to its pre-construction contours and conditions); offsite in-kind restoration; onsite ecological enhancement of similar ecological function and value. Other options may include permittee-responsible mitigation through stakeholder mitigation projects to be coordinated with NJDEP, NOAA, and USACE.
- Ocean Wind would implement the Submerged Aquatic Vegetation (SAV) Monitoring Plan (Inspire 2022c). This plan, which is described in detail in Section 2.5.5, is designed to document baseline delineations and conditions of SAV beds, assess potential impacts to these SAV beds as a result of the construction and operations of the inshore export cable(s) associated with the Project, and track recovery of these SAV beds over time to inform potential mitigation strategies. Survey protocols and methodologies were developed with input from stakeholder groups, including NJDEP, NOAA, and BOEM.
- Ocean Wind would implement the SAV Mitigation Plan dated November 2022 (Ocean Wind 2022d), which includes mapping efforts, pre- and post-construction monitoring activities, restoration, and annual reporting. Restoration activities are proposed to address the goal of a 3:1 mitigation ratio where permanent impacts are realized on existing SAV. Restoration will be undertaken directly in areas of impact (1:1) in addition to mitigation in additional areas (2:1) that have experienced declines in SAV coverage due to factors other than Ocean Wind construction activities. The SAV Mitigation Plan identifies nine parcels as potential sites for SAV restoration, which include seven on the western side of Barnegat Bay and two near or within the Sedge Island Management Area near Barnegat Inlet on the eastern side of the bay. These sites will be evaluated for mitigation efforts based on site conditions, coordination with agencies, and coordination with local experts. Mitigation sites will be prioritized by proximity to direct project impacts, however alternative sites may be proposed in coordination with the appropriate agencies. Restoration activities would be scheduled after construction activities at the sites have been completed. Seeds from suitable donor beds would be identified, collected from plants during the summer and stored until the fall, and then dispersed in fall (October-November) for the best chance of success, as well as to avoid other harmful impacts to estuarine species such as winter flounder and anadromous fish. The likely method of seed dispersion involves spreading by hand from a shallow-draft vessel, or via personnel wading in shallow waters. Monitoring efforts of SAV would begin in 2023 (pre-construction phase) and continue annually throughout construction and into the post-construction phase (2024-2033). Monitoring would occur both in areas where restoration activities occurred and those where no impacts occurred. This will allow the opportunity to assess the degree of restoration success as well as provide insight to any additional indirect impacts that may have occurred during construction or impacts from additional activities near the project site. Reports will be generated to provide a record of progress and make recommendation for future actions or adjustment to the mitigation plan. Two sets of annual reports will be generated: one detailing activities and objectives for the following year, and one annual report detailing actions from the previous year, including an assessment of goals and progress. At the

conclusion of SAV mitigation (anticipated 2033), a final synthesis document will be compiled for the entire project.

6.3 Alternative Project Designs that Could Avoid/Minimize Impacts

The following section discusses alternative turbine layouts and export cable route proposed for the Project. Although all alternatives are not specifically geared toward reducing the impacts on EFH, these alternatives would still benefit and minimize impacts to EFH. To provide additional context to the acres calculated for maximum potential impacts of each alternative, tallies of benthic habitat types by modifiers and by NOAA Habitat Complexity Category are provided in Table 10.2-6 and Table 10.2-7 of Appendix 10.2 of this document.

6.3.1 Alternative B—No Surface Occupancy at Select Locations to Reduce Visual Impacts

Alternative B was developed through the scoping process for the Draft EIS in response to public comments concerning the visual impacts of the Project. Under Alternative B, no surface occupancy would occur at select WTG positions to reduce the visual impacts of the proposed Project. The range of design parameters for Project components and activities to be undertaken for construction and installation, O&M, and conceptual decommissioning would be the same as described for the Proposed Action. Alternative B includes two sub-alternatives to account for two different turbine sizes and power-generating capabilities. Each of the below sub-alternatives may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need. Both sub-alternatives would include fewer turbines than the proposed turbine layout, resulting in a smaller impact footprint and a reduction in impacts to EFH.

- **Alternative B-1:** No Surface Occupancy at Select Locations to Reduce Visual Impacts (Smaller Turbine Model) (Figure 6-1). This alternative would exclude placement of WTGs at up to nine WTG positions that are located nearest to coastal communities (positions F01 to K01 and B02 to D02).
- **Alternative B-2:** No Surface Occupancy at Select Locations to Reduce Visual Impacts (Larger Turbine Model) (Figure 6-2). This alternative would exclude placement of WTGs at up to 19 WTG positions C03 that are located nearest to coastal communities (positions F01 to K01, A02 to K02, A03). Selection of this alternative would be contingent on the larger turbine with a 240-meter rotor diameter being commercially available when BOEM issues its record of decision as well as its technical and economic feasibility, and consistency with the purpose and need.

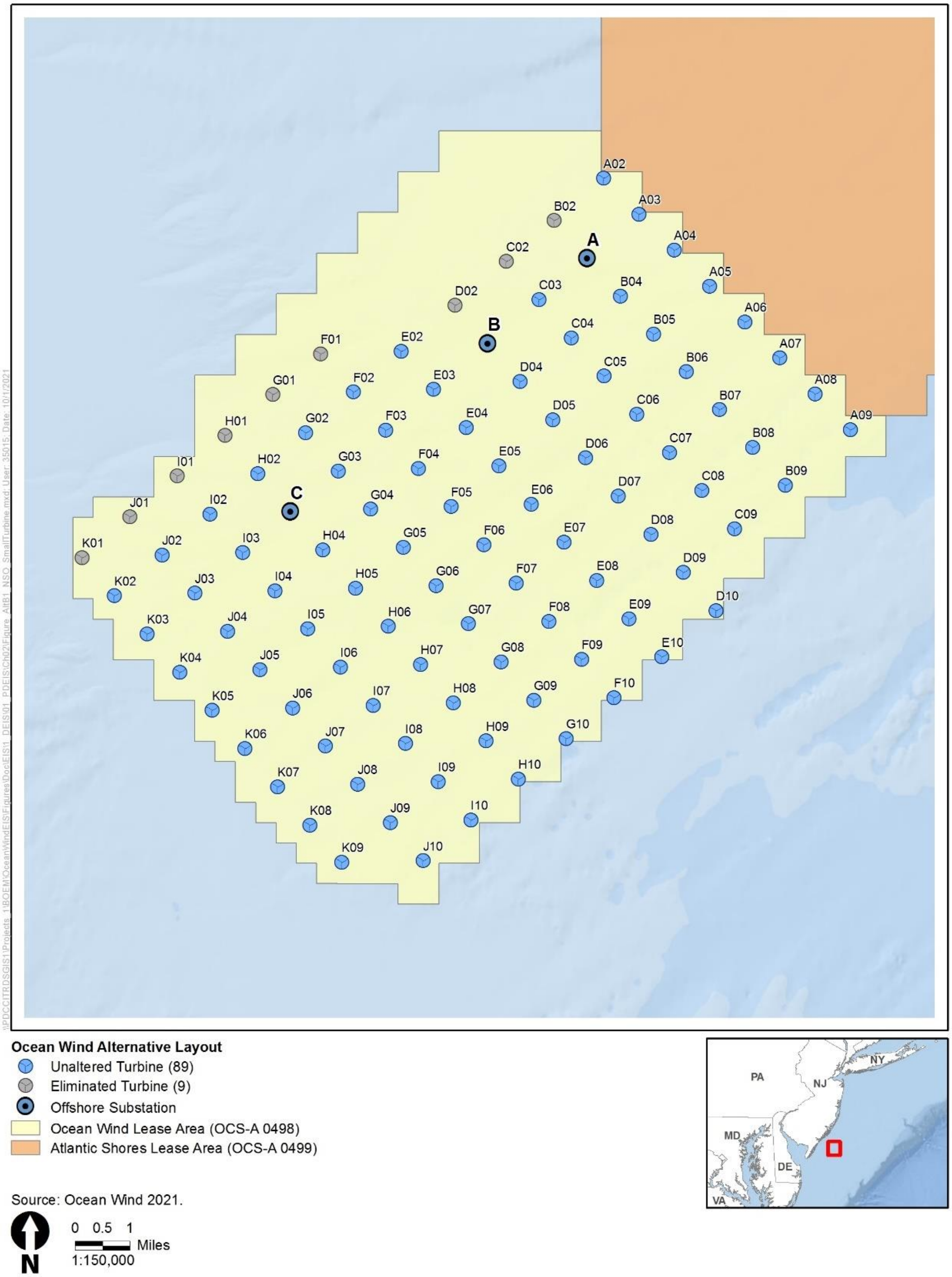


Figure 6-1 Alternative B-1: No Surface Occupancy at Select Locations to Reduce Visual Impacts (Smaller Turbine Model)

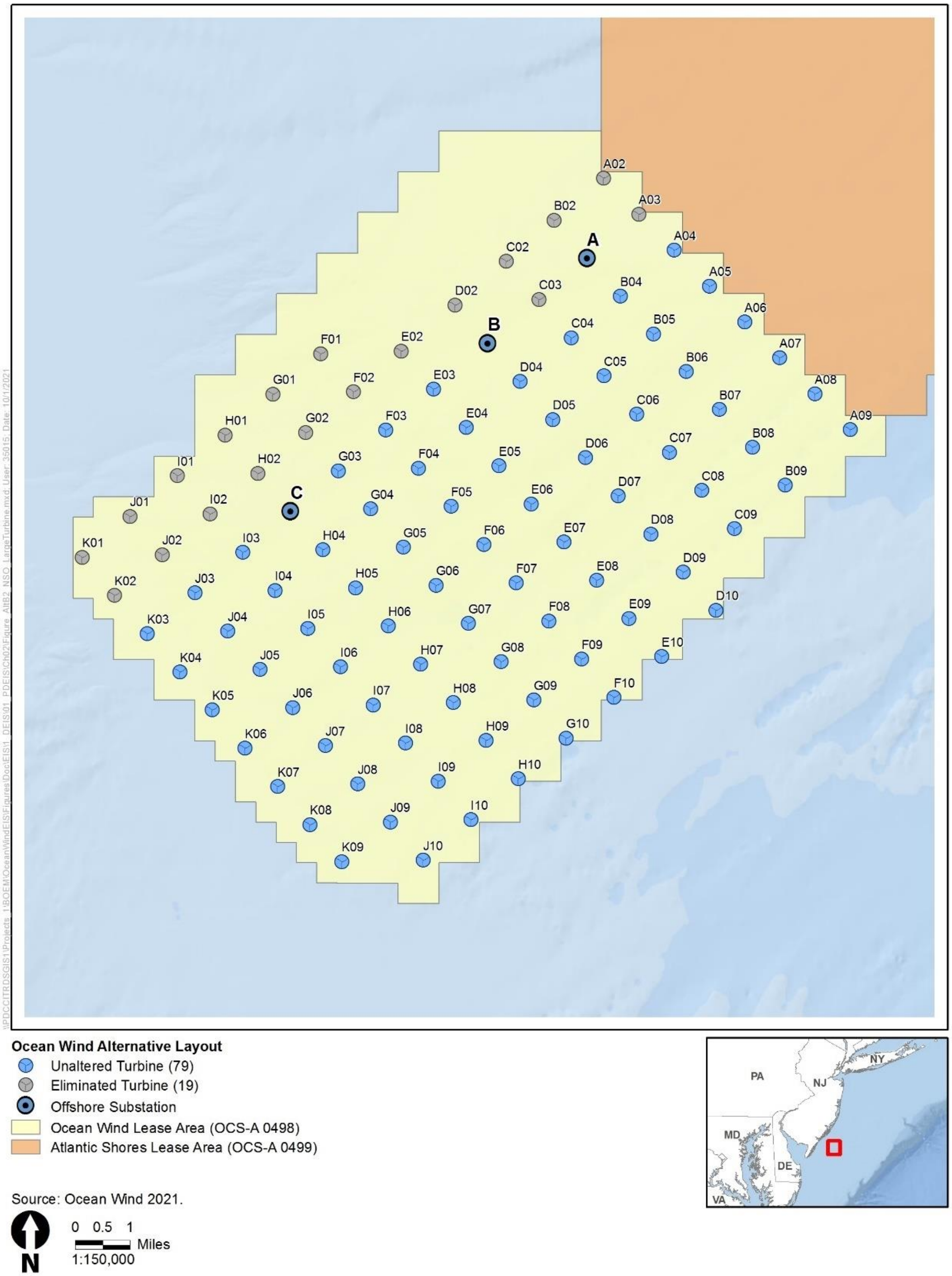


Figure 6-2 Alternative B-2: No Surface Occupancy at Select Locations to Reduce Visual Impacts (Larger Turbine Model)

6.3.2 Alternative C—Wind Turbine Layout Modification to Establish a Buffer Between Ocean Wind and Atlantic Shores

Alternative C was developed through the scoping process for the Draft EIS in response to public comments from the USCG, the Responsible Offshore Development Alliance (RODA), and commercial fishermen concerning the different layouts between the Ocean Wind 1 and Atlantic Shores South projects and the need for a buffer between the two projects in the adjacent lease areas. Under Alternative C, modifications would be made to the wind turbine array layout to create a 0.81-nm to 1.08-nm buffer between WTGs in OCS-A 0498 (Ocean Wind 1 Lease Area) and WTGs in OCS-A 0499 (Atlantic Shores South Lease Area). Atlantic Shores South would also need to modify its wind turbine layout in order to create a total buffer distance of between 0.8 nm and 1.1 nm.

Each of the below sub-alternatives may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need. The range of design parameters for Project components and activities to be undertaken for construction and installation, O&M, and conceptual decommissioning would be the same as described for the proposed layout. Both sub-alternatives would include fewer turbines than the proposed turbine layout, resulting in a smaller impact footprint and a reduction in impacts to EFH.

- **Alternative C-1:** No Surface Occupancy to Establish a Buffer with Turbine Relocation (Figure 6-3). This alternative would result in no surface occupancy along the northeastern boundary of the Ocean Wind 1 Lease Area through the exclusion of eight WTG positions (A02 to A09), relocation of up to eight WTG positions to the northern portion of the Ocean Wind 1 Lease Area, or some combination of exclusion and relocation of WTG positions, to allow for a 0.81-nm to 1.08-nm buffer between WTGs in the Ocean Wind 1 Lease Area and WTGs in the Atlantic Shores South Lease Area.
- **Alternative C-2:** No Surface Occupancy to Establish a Buffer with Turbine Layout Compression (Figure 6-4). This alternative would result in no surface occupancy along the northeastern boundary of the Ocean Wind 1 Lease Area to allow for an 0.81-nm to 1.08-nm buffer (Figure 6-4) between WTGs in the Ocean Wind 1 Lease Area and WTGs in the Atlantic Shores South Lease Area. However, under Alternative C-2, the wind turbine array layout would be compressed to allow for a full build of up to 98 WTGs. Ocean Wind 1's turbine array row spacing would be reduced from 1 nm between rows to no less than 0.99 nm between rows.

Additional site investigations may be needed for alternatives that would relocate WTG positions or compress the WTG layout. Collecting and processing the additional survey data could lead to a Project delay of up to 2 years.

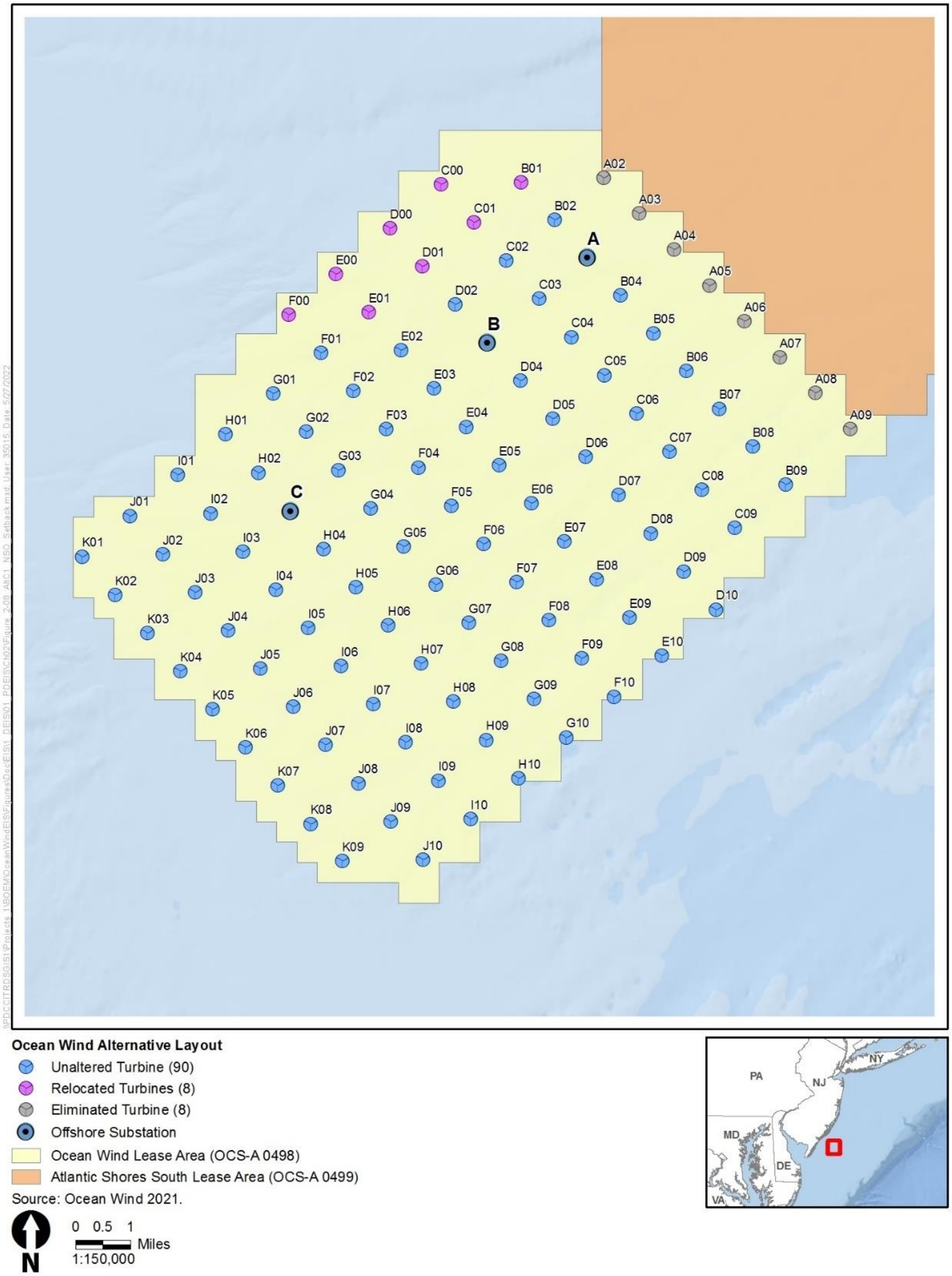


Figure 6-3 Alternative C-1: No Surface Occupancy to Establish a Buffer with Turbine Relocation

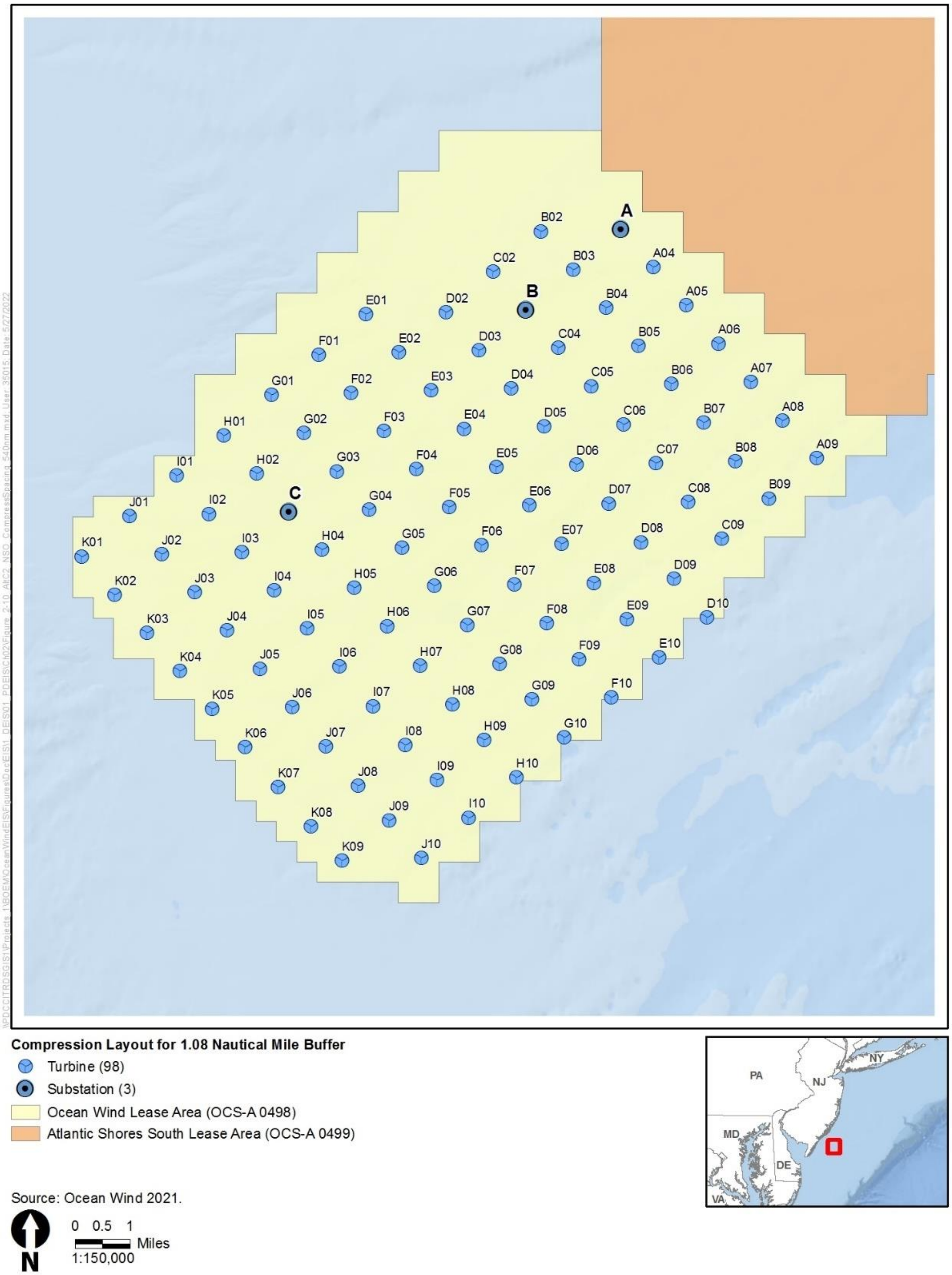


Figure 6-4 Alternative C-2: No Surface Occupancy to Establish a Buffer with Turbine Layout Compression (Compression Layout for 1.08-nm Buffer)

6.3.3 Alternative D—Sand Ridge and Trough Avoidance

Under Alternative D (Figure 6-5), the construction, O&M, and eventual decommissioning of a 1,100 MW wind energy facility on the OCS offshore New Jersey, subject to applicable mitigation measures. However, modifications would be made to the wind turbine array layout to minimize impacts on sand ridge and trough features in the northeastern corner of the Lease Area. This alternative would result in the exclusion of up to 15 WTG positions in the sand ridge and trough area. These physical features are found throughout the OCS in the mid-Atlantic and provide important habitat for several species. Ridge and swale habitat provide complex physical structures that affect the composition and dynamics of ecological communities, with increased structural complexity often leading to greater species diversity, abundance, overall function, and productivity. The sand ridges and troughs are areas of biological significance for migration and spawning of mid-Atlantic fish species, many of which are recreationally targeted in those specific areas. Although the overall artificial reef effect would be decreased by reducing the total number of WTGs in the Lease Area, the biological benefits of preserving natural fish habitat may be beneficial. Selection of this alternative with the exclusion of more than nine WTGs would be contingent on the larger turbine with a 240-meter rotor diameter being commercially available when BOEM issues its ROD as well as its technical and economic feasibility, and consistency with the purpose and need. This alternative would include fewer turbines than the proposed turbine layout, resulting in a smaller impact footprint and a reduction in impacts to EFH.

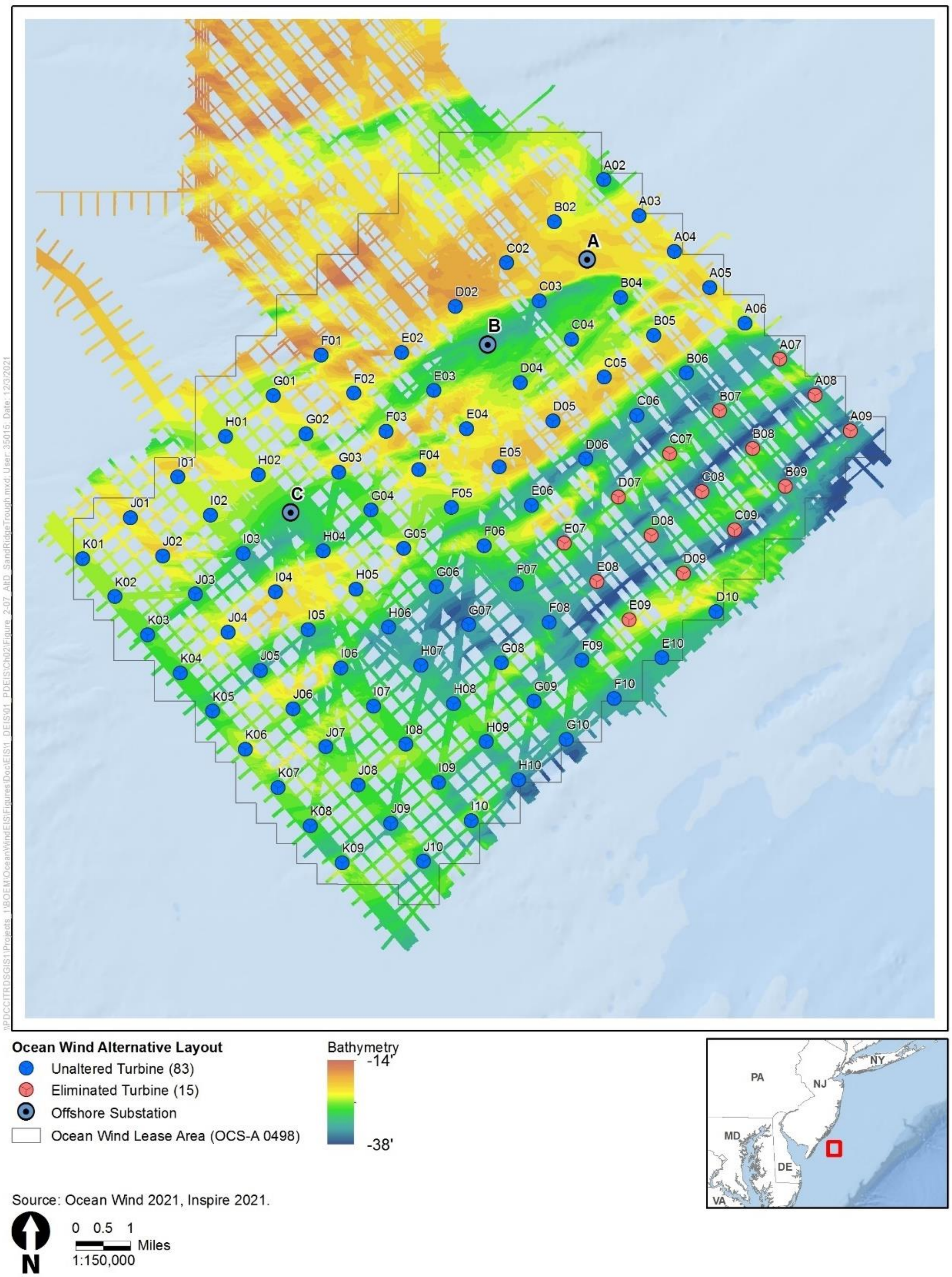


Figure 6-5 Alternative D: Sand Ridge and Trough Avoidance Alternative

6.3.4 Alternative E—Submerged Aquatic Vegetation Avoidance

Under Alternative E (Figure 6-6), the construction, O&M, and eventual decommissioning of an 1,100 MW wind energy facility on the OCS offshore New Jersey, subject to applicable mitigation measures. However, the Oyster Creek export cable route option traveling directly across the barrier island would not be used and the export cable route would be limited to the option developed to minimize impacts on SAV in Barnegat Bay. The SAV avoidance export cable route option would make landfall within an auxiliary parking lot of Swimming Area 2 in Island Beach State Park and then continue north within parking lots, then northwest under Shore Road before entering Barnegat Bay. Upon entering Barnegat Bay, the export cable route would run west within a previously dredged channel and then reconnect to the Oyster Creek export cable route in Barnegat Bay. The alternative may be combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need.

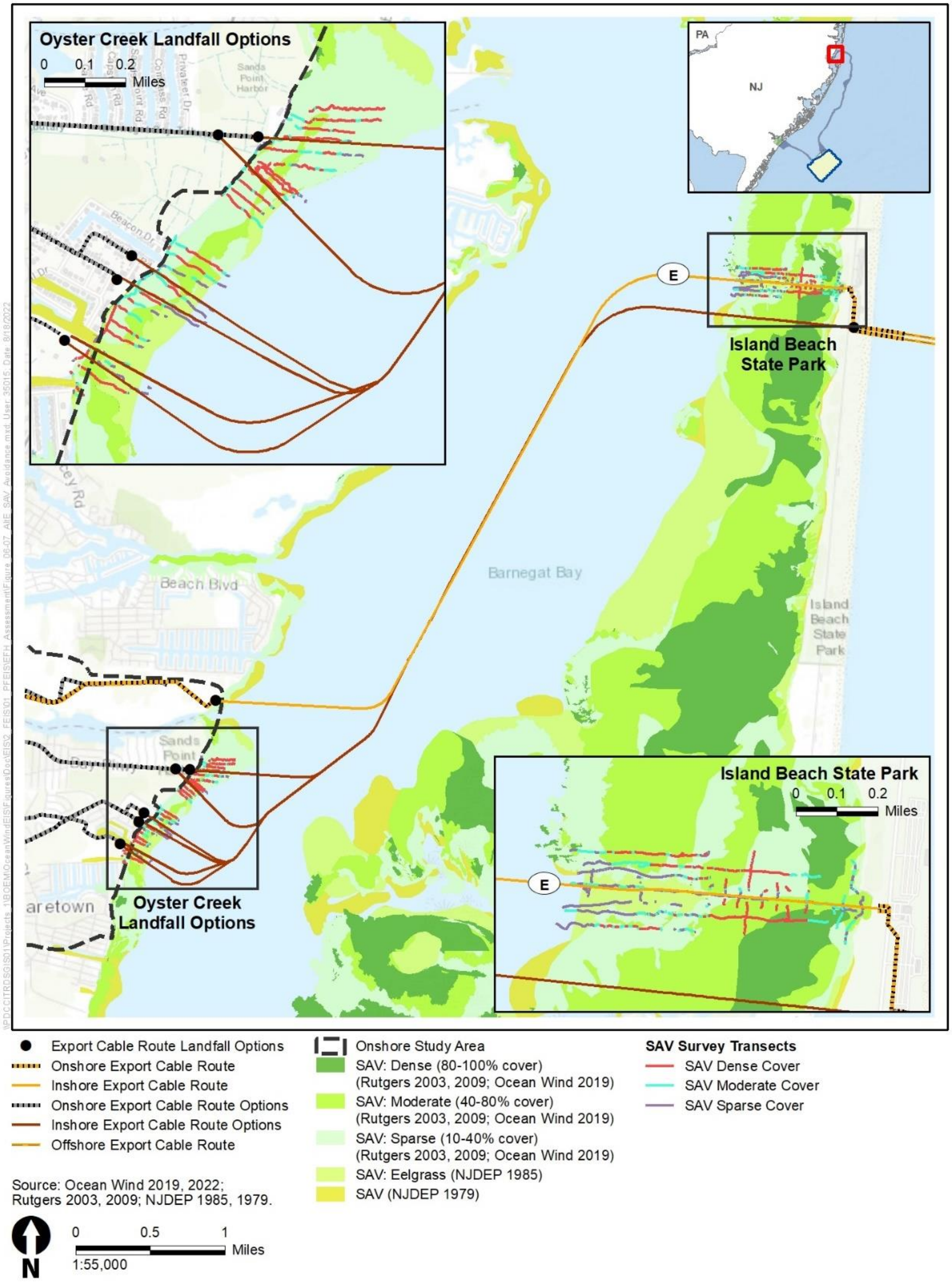


Figure 6-6 Alternative E: SAV Avoidance Alternative

6.4 Environmental Monitoring

6.4.1 Site Specific Monitoring Plan

During the permitting process and in consultation with the resource agencies, Ocean Wind would develop and implement a site-specific monitoring program to ensure that environmental conditions are monitored during construction, operation, and decommissioning phases. It would be designed to ensure environmental conditions are monitored and reasonable actions are taken to avoid and/or minimize seabed disturbance and sediment dispersion, consistent with permit conditions. Avoiding and/or minimizing seabed disturbance and sediment dispersion would help minimize impacts primarily to benthic EFH habitat and benthic or epibenthic EFH species and/or life stages, with secondary effects on EFH species and/or life stages that prey on benthic and epibenthic organisms.

6.4.2 HRG and Geotechnical Surveys

HRG surveys would consist of multibeam depth sounding, seafloor imaging, and shallow- and medium-penetration sub-bottom profiling within the Project area that would acoustically map seabed features—seafloor topography, bathymetry, stratigraphy, archaeological elements, hazards, and other characteristics and help inform the geotechnical surveys that would examine soil structure and other attributes that, combined with geophysical findings, create the geological model needed to establish engineering parameters for turbine foundations, substations, cable burial trenches, and other infrastructure. The geotechnical surveys would take place prior to construction and the plans for these surveys were under review at the time of writing this EFH assessment. No geotechnical surveys are planned for the construction or post-construction phases. The HRG and geotechnical surveys would help identify sensitive habitats (e.g., shellfish and SAV beds) and allow these areas to be avoided to the extent practicable for siting of the WTGs, OSS, and cable routes. Identifying and avoiding and/or minimizing to the extent practicable the disturbance to sensitive seabed habitats would help minimize impacts primarily to benthic EFH habitat and benthic or epibenthic EFH species and/or life stages, with secondary effects on EFH species and/or life stages that prey on benthic and epibenthic organisms.

6.4.3 Fisheries Surveys

Ocean Wind would conduct seven fisheries monitoring surveys as part of their Fisheries Monitoring Plan. They include a trawl survey, synoptic eDNA sampling, multi-method survey for structure-associated fishes, clam survey, pelagic fish survey, acoustic survey, and collection of oceanographic data. Much of the research described in this plan would be performed on commercial fishing vessels that are contracted for this monitoring. Further, all of the field work and data analysis described in the monitoring plan would be performed by researchers at Rutgers University and Monmouth University. These surveys would help:

- Identify and confirm which dominant benthic, demersal, and pelagic species are using the Project site, and when these species may be present where development is proposed;
- Establish a pre-construction baseline which may be used to assess whether detectable changes associated with proposed operations occurred in post-construction abundance and distribution of fisheries;
- Collect additional information aimed at reducing uncertainty associated with baseline estimates and/or to inform the interpretation of research results; and
- Develop an approach to quantify any substantial changes in the distribution and abundance of fisheries associated with proposed operations

These surveys would provide information about EFH species in the Project area and potential changes to their ecosystem and population structure as a result of the Project, helping to inform regulatory agencies as it relates to wind project impacts on EFH species so they can better management them.

The surveys and the EFH species targeted are discussed below.

6.4.3.1 Trawl Survey & Synoptic Environmental DNA (eDNA) Sampling

A Northeast Area Assessment and Monitoring Program style trawl survey would be used to sample the fish and invertebrate community in and around the Ocean Wind Offshore Windfarm Project lease area before, during, and after construction. The trawl survey would be paired with synoptic eDNA sampling to allow for assessment of the species composition in the Project Area during all three Project phases.

The trawl survey paired with the eDNA survey would provide information relative biomass, distribution and demographics of fisheries resources within the impact area and the control area before, during, and after construction as well as provide information about the possible impacts the Project may have on the relative abundance, distribution, and demographics of fishery resources. Biological sampling would also occur for a number of targeted species, including EFH species: black sea bass, monkfish, summer flounder, scup, and Atlantic herring.

6.4.3.2 Multi-Method Survey for Structure-Associated Fishes

This survey would assess the relative abundance and demographics of structure-associated fish species in the Ocean Wind Offshore Windfarm Project area that may otherwise be underrepresented in the trawl survey. A multi- method sampling approach (rod and reel, BRUVs, and chevron traps) would be used to conduct four seasonal surveys (spring, summer, fall, and winter) of structured habitats annually to sample structure-associated fish EFH species such as black sea bass, NOAA trust species such as tautog, and other species that may not be well represented in trawl survey catches. The timing of the structured habitat survey would be coincident with the seasonal bottom trawl survey.

6.4.3.3 Pelagic Fish Survey

This non-extractive survey of pelagic fish would occur in and around the Lease Area to investigate the habitat use, abundance, and distribution of larger more mobile pelagic species including pelagic EFH species, that would not be well sampled using a trawl. The pelagic fish survey would be executed using two sampling tools; towed cameras as self-baited traps (mobile BRUVs; Figure 15) and autonomous gliders equipped with echosounders.

6.4.3.4 Clam Survey

An annual dredge survey for surfclams would be performed in the Lease Area and a nearby control area using a before-after-control-impact (BACI) statistical design. The survey would be conducted in August to correspond with standard practices for the federal clam survey and to enable data comparison with federal data sources. The pre-construction surveys would occur in August 2022 and 2023. Monitoring would continue during construction, and at least 2 years of post-construction clam surveys are planned.

6.4.3.5 Acoustic Telemetry

This study would use a combination of fixed station receivers and active mobile telemetry to assess the movements of EFH species summer flounder, black sea bass, smooth dogfish, and clearnose skate and the NOAA Trust resource horseshoe crab. The study would be conducted in the Lease Area and adjacent inshore areas. Finally, oceanographic data collected through gliders, shipboard observations, and regional ocean observatories would be integrated with each of the sampling tasks described above to understand how the abundance and distribution of fish and invertebrate species is influenced by seasonally dependent ocean stratification in and around the Ocean Wind Offshore Windfarm Project lease site.

6.4.3.6 Oceanographic Data

The collection of oceanographic data would provide the ability to associate ocean measures, particularly those characterizing the seasonal stratification, with each of the other six survey components described above. Measures to be collected include glider profiles of ocean temperature, ocean salinity, ocean density, ocean currents, and the observed distribution of primary producers. This would allow a quantification of the connection between EFH target species and the ocean characteristics that would be critical to accurately assess changes through the pre-construction, construction, and post-construction phases of the Ocean Wind Project on those species.

6.4.4 Benthic Monitoring Plan

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 and induce them to leave the area.

6.4.5 Protected Species Mitigation and Monitoring Plan

As part of the protected species mitigation and monitoring plan, both visual observations and PAM systems would be used to monitor for marine mammals during HRG surveys, pile driving, and UXO detonation activities. Various zones would be established to monitor for marine mammals and if necessary to shut down operations if warranted. Level B zone is the area of water ensonified by a sound source to an acoustic isopleth defined as a threshold at which onset of a behavioral disturbance can occur. Level A zone is the area of water ensonified by a sound source to an acoustic isopleth defined as a threshold at which onset of a permanent threshold shift (PTS) in hearing can occur, and shutdown zones shutdown zone (SZ) is the area in which equipment shut down or other active mitigation measures must be applied once a source is active if a protected species is sighted inside the corresponding zone.

For HRG surveys the SZ is 100 meters. For pile driving the SZ ranges from 1,000 – 1,800 meters during the summer and 1,430 – 2,490 meters during the winter depending on the species observed, while vibratory sheet pile driving has an SZ range of 60 – 100 meters year-round depending on the species observed. For UXO detonation, the clearance zone for conducting operations ranges from 50 – 16,200 meters depending on the size of the charge to be detonated and the species observed. These shut down protocols would temporarily reduce the area of effects on EFH-designated species and the prey they feed upon that are within the SZ.

7. NOAA Trust Resources

NOAA Trust Resources are living marine resources that include commercial and recreational fishery resources (marine fish and shellfish and their habitats); anadromous species (fish, such as salmon and striped bass, that spawn in freshwater and then migrate to the sea); endangered and threatened marine species and their habitats; marine mammals, turtles, and their habitats; marshes, mangroves, seagrass beds, coral reefs, and other coastal habitats; and resources associated with National Marine Sanctuaries and National Estuarine Research Reserves.

7.1 NOAA Trust Resource Species

Sixteen species of NOAA Trust Resources have been identified within the general vicinity of the WFA, OECRC, and IECRC. Detailed species descriptions and life history information are provided in FMP (MAFMC 1998; NEFMC 2017; NOAA 2009). Table 7-1 discusses species and life stage within the Project area, as well as the impact determination for each NOAA Trust Resource species.

The following NOAA Trust Resource species or species groups may utilize habitat within the Project area:

- River herring (alewife [*Alosa pseudoharengus*], and blue herring [*Alosa aestivalis*])
- American eel (*Anguilla rostrata*)
- American shad (*Alosa sapidissima*)
- Striped bass (*Morone saxatilis*)
- Blackfish/tautog (*Tautoga onitis*)
- Weakfish (*Cynoscion regalis*)
- Forage species (Atlantic menhaden [*Brevoortia tyrannus*], bay anchovy [*Anchoa mitchilli*], and sand eel/sand lance [*Ammodytes americanus*])
- Blue crab (*Callinectes sapidus*)
- Horseshoe crab (*Limulus polyphemus*)
- Bivalves (Blue mussel [*Mytilus edulis*], Eastern oyster [*Crassostrea virginica*], quahog [*Mercenaria mercenaria*], and soft-shell clams [*Mya arenaria*])
- Spot (*Leiostomus xanthurus*)
- Atlantic croaker (*Micropogonias undulatus*)
- Spotted Hake (*Urophycis regia*)
- Smallmouth flounder (*Microstomus kitt*)
- Bobtail squid (*Sepiola atlantica*)
- Northern kingfish (*Menticirrhus saxatilis*)
- Sea robins (*Triglidae spp*.)
- Gulf stream flounder (*Citharichthys arctifrons*)

Table 7-1 Trust Resources Determination by Species or Species Group

Species	Life Stage within Project Area	Impact Determination	Rationale for Determination
River herring (alewife, blueback herring)	Juvenile, Adult	short-term and permanent impacts	Short-term disturbance effects would occur over approximately 4,542 acres[7] (1,838.1 hectares) of benthic habitat. Only a small area (tens of acres) would be affected at any given time. Benthic community structure would recovery rapidly, within a few months of the activity. Approximately 232 acres[8] (93.89 hectares) of benthic habitat would be displaced or altered over the long-term by placement of the monopile foundations and cable and foundation scour protection (boulders, concrete pillows). Once scour protection is colonized it would provide habitat features for species associated with hard substrates. Short-term noise disturbance from monopile installation would reduce habitat suitability for these species within a 16-mile radius of pile driving activity. Habitat conditions would be unaffected after construction is complete. Operational noise effects are below established behavioral and injury effects thresholds for fish. Dredging associated with the Project may occur annually, with clamshell or suction dredging occurring for up to 24 hours a day for up to five months. However, this is a conservative window and dredging is not expected to occur throughout this time period. Dredging may result in increased local TSS or short-term displacement, but impacts are expected to be short-term and limited in spatial extent. Collectively, areas affected by short-term construction-related impacts would rapidly return to baseline conditions within minutes to months after the Project is completed. Long-term habitat alterations and operational effects on habitat would be minimized because: • Impacts are limited in intensity and extent; • Species occurrence is limited; • Long-term impacts may produce new potentially suitable habitats, and/or;
American eel	Larvae, Juvenile, Adult	short-term and permanent impacts	
Striped bass	Juvenile, Adult	short-term and permanent impacts	
Blackfish	Juvenile, Adult	short-term and permanent impacts	
Weakfish	Juvenile, Adult	short-term and permanent impacts	
Spot	Juvenile, Adult	short-term and permanent impacts	
Atlantic croaker	Juvenile, Adult	short-term and permanent impacts	
Spotted hake	Juvenile, Adult	short-term and permanent impacts	
Smallmouth flounder	Juvenile, Adult	short-term and permanent impacts	
Bobtail squid	Juvenile, Adult	short-term and permanent impacts	
Northern kingfish	Juvenile, Adult	short-term and permanent impacts	
Sea robins	Juvenile, Adult	short-term and permanent impacts	
Gulf stream flounder	Juvenile, Adult	short-term and permanent impacts	

[7] Total Temporary Benthic Disturbance, COP Volume II, Table 2.2.5-5 (Ocean Wind 2022a)
[8] Total Permanent Benthic Disturbance, COP Volume II, Table 2.2.5-5 (Ocean Wind 2022a)

Species	Life Stage within Project Area	Impact Determination	Rationale for Determination
Forage species (Atlantic menhaden, bay anchovy, sand eel)	All	short-term and permanent impacts	
American shad	Juvenile, Adult	short-term and permanent impacts	Short-term noise disturbance from monopile installation would reduce habitat suitability for this species within a 16-mile radius of pile driving activity in the wind farm. Habitat conditions would be unaffected after construction is complete. Operational noise effects are below established behavioral and injury effects thresholds for fish. As an anadromous species, juveniles have the potential to occur within nearshore waters near the export cable. Individuals could be displaced for the short-term during construction activities, but long-term impacts are not expected.
Blue crab	All	short-term and permanent impacts	Both of these species are known to occur within the Project area. Adults and may use the habitat for spawning. Dredging impacts could include increased local TSS, loss of larvae due to suction dredging, or short-term displacement of individuals. However, these impacts are either short-term, limited in spatial extent, or insignificant to the success of the species. See Section 7.2 below for additional information on horseshoe crabs.
Horseshoe crab	All	short-term and permanent impacts	

Species	Life Stage within Project Area	Impact Determination	Rationale for Determination
Bivalves (blue mussel, eastern oyster, ocean quahog, soft-shell clam)	All	short-term and permanent impacts	Short-term disturbance effects would occur over approximately 4,542 acres[9] (1,838.1 hectares) of benthic habitat. Only a small area (tens of acres) would be affected at any given time. Benthic community structure would recovery rapidly, within a few months of the activity. Approximately 232 acres[10] (93.89 hectares) of benthic habitat would be displaced or altered over the long-term by placement of the monopile foundations and cable and foundation scour protection (boulders, concrete pillows). WFA and OECRC impacts have been sited to avoid and minimize overlap of long-term effects with known shellfish habitats in designated EFH. The benthic community structure would adapt and recover rapidly, within a few months of the activity.

EFH = essential fish habitat; OECRC = Offshore Export Cable Route Corridor; TSS = total suspended sediment; WFA = Wind Farm Area

[9] Total Temporary Benthic Disturbance, COP Volume II, Table 2.2.5-5 (Ocean Wind 2022a)
[10] Total Permanent Benthic Disturbance, COP Volume II, Table 2.2.5-5 (Ocean Wind 2022a)

7.2 Additional Information

Ocean Wind estimates that Project activities would result in short-term and permanent benthic disturbance to the Carl N. Shuster Horseshoe Crab Reserve (Table 7-2).

Table 7-2 Indicative Impacts of the Project on Benthic Habitat in the Carl N. Shuster Horseshoe Crab Reserve

Component	Short-term Benthic Disturbance (acres)	Permanent Benthic Disturbance (acres)	Total Benthic Disturbance within Carl N. Shuster HorseshoeCrab Reserve (acres)
WTG Foundations	-	2.3	0.1
WTG Scour Protection	-	58	2.4
Offshore SubstationFoundations	-	0.1	-
Offshore Substation ScourProtection	-	3	-
Array Cables	2,220	77 (cable protection)	29
Substation InterconnectorCables	222	8 (cable protection)	-
Offshore Export Cables withinWind Farm Area	120	4 (cable protection)	-
TOTAL within Wind FarmArea	***2,562***	***150***	***32***
Offshore Export Cables outside Wind Farm Area	1,980	82 (cable protection)	113
TOTAL for Project	**4,542**	**232**	**145**

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8. Conclusion

Forty-four species of finfish, elasmobranchs, and invertebrates with designated EFH occur within the WFA and OECRC footprints of the Project area. The Proposed Action, described in Section 2, includes construction, operation and maintenance, and decommissioning of the Project components. Project decommissioning would occur at the end of the 35-year planned lifetime of the Project and would be subject to separate EFH consultation at that time. EFH-designated species are discussed in Section 4. Impact analyses of Project activities on EFH are analyzed in Section 5. Impacts to EFH species with benthic life stages within the Project Area are summarized in Table 10.2-5. Impacts to EFH species with pelagic life stages within the Project Area are summarized in Table 10.2-6. Impacts associated with construction activities, such as pile driving and jet plowing, are likely to be greater than those associated with operation and maintenance, such as sound produced by operational turbines. EFH-designated species with one or more demersal life stage are more likely to be subjected to long-term or permanent adverse impacts than species with only pelagic life stages, primarily due to the installation of the turbine foundations and scour and cable protection measures, and the permanent alteration and conversion of benthic habitat.

Project construction would result in short-term, long-term, and permanent adverse effects on the environment that could affect habitat suitability for EFH and EFH-designated species. Short-term adverse effects include construction-related underwater noise impacts; crushing and burial effects; and disturbance of bottom substrates resulting in increased turbidity and sedimentation. These effects would occur intermittently at varying locations in the Project area over the duration of Project construction but are not expected to cause permanent effects on EFH. Depending on the nature, extent, and severity of each effect, this may temporarily reduce the suitability of EFH for managed species, which would result in short-term adverse effects on EFH for those species. For example, underwater noise from pile driving could temporarily render the affected habitats unsuitable for EFH-designated species. Long-term and permanent impacts could result from alteration of the water column and benthic habitats, habitat conversion, hydrodynamic effects, and food web effects. However, APMs such as sound attenuation and soft start procedures could minimize such acoustic impacts.

Additional Project APMs are described in Table 6-1. The implementation of APMs would likely result in the avoidance and minimization of some of the short-term, long-term, and permanent Project impacts to EFH described in this assessment.

The operation and maintenance of the WFA and OECRC would result in long-term and permanent adverse effects on EFH for some life stages of EFH-designated species (Section 5.2). These impacts include alteration of water column and benthic habitats, habitat conversion, operational noise, EMF and heat effects, hydrodynamic effects, and food web effects. Monopile foundations, scour protection, cable protection, and operational maintenance and improvements would alter or convert habitat.

The Project would also affect habitats for NOAA Trust Resources known or likely to occur in the Project area (Section 7).

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10. Appendices

10.1 Additional Project Information

This list includes documents that will be provided to NMFS, either concurrently with the EFH assessment through the file transfer site (Teams or Kiteworks) or as hyperlinks to access the documents online.

- Ocean Wind 1 Construction and Operations Plan, October 2022 (file transfer site)
- April 2022 Benthic Habitat Report (Appendix E, Ocean Wind COP – page 114 of 1043) https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/OCW01_COP_Volume%20III_Appendix%20E_PUBLIC_20220614.pdf
- August 2022 Benthic Habitat Report (file transfer site)
- SAV Survey Report (Appendix E, Ocean Wind COP – page 31 of 1043) https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/OCW01_COP_Volume%20III_Appendix%20E_PUBLIC_20220614.pdf
- Results of the Baseline Submerged Aquatic Vegetation 2022 Field Survey (Addendum to the *Ocean Wind Offshore Wind Farm Benthic Habitat Mapping and Benthic Assessment to Support Essential Fish Habitat Consultation* report) (file transfer site)
- Acoustic Report (Appendix R, Ocean Wind COP) https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/OCW01_COP_Volume%20III_Appendix%20R_20220614.pdf
- Protected Species Mitigation and Monitoring Plan (Appendix AA, Ocean Wind COP) https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/OCW01_COP_Volume%20III_Appendix%20AA_20220614.pdf
- Fisheries Monitoring Plan (file transfer site)
- Benthic Monitoring Plan (file transfer site)
- Access to Ocean Wind 1 Popup Mapper (updated access information sent via email to NMFS staff on 7/14/22)
- Submerged Aquatic Vegetation Monitoring Plan (file transfer site)
- Submerged Aquatic Vegetation Mitigation Plan (file transfer site)

10.2 Additional EFH Information

10.2.1 EFH

Table 10.2-1 10-by-10 Squares of Latitude and Longitude Used to Determine EFH-designated species within Project Area

NMFS Quadrangle Reference Number	Project Component	Latitude and Longitude of Quadrangle Centroid	
		Latitude	Longitude
1528	IECRC – Estuarine portion and Oyster Creek landing	39.91249	-74.039
1594	IECRC and OECRC	39.750883	-74.079691
1662	OECRC	39.583198	-74.082403
1733	OECRC	39.415731	-74.24841
1791	OECRC	39.416776	-74.082907
1809	IECRC – Estuarine portion and BL England landing	39.237443	-74.568753
1867	OECRC and WFA	39.250109	-74.249583
1868	OECRC and WFA	39.25011	-74.082907
1876	OECRC	39.249864	-74.416023
1949	WFA	39.083443	-74.249582
1950	WFA	39.083444	-74.082907
1957	WFA	39.083441	-74.416259

Source: MAFMC, NMFS, NEFMC
IECRC = Inshore Export Cable Route Corridor; NMFS = National Marine Fisheries Service; OECRC = Offshore Export Cable Route Corridor; WFA = Wind Farm Area

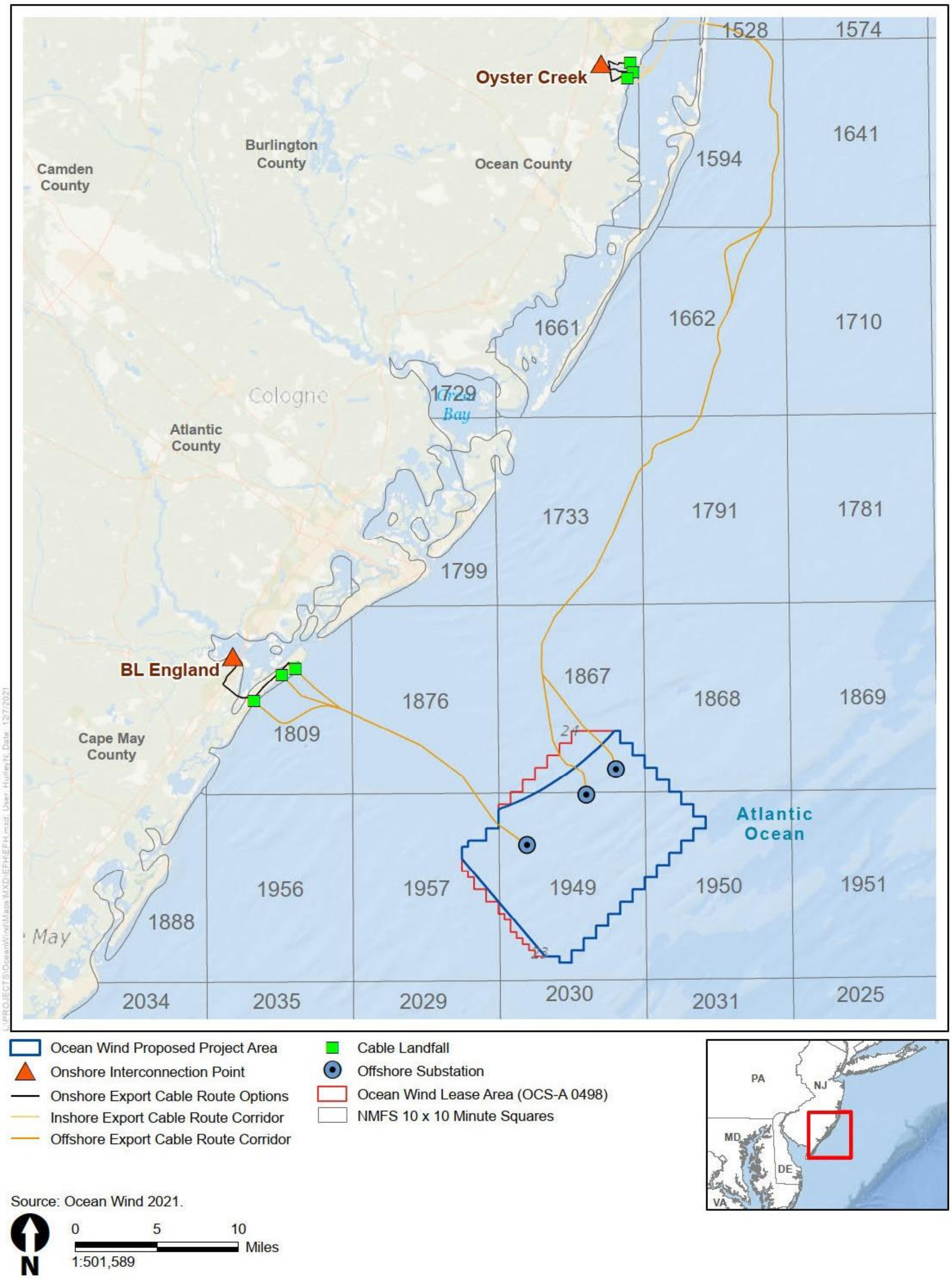

Figure 10.2-1 10-by-10 Squares of Latitude and Longitude Used for Determining Essential Fish Habitat Species within the Project Area

10.2.2 Wetlands

Table 10.2-2 Tidal Wetland Communities in the Geographic Analysis Area

Wetland Community	Acres
Disturbed Tidal Wetlands	34
Phragmites Dominated Coastal Wetlands	700
Saline Marsh (High Marsh)	465
Saline Marsh (Low Marsh)	18,961

Source: NJDEP 2015

Table 10.2-3 Summary of Wetland Impacts from along Indicative Onshore Export Cable Routes by NJDEP Wetland Community type within the study areas.

Onshore Export Cable Route	NJDEP Wetland Community Type	Acres of Short-Term Impact	Impact Breakdown by Route and Workspace	Duration	Acres of Long Term or Permanent Habitat Alteration
BL England	*Phragmites*-dominated coastal wetlands	0.35	All routes the same	Short term	N/A
	Saline marsh (low marsh)	0.18	All routes the same	Short term	N/A
Oyster Creek	Saline marsh (high marsh)	2.54	Bay Parkway 0.03 Farm Property workspace 2.50	Short term	N/A
	Saline marsh (low marsh)	2.72	Bay Parkway 0.03 Bay Parkway South workspace: 4.37	Short term	N/A
	Phragmites-dominated coastal wetlands	4.37	Farm Property workspace 4.37	Short term	N/A
	Disturbed tidal wetlands	0.05	Marina Alternative workspace	Short term	N/A

10.2.3 Boulder Locations – WFA and OECRC/IECRC

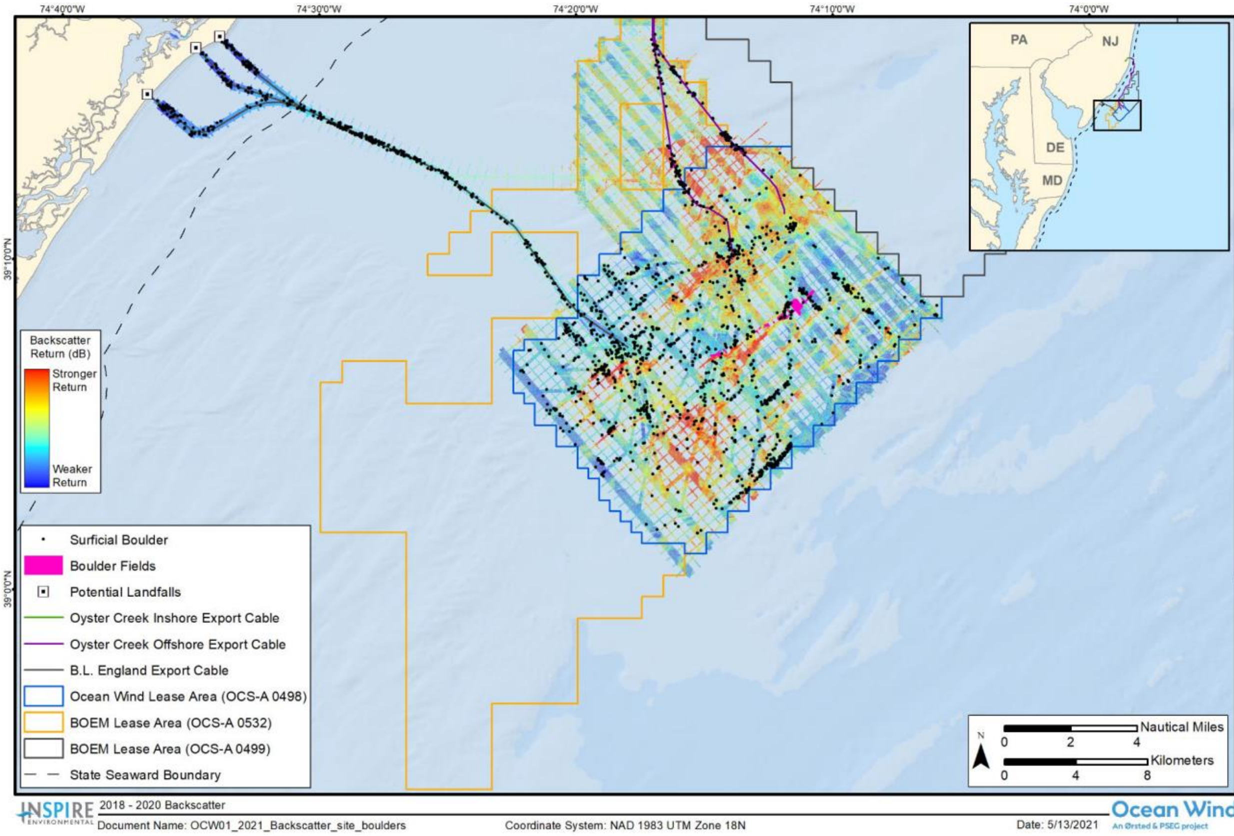

Figure 10.2-2 Boulder Fields and Individual Boulders on Backscatter Data over Hill-shaded Bathymetry at the Wind Farm Area

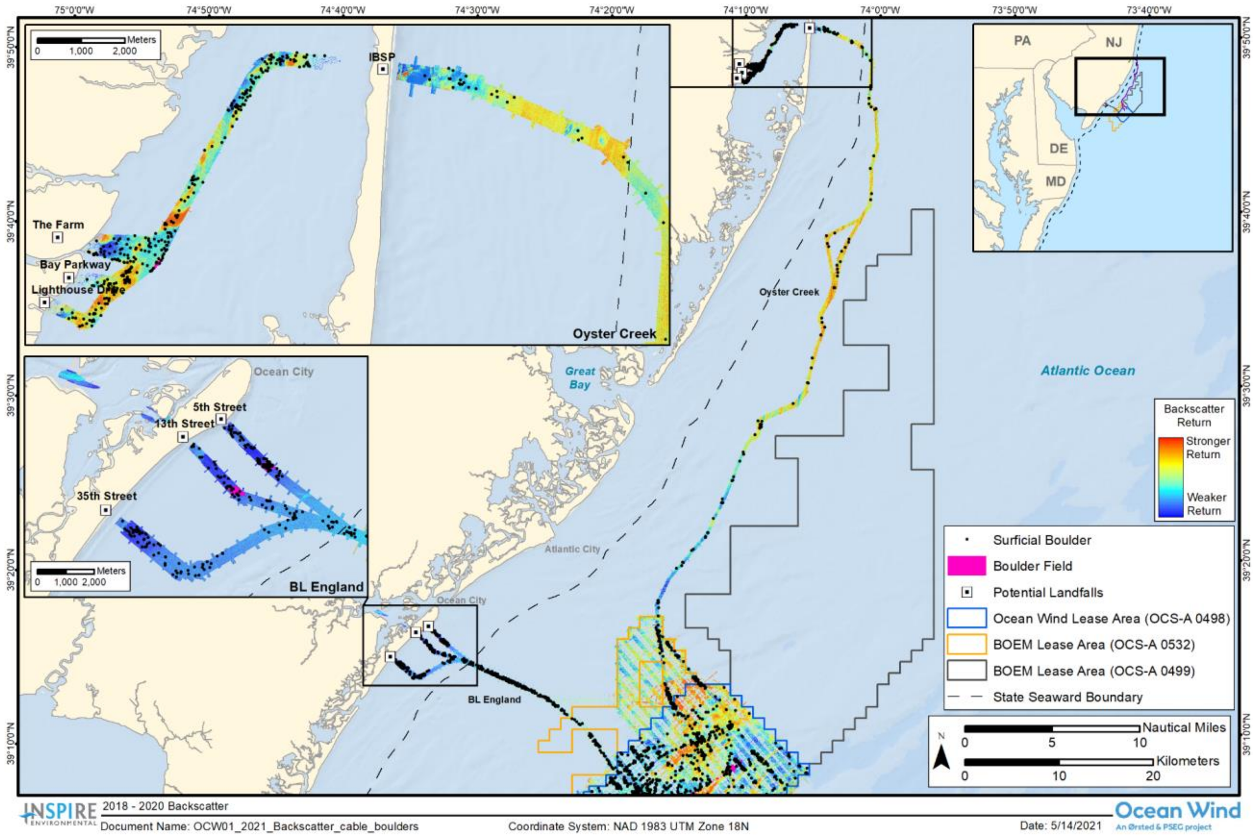

Figure 10.2-3 Boulder Fields and Individual Boulders on Backscatter over Hill-shaded Bathymetry Data along the BL England Offshore Export Cable Route Corridor and the Oyster Creek Offshore and Inshore Export Cable Route Corridors

10.2.4 Submerged Aquatic Vegetation in Landfall Areas

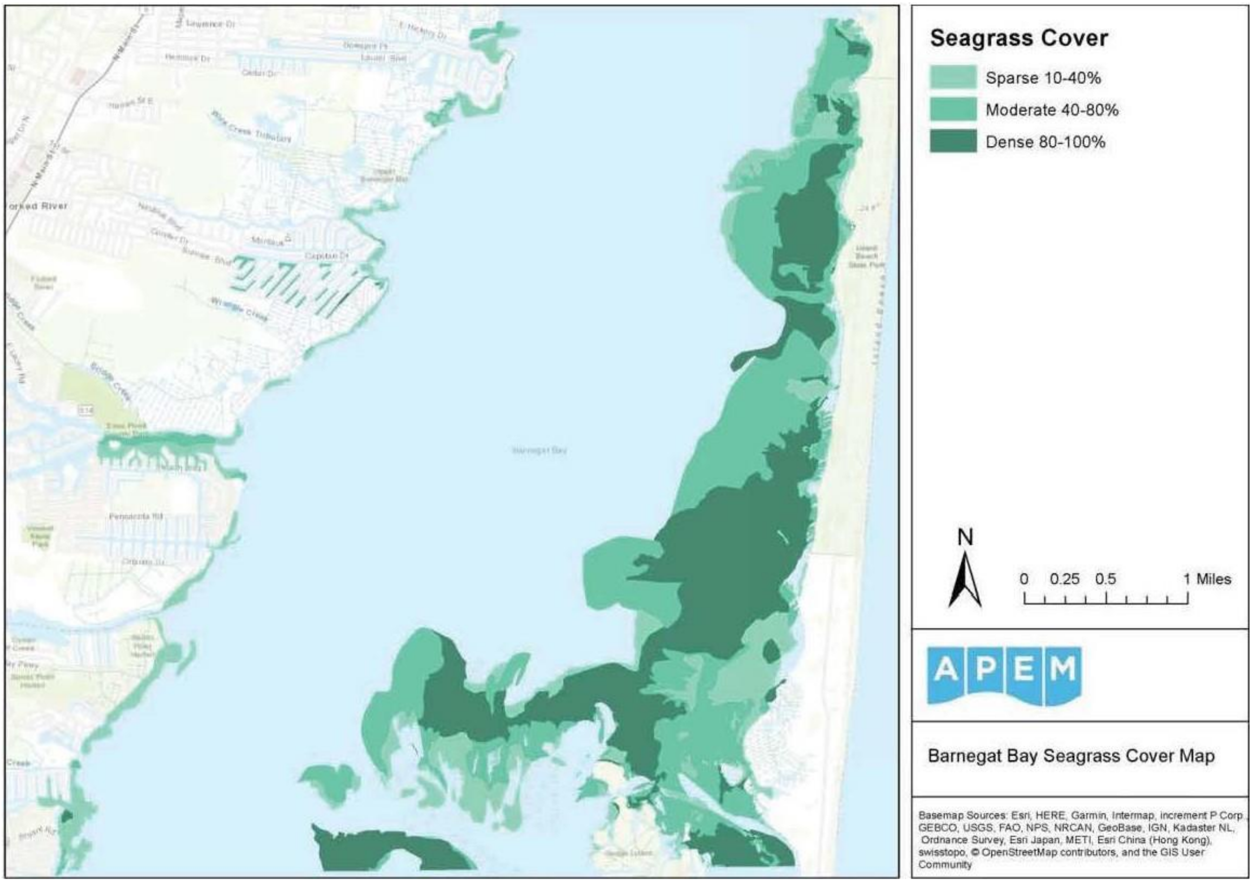

Figure 10.2-4 Seagrass Coverage Map of the Barnegat Bay survey Area, 2019 Survey

Figure showing Seagrass Coverage Map of the Great Egg Harbor Survey Area from Survey conducted by Ocean Wind in 2019. Figure depicts seagrass in three densities: sparse (10 to 40%), moderate (40 to 80%), and dense (80 to 100%).

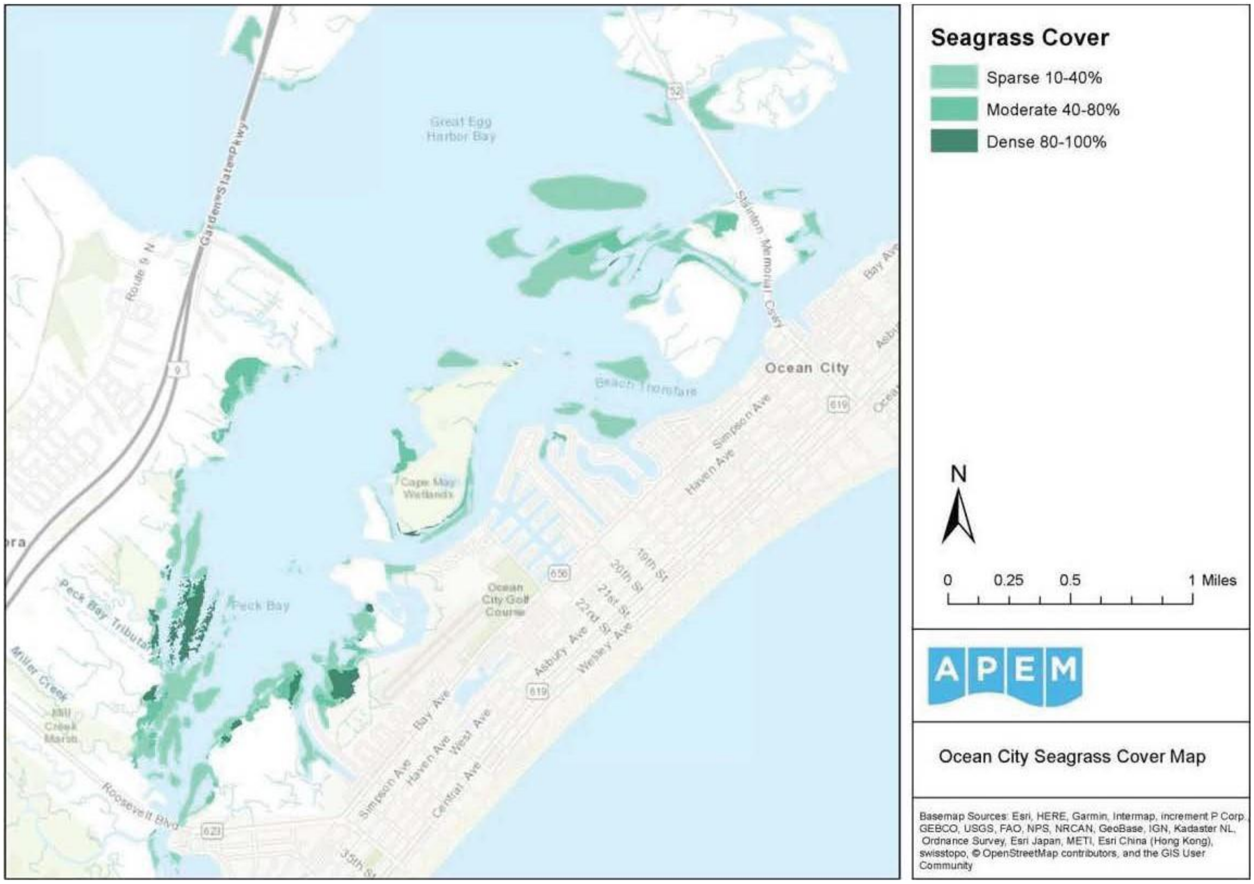

Figure 10.2-5 Seagrass Coverage Map of the Great Egg Harbor Survey Area, 2019 Survey

Figure 10.2-6 SAV Percent Cover Estimates at East Side of Island Beach State Park Landing, 2019 and 2020 (Phase 1 and Phase 2) Surveys

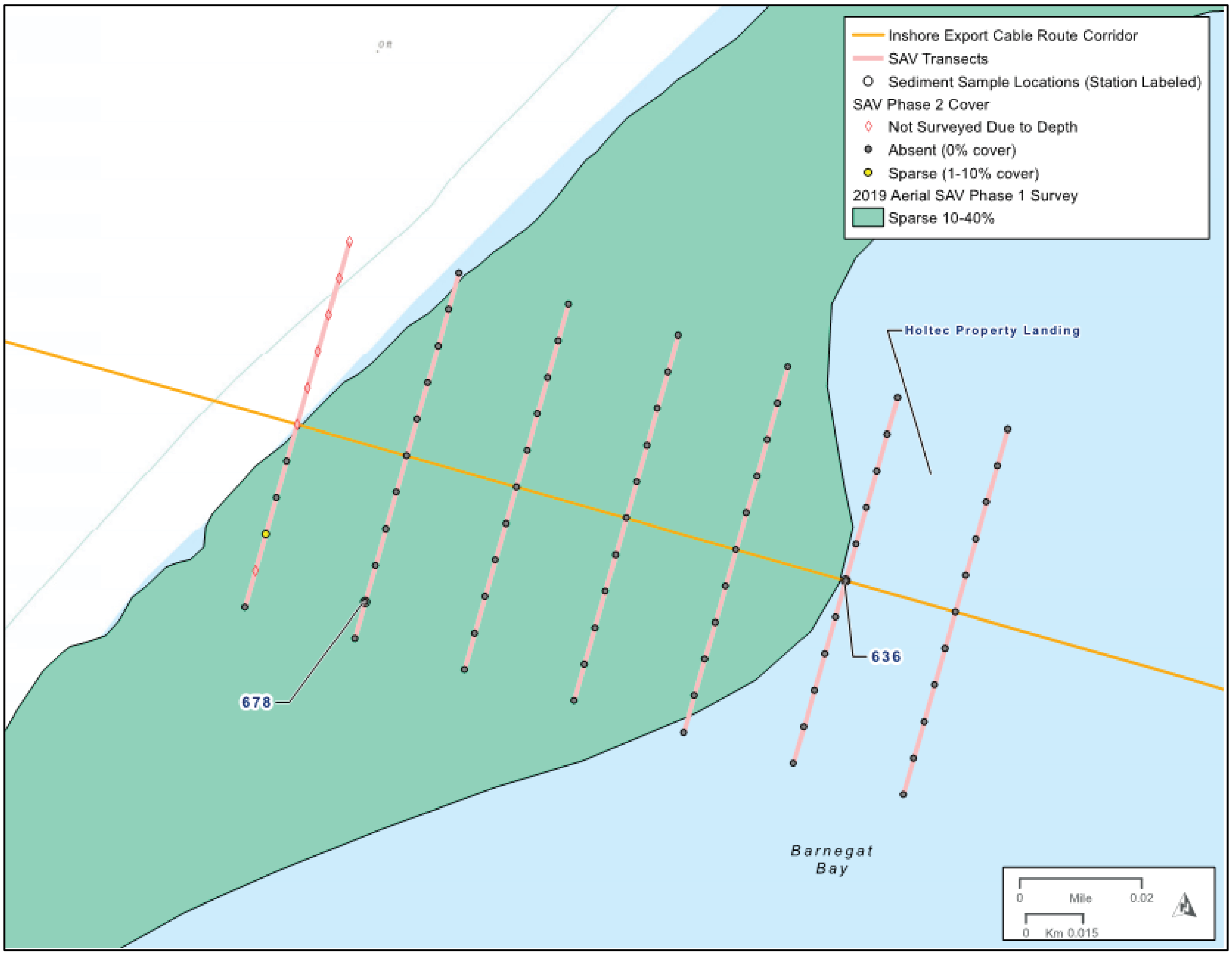

Figure 10.2-7 SAV Percent Cover Estimates at Holtec Property Landing, 2019 and 2020 (Phase 1 and Phase 2) Surveys

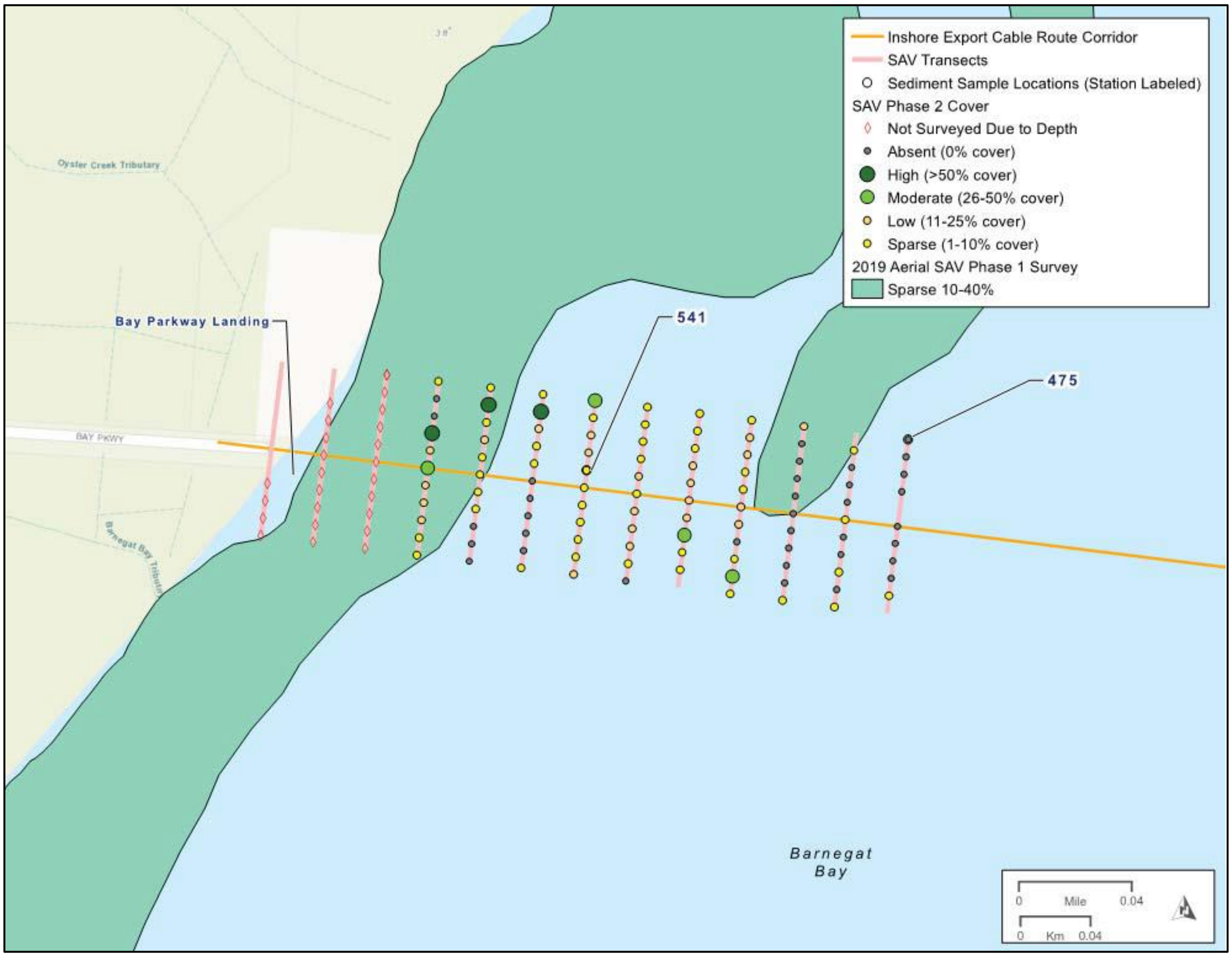

Figure 10.2-8 SAV Percent Cover Estimates at Bay Parkway Landing, 2019 and 2020 (Phase 1 and Phase 2) Surveys

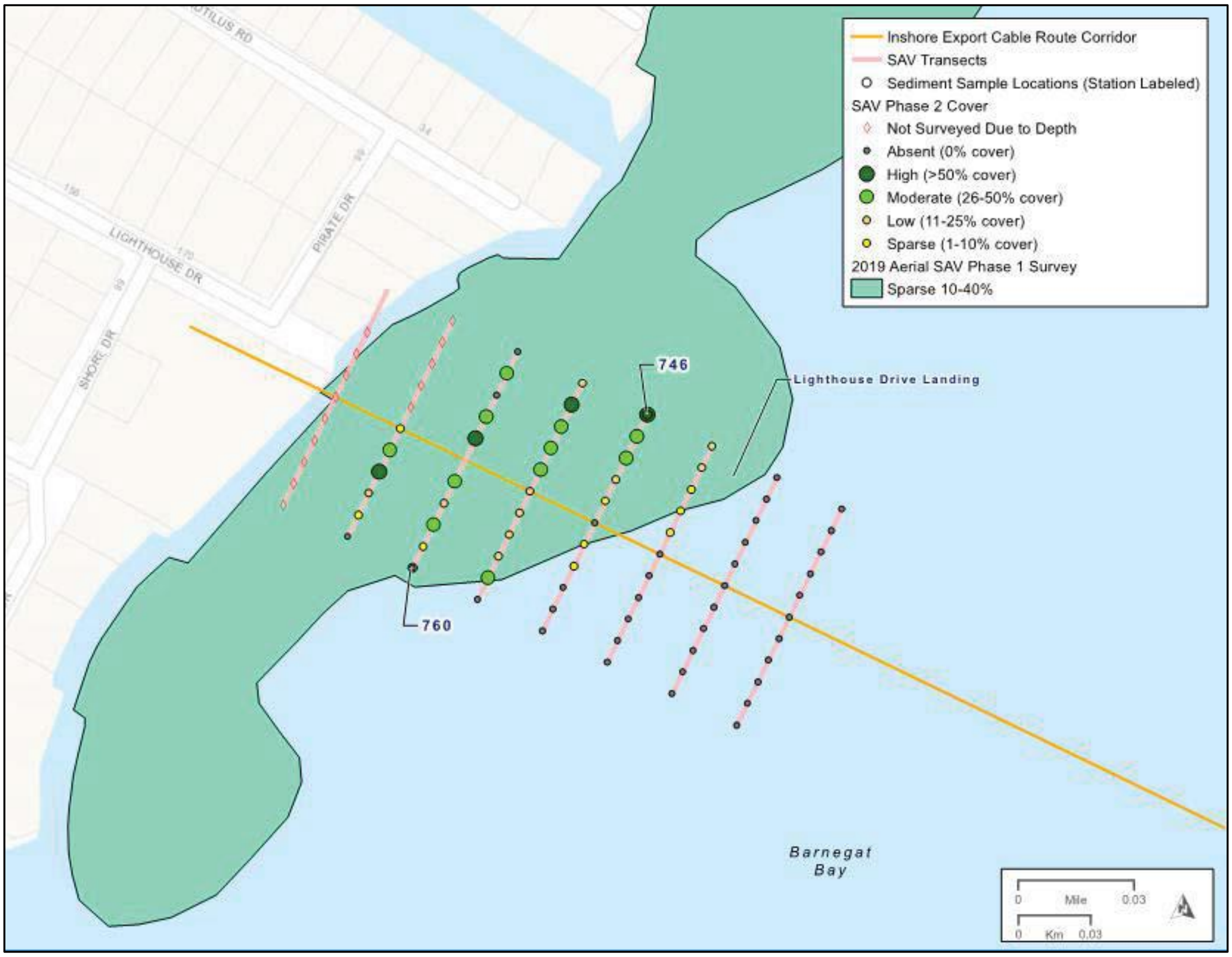

Figure 10.2-9 SAV Percent Cover Estimates at Lighthouse Drive Landing, 2019 and 2020 (Phase 1 and Phase 2) Surveys

Figure 10.2-10 SAV Presence and Sample Points Collected in the Area of the Prior Channel Option of the Oyster Creek IECRC

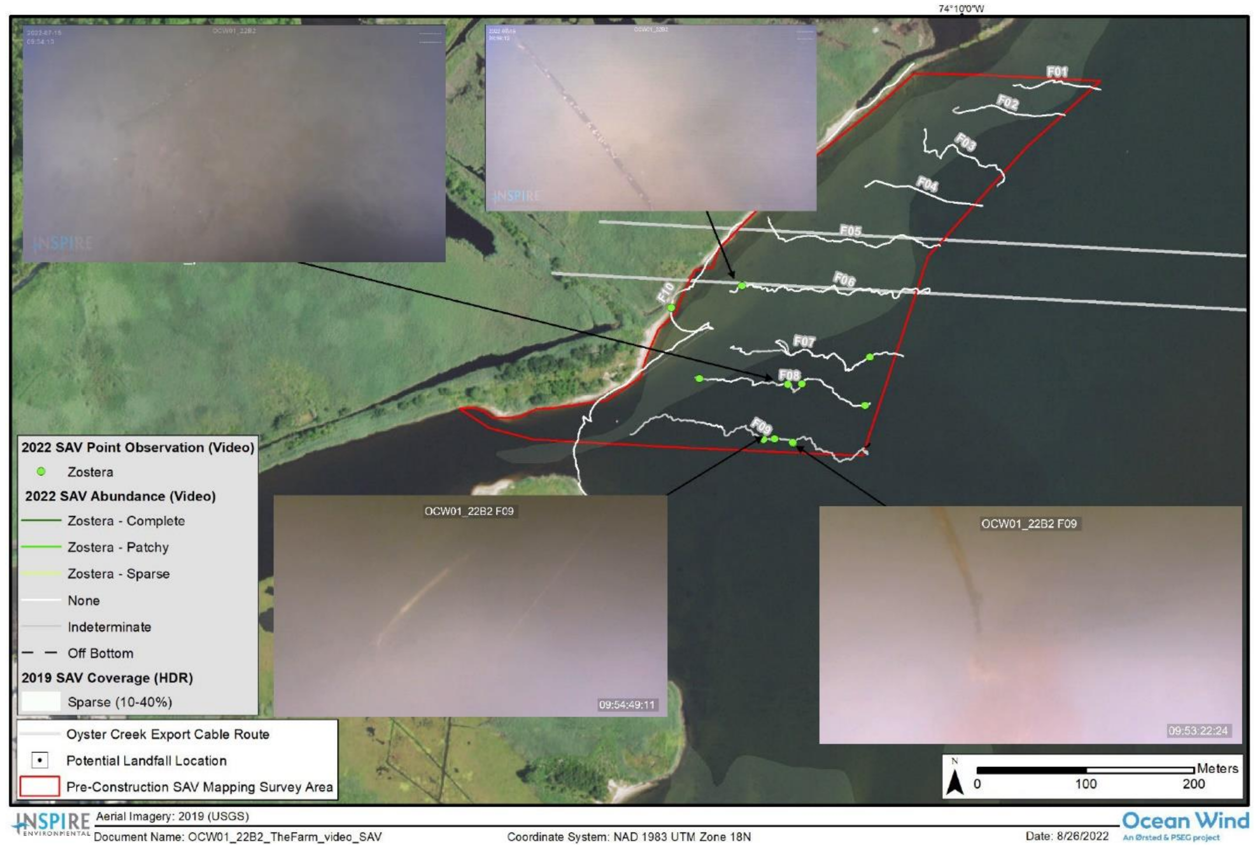

Figure 10.2-11 SAV Observed Along the Video Transects at the Farm (July 2022)

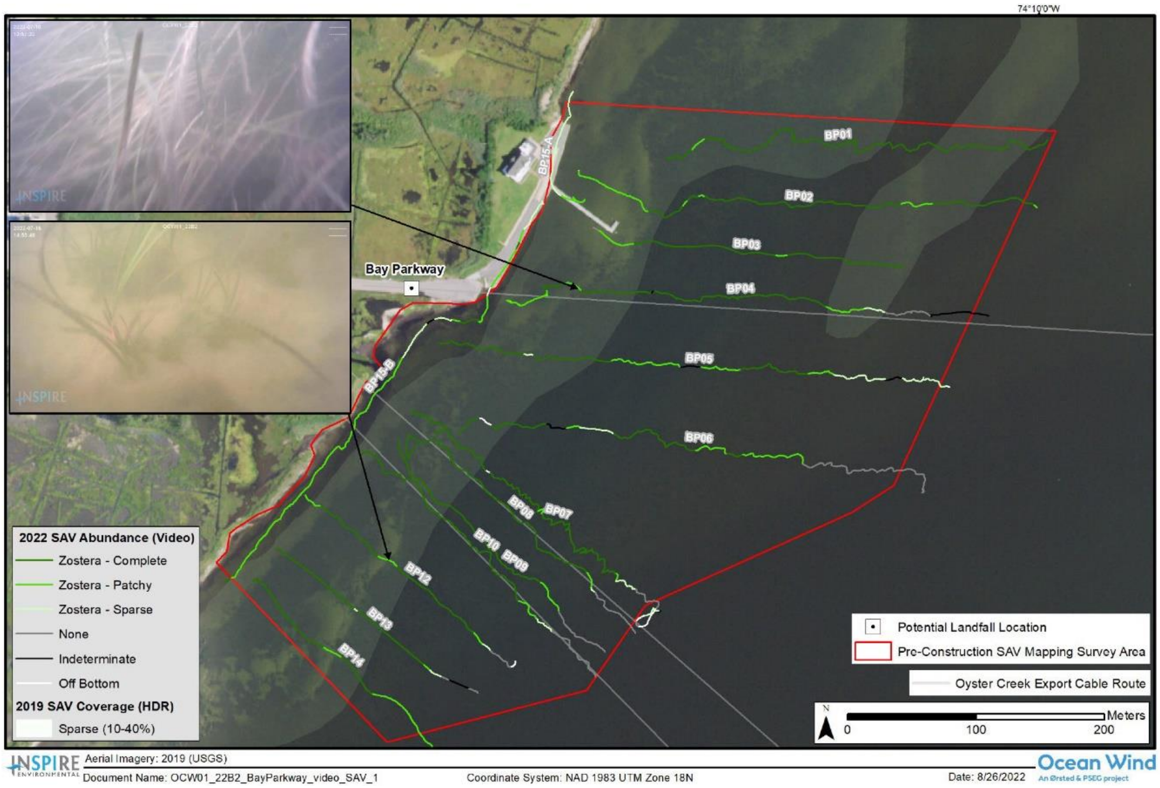

Figure 10.2-12 SAV Observed Along the Video Transects at Bay Parkway (July 2022)

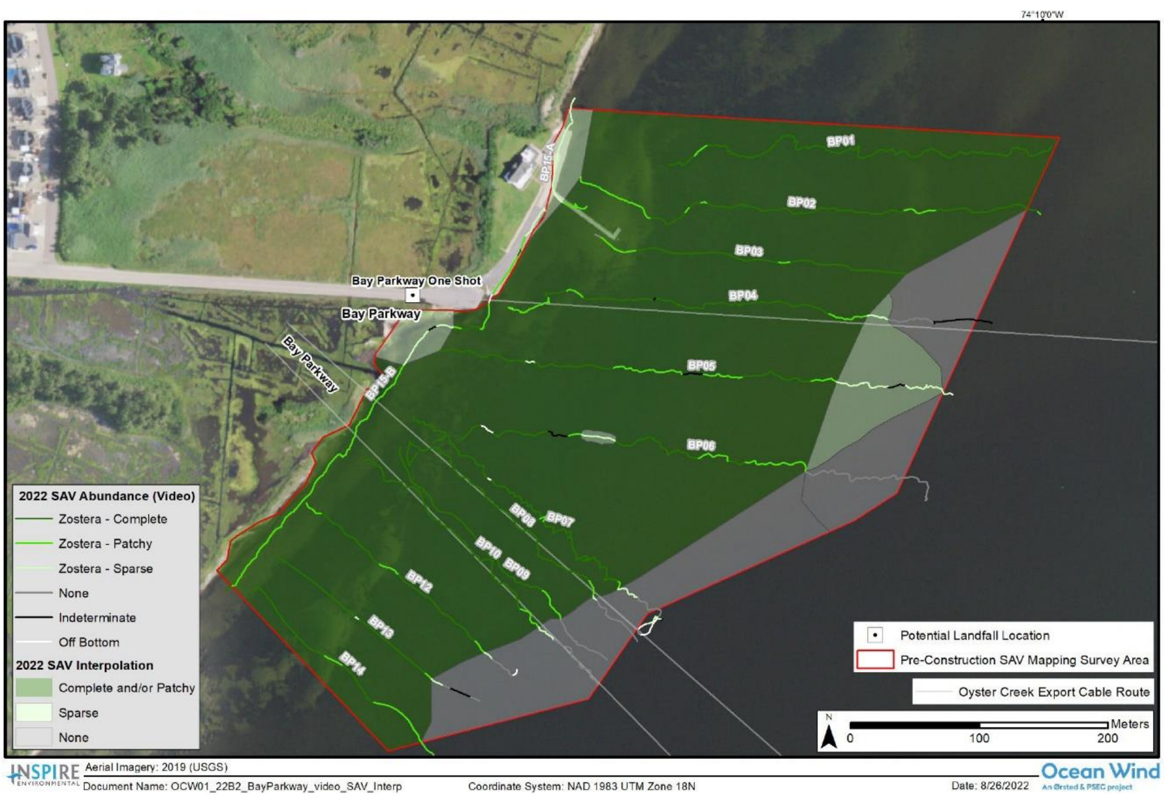

Figure 10.2-13 Estimated SAV Habitat Acreage (including observations of both patchy and complete SAV coverage in video data) at Bay Parkway (July 2022)

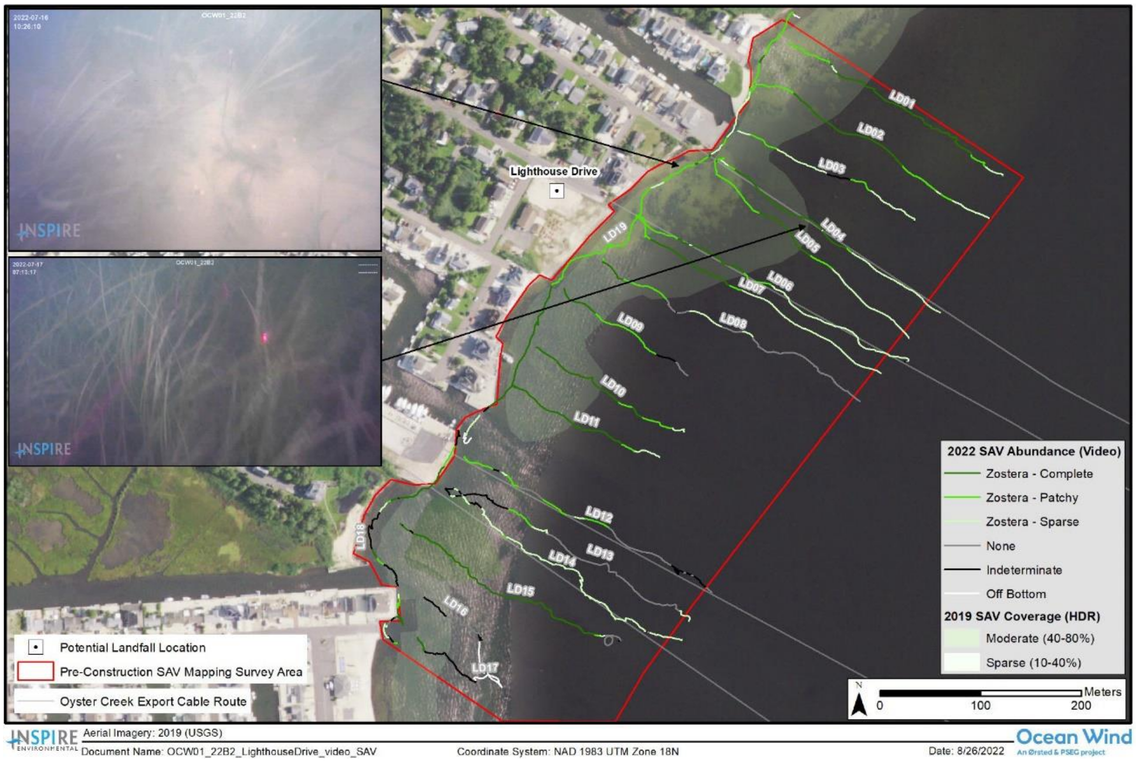

Figure 10.2-14 SAV Observed Along Video Transects at Lighthouse Drive (July 2022)

Figure 10.2-15 Estimated SAV Habitat Acreage (including observations of both patchy and complete SAV coverage in video data) at Lighthouse Drive (July 2022)

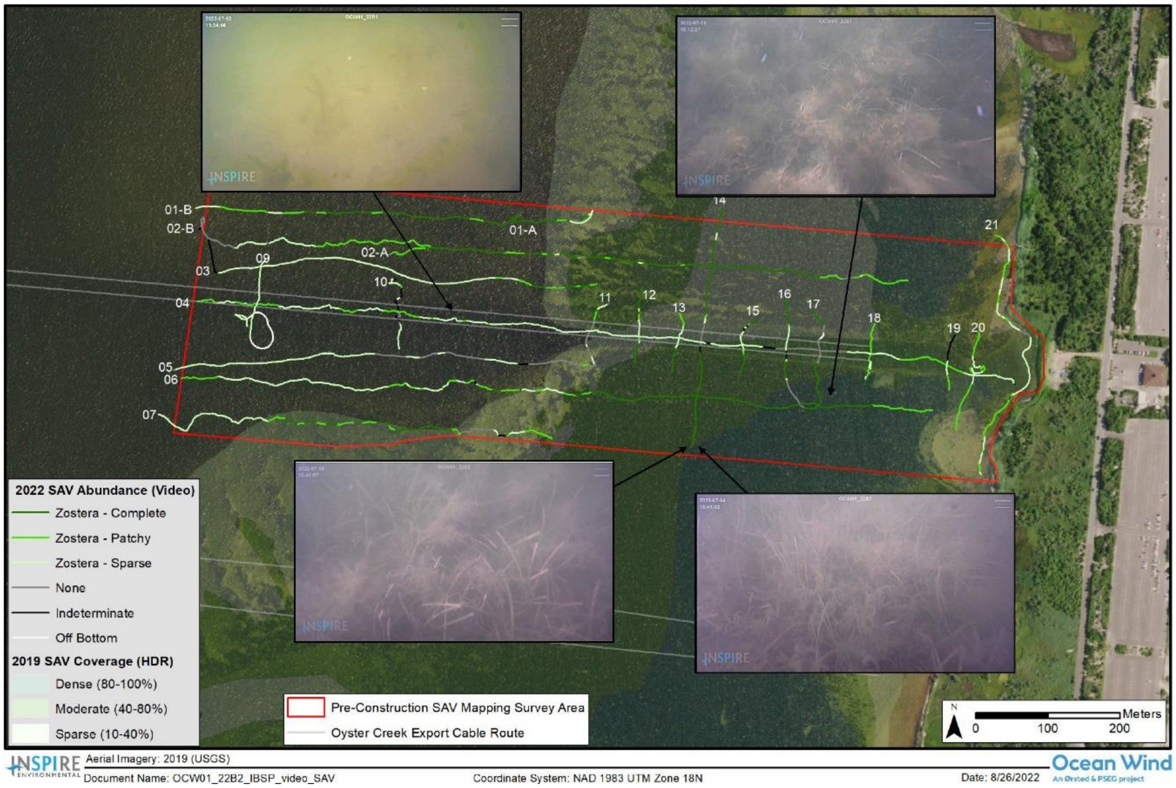

Figure 10.2-16 SAV Observed Along Video Transects at IBSP (July 2022)

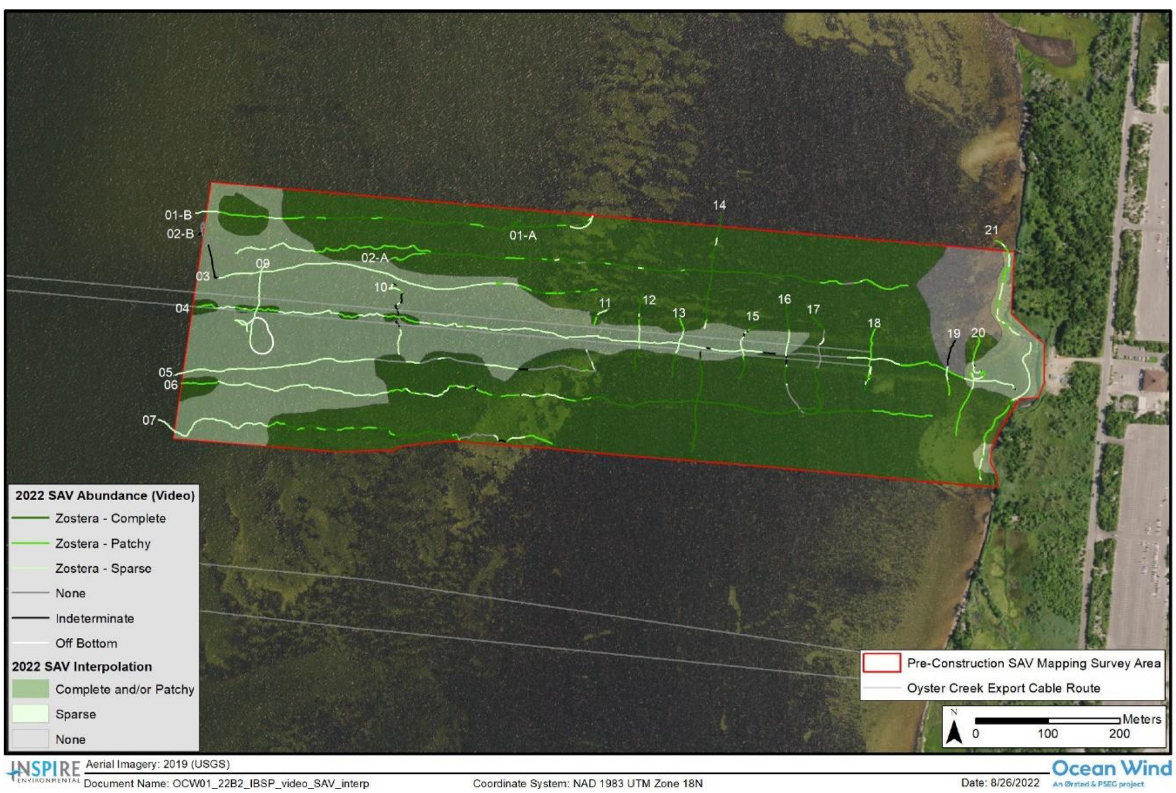

Figure 10.2-17 Estimated SAV Habitat Acreage (including observations of both patchy and complete SAV coverage in the video data) at IBSP (July 2022)

10.2.4.1 Historic SAV Surveys, Individual Maps

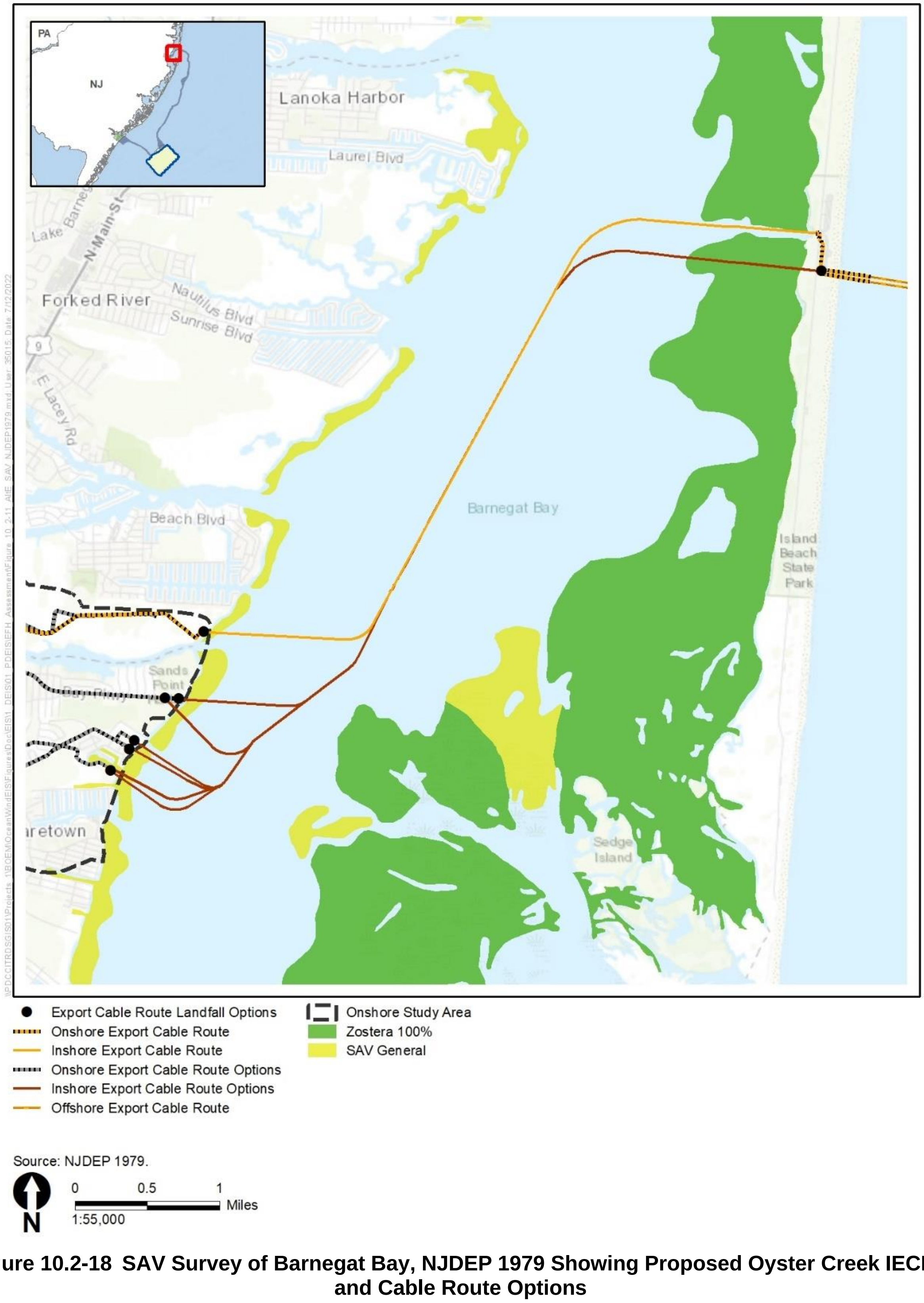

Figure 10.2-18 SAV Survey of Barnegat Bay, NJDEP 1979 Showing Proposed Oyster Creek IECRC and Cable Route Options

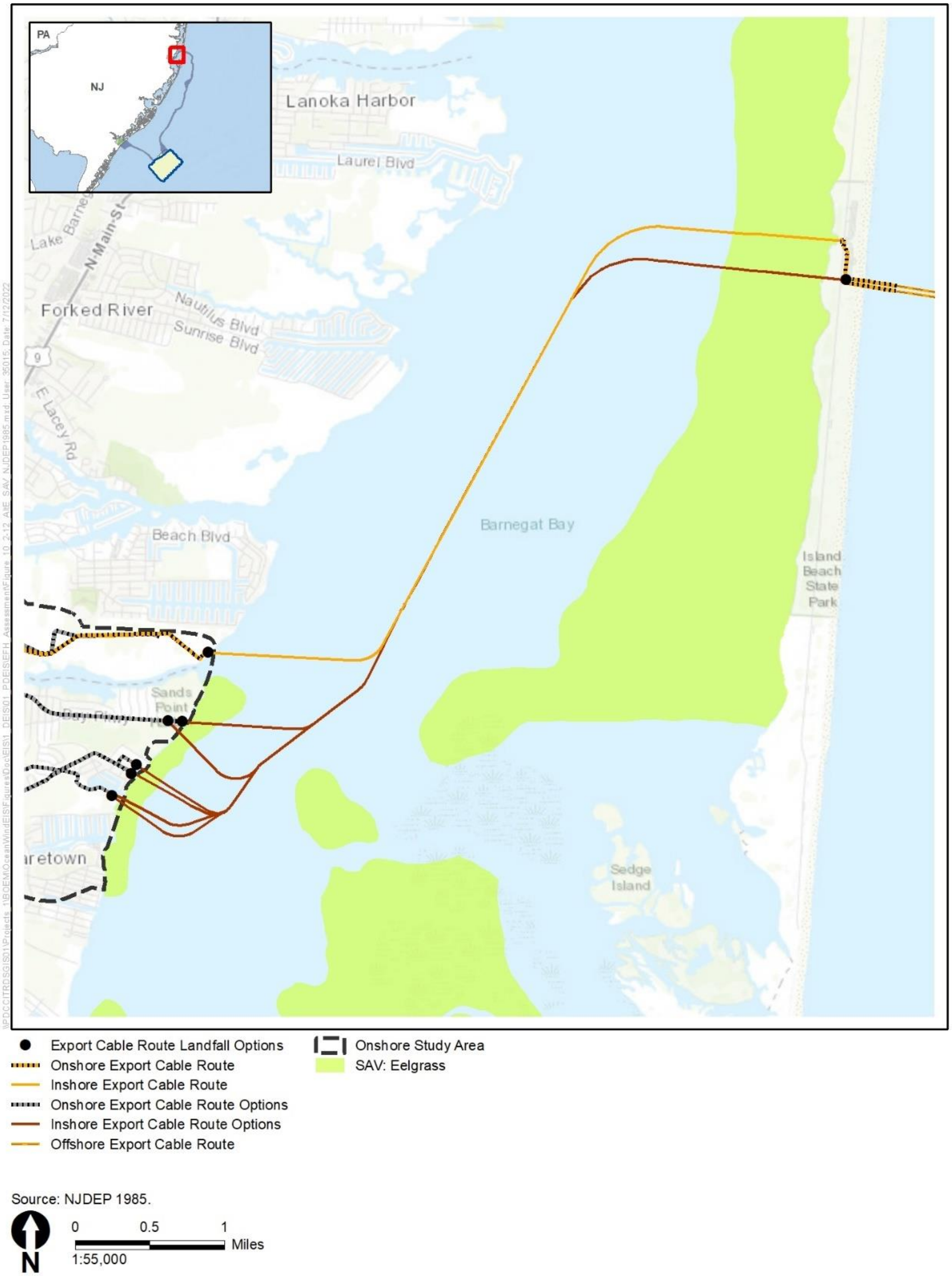

Figure 10.2-19 SAV Survey of Barnegat Bay, NJDEP 1985 Showing Proposed Oyster Creek IECRC and Cable Route Options

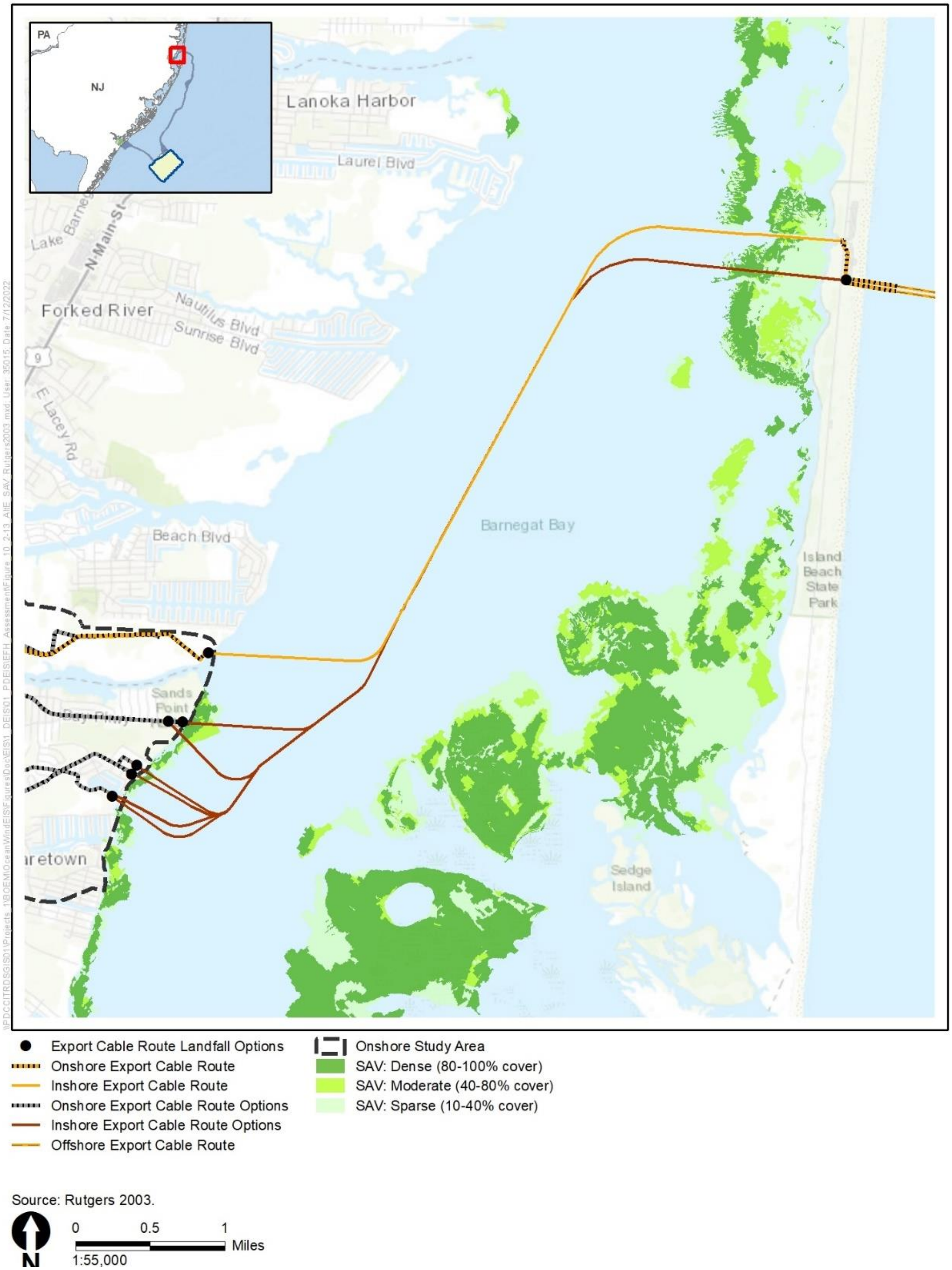

Figure 10.2-20 SAV Survey of Barnegat Bay, Rutgers 2003 Showing Proposed Oyster Creek IECRC and Cable Route Options

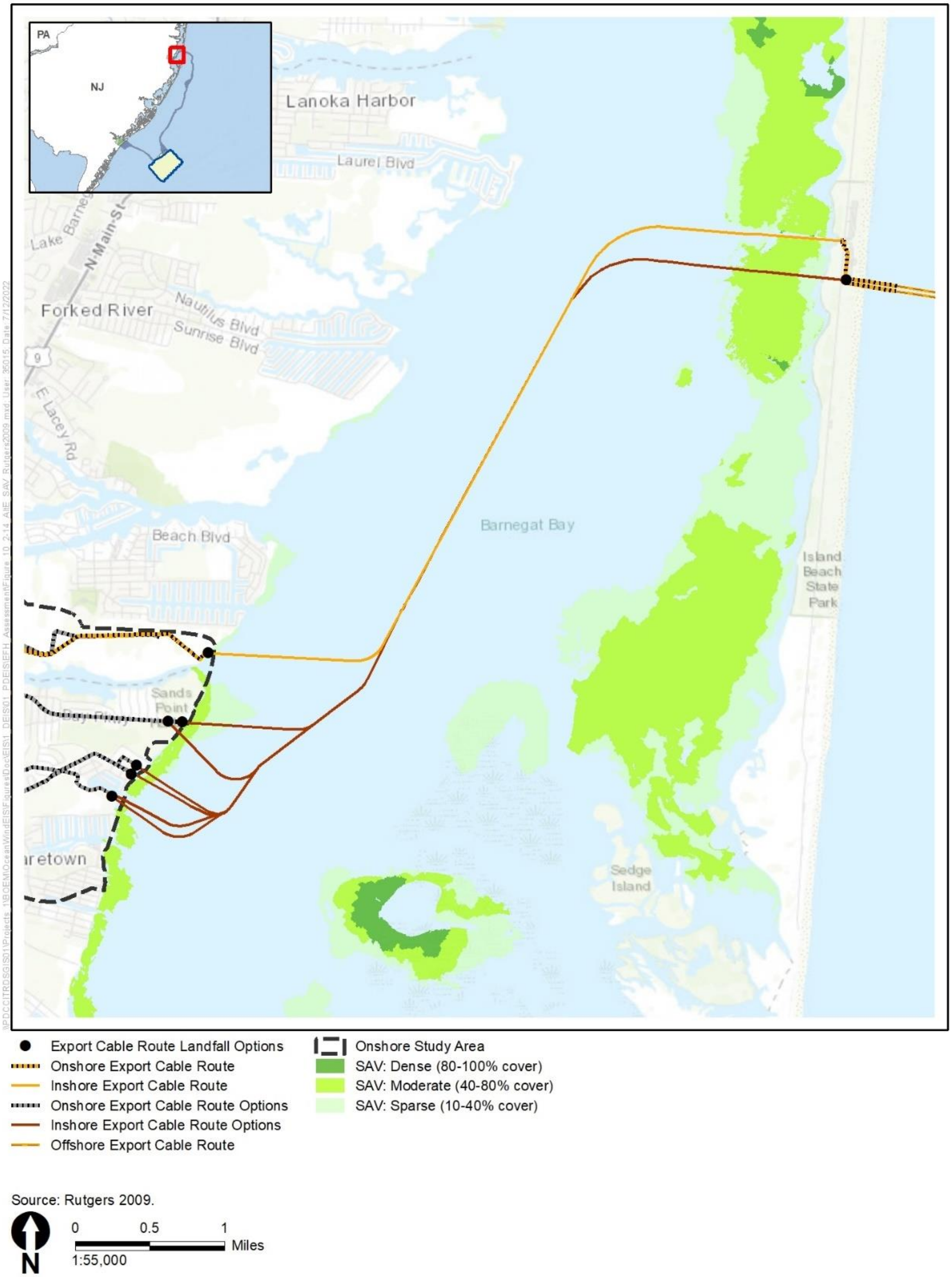

Figure 10.2-21 SAV Survey of Barnegat Bay, Rutgers 2009 Showing Proposed Oyster Creek IECRC and Cable Route Options

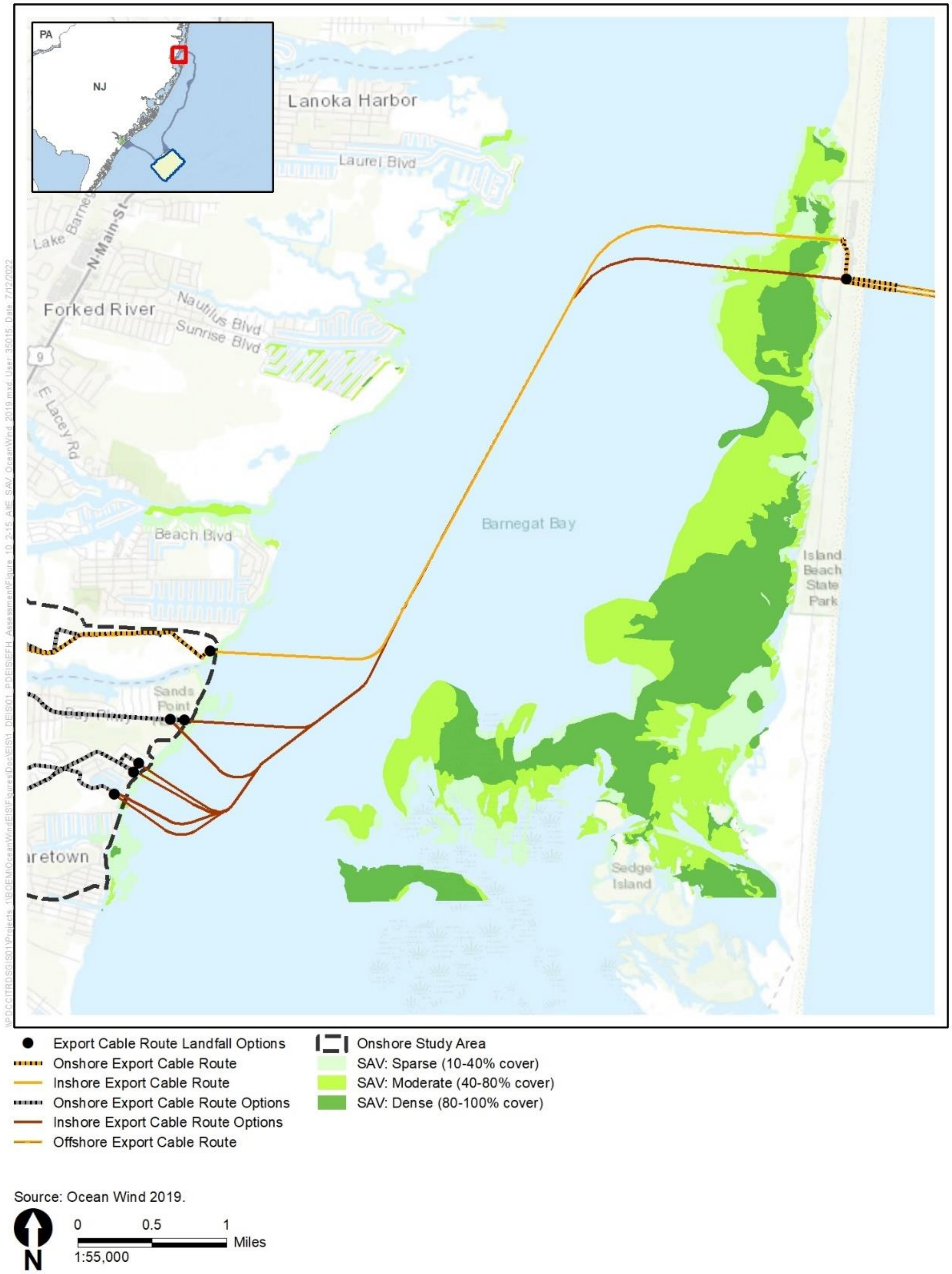

Figure 10.2-22 SAV Survey of Barnegat Bay, Ocean Wind 2019 Showing Proposed Oyster Creek IECRC and Cable Route Options

10.2.5 Summary of Impacts to EFH Species with Benthic Life Stages within the Project Area

Table 10.2-4 Summary of Impacts to EFH-designated Species with Benthic Life Stages within the Project Area

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Adverse Impact
Atlantic Cod	Egg	Pelagic habitats and high-salinity zones of bays and estuaries	WFA, IECRC, and OECRC	Short-term direct
	Larvae	Pelagic habitats and high-salinity zones of bays and estuaries	WFA, IECRC, and OECRC	Short-term direct
	Adult	Structurally complex hard bottom composed of gravel, cobble, and boulder substrates with and without epifauna and macroalgae	WFA, IECRC, and OECRC	Short-term direct
Atlantic Sea Scallop	Egg	Sand and gravel substrate in inshore areas and on the continental shelf	WFA, IECRC, and OECRC	Short-term direct Long-term indirect
	Larvae	Benthic and water column in inshore and offshore areas	WFA, IECRC, and OECRC	Short-term direct Long-term indirect
	Juvenile	Benthic habitat with firm sand, gravel, shell, or rock	WFA, IECRC, and OECRC	Short-term direct Long-term indirect
	Adult	Benthic habitat with firm sand, gravel, shell, or rock	WFA, IECRC, and OECRC	Short-term direct Long-term indirect
Black Sea Bass	Larvae	Close to shore on continental shelf	WFA and OECRC	Short-term direct
	Juvenile	Demersal waters over the continental shelf, inland bays, and estuaries	WFA, IECRC, and OECRC	Short-term, long-term, permanent direct
	Adult	Demersal waters over the continental shelf, inland bays, and estuaries	WFA, IECRC, and OECRC	Short-term, long-term, permanent direct
Monkfish	Egg	Surface waters	WFA, IECRC, and OECRC	Short-term direct
	Larvae	Initially pelagic and transition to benthic habitat	WFA, IECRC, and OECRC	Short-term direct
	Juvenile	Subtidal benthic habitat on hard sand, pebbles, gravel, broken shell, soft mud, and rocky substrate	WFA and OECRC	Short-term direct

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Adverse Impact
	Adult	Benthic habitat on hard sand, pebbles, gravel, broken shell, soft mud, and rocky substrate	WFA and OECRC	Short-term direct
Ocean Pout	Egg	Hard bottom habitat	WFA and OECRC	Short-term direct
	Juvenile	Intertidal and subtidal benthic habitat on shells, rocks, algae, soft sediments, sand, and gravel	WFA, IECRC, and OECRC	Short-term direct
	Adult	Subtidal and benthic habitats on mud and sand substrates, as well as shell, gravel, and boulder	WFA, IECRC, and OECRC	Short-term direct
Ocean Quahog	Juvenile	Offshore sandy substrates	WFA and OECRC	Short-term direct Long-term indirect
	Adult	Pelagic habitats on continental shelf	WFA and OECRC	Short-term direct
Red Hake	Egg	Pelagic habitats on the continental shelf	WFA, IECRC, and OECRC	Short-term direct
	Larvae	Free floating at surface with debris, sargassum, and jellyfish	WFA, IECRC, and OECRC	Short-term direct
	Juvenile	Depression in substrate on fine, silty sand; eelgrass, deep areas offshore in sea scallops	WFA, IECRC, and OECRC	Short-term direct
	Adult	Benthic habitat of sand and mud in depressions	WFA and OECRC	Short-term direct
Scup	Juvenile	Demersal waters over the continental shelf and inshore estuaries; found in mud, sand, mussel beds	WFA, IECRC, and OECRC	Short-term direct Long-term indirect
	Adult	Soft, sandy substrate on or near structures such as rocky ledges, wrecks, artificial reefs, and mussel beds	WFA, IECRC, and OECRC	Short-term direct
Spiny Dogfish	Juvenile	Pelagic habitats on continental shelf	WFA and OECRC	Short-term direct
	Adult	Pelagic habitats on continental shelf	WFA and OECRC	Short-term direct
Summer Flounder	Egg	Pelagic habitats on continental shelf	WFA, IECRC, and OECRC	Short-term direct
	Larvae	Buried in inshore coastal and marine sandy bottom substrate	WFA, IECRC, and OECRC	Short-term direct

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Adverse Impact
	Juvenile	Estuaries, soft-bottom habitat such as mudflats, seagrass beds, marsh creeks, open bays	WFA, IECRC, and OECRC	Short-term direct
	Adult	Demersal waters over the continental shelf and sandy or muddy bottoms of inshore estuaries	WFA, IECRC, and OECRC	Short-term direct Long-term indirect
	HAPC	SAV habitat, including 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	IECRC	Short-term direct
Atlantic Surfclam	Juvenile	Medium sands, fine and silty-fine sands	WFA, IECRC, and OECRC	Short-term direct Long-term indirect
	Adult	Medium sands, fine and silty-fine sands	WFA, IECRC, and OECRC	Short-term direct Long-term indirect
Silver Hake	Egg	Pelagic habitat on the continental shelf	WFA, IECRC, and OECRC	Short-term direct
	Larvae	Pelagic habitat on the continental shelf	WFA, IECRC, and OECRC	Short-term direct
	Juvenile	Benthic habitat of all substrate types	WFA, IECRC, and OECRC	Short-term direct
	Adult	Silt-sand substrate, sandwave crests, shell, and biogenic depressions	WFA, IECRC, and OECRC	Short-term direct
White Hake	Adult	Fine-grained, muddy substates and mixed soft and rocky habitat	WFA, IECRC, and OECRC	Short-term direct
Windowpane Flounder	Egg	Pelagic habitat on the continental shelf, coastal bays, and estuaries	WFA, IECRC, and OECRC	Short-term direct
	Larvae	Pelagic habitat on the continental shelf, coastal bays, and estuaries	WFA, IECRC, and OECRC	Short-term direct
	Juvenile	Mud and sandy substrates in intertidal and sub-tidal habitat	WFA, IECRC, and OECRC	Short-term direct Long-term indirect
	Adult	Mud and sandy substrates in intertidal and subtidal habitat	WFA, IECRC, and OECRC	Short-term direct Long-term indirect
Winter Flounder	Egg	Sand, muddy sand, mud, macroalgae, gravel bottom substrates	WFA, IECRC, and OECRC	Short-term direct Long-term indirect

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Adverse Impact
	Larvae	Pelagic habitat on the continental shelf, estuarine, and coastal areas	WFA, IECRC, and OECRC	Short-term direct
	Juvenile	Mud, sand, rocky substrates, tidal wetlands, eelgrass habitat	WFA, IECRC, and OECRC	Short-term direct Long-term indirect
	Adult	Mud and sandy substrates; hard-bottom	WFA, IECRC, and OECRC	Short-term direct Long-term indirect
Witch Flounder	Egg	Pelagic habitat on the continental shelf	WFA and OECRC	Short-term direct
	Larvae	Pelagic habitat on the continental shelf	WFA and OECRC	Short-term direct
	Adult	Subtidal benthic habitat on the outer continental shelf and slope, with mud and muddy sand substrates	WFA and OECRC	Short-term direct
Yellowtail Flounder	Egg	Coastal and continental shelf in water column	WFA, IECRC, and OECRC	Short-term direct
	Larvae	Coastal and continental shelf in water column	WFA, IECRC, and OECRC	Short-term direct
	Juvenile	Sandy substrates	WFA and OECRC	Short-term direct
	Adult	Sand, sand with mud, shell hash, gravel, and rocks	WFA and OECRC	Short-term direct
Clearnose Skate	Juvenile	Mud and sand, but also on gravelly and rocky substrate	WFA, IECRC, and OECRC	Short-term direct
	Adult	Mud and sand, but also on gravelly and rocky substrate	WFA, IECRC, and OECRC	Short-term direct
Little Skate	Juvenile	Sand and gravel substrates, but also on mud	WFA, IECRC, and OECRC	Short-term direct
	Adult	Sand and gravel substrates, but also on mud	WFA, IECRC, and OECRC	Short-term direct
Winter Skate	Juvenile	Sand and gravel substrates, but also on mud	WFA, IECRC, and OECRC	Short-term direct
	Adult	Sand and gravel substrates, but also on mud	WFA, IECRC, and OECRC	Short-term direct

Source: Ocean Wind 2022a
IECRC = Inshore Export Cable Route Corridor; OECRC = Offshore Export Cable Route Corridor; WFA = Wind Farm Area

10.2.6 Summary of Impacts to EFH Species with Pelagic Life Stages within the Project Area

Table 10.2-5 Summary of Impacts to EFH-designated Species with Pelagic Life Stages within the Project Area

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Impact
Albacore Tuna	Juvenile and Adult	Inshore and pelagic surface waters. Offshore and coastal pelagic habitat	WFA and OECRC	No short or long-term direct or indirect
Atlantic Angel Shark	Neonate, Juvenile, and Adult	Continental shelf habitats from Cape May, New Jersey, to Cape Lookout, North Carolina	WFA and OECRC	Short-term indirect
Atlantic Butterfish	Egg	Pelagic habitats in inshore estuaries and embayments and over bottom depths of 1,500 feet (457 meters) or less	WFA, IECRC, and OECRC	Short-term direct
	Larvae	Pelagic habitats in depths between 101.7 and 1,148.2 feet (31 and 350 meters)	WFA and OECRC	Short-term direct
	Juvenile	Surface waters associated with flotsam and large jellyfish	WFA, IECRC, and OECRC	No short or long-term direct or indirect
	Adult	Bottom depths between 32.8 and 820 feet (10 and 250 meters)	WFA and OECRC	Short-term direct
Atlantic Herring	Larvae	Water column within inshore and estuarine waters	WFA and OECRC	Short-term direct Long-term indirect
	Juvenile	Pelagic and bottom waters of inland bays	WFA, IECRC, and OECRC	No short or long-term direct or indirect
	Adult	Pelagic and bottom waters of inland bays	WFA, IECRC, and OECRC	No short or long-term direct or indirect
Atlantic Mackerel	Egg	Pelagic in upper water column	WFA and OECRC	Short-term direct Long-term indirect
	Larvae	Bottom waters ranging between 32.8 to 426.5 feet (10 to 130 meters)	WFA and OECRC	Short-term direct Long-term indirect
	Juvenile	Bottom waters ranging from surface to 1,115 feet (340 meters)	WFA and OECRC	No short or long-term direct or indirect
	Adult	Bottom waters ranging from surface to 1,115 feet (340 meters)	WFA and OECRC	No short or long-term direct or indirect
Atlantic Sharpnose	Adult	Coastal, shallow habitat including enclosed bays, sounds, harbors, and marine to brackish estuaries	WFA and OECRC	No short or long-term direct or indirect

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Impact
Basking Shark	Neonate, Juvenile, and Adult	Coastal and oceanic deepwater habitat	WFA and OECRC	No short or long-term direct or indirect
Blue Shark	Neonate, Juvenile, Adult	Offshore pelagic habitat	WFA and OECRC	No short or long-term direct or indirect
Bluefin Tuna	Juvenile	Inshore and pelagic surface waters	OECRC	No short or long-term direct or indirect
	Adult	Offshore and coastal pelagic habitat	WFA and OECRC	No short or long-term direct or indirect
Common Thresher Shark	Neonate, Juvenile, and Adult	Inshore, coastal, and oceanic waters	WFA and OECRC	No short or long-term direct or indirect
Yellowfin Tuna	Juvenile	Offshore, coastal, and pelagic waters	WFA and OECRC	No short or long-term direct or indirect
	Adult	Offshore, coastal, and pelagic waters	WFA and OECRC	No short or long-term direct or indirect
Bluefish	Egg	Mid-shelf waters ranging from 98.4 to 229.6 feet (30 to 70 meters)	WFA and OECRC	Short-term direct Long-term indirect
	Larvae	Oceanic waters no deeper than 49.2 feet (15 meters) in water column; transported to estuarine nurseries	WFA and OECRC	Short-term direct Long-term indirect
	Juvenile	Pelagic nearshore areas and estuaries with sand, mud, or clay substrate	WFA, IECRC, and OECRC	No short or long-term direct or indirect
	Adult	Oceanic, nearshore, and continental shelf waters; inland bays; not associated with specific substrate	WFA, IECRC, and OECRC	No short or long-term direct or indirect
Dusky Shark	Neonate	Water column depth of 4.3 to 15.5 meters	WFA and OECRC	No short or long-term direct or indirect
	Juvenile	Coastal and pelagic waters inshore of the continental shelf break	WFA and OECRC	No short or long-term direct or indirect
	Adult	Coastal and pelagic waters inshore of the continental shelf break	WFA and OECRC	No short or long-term direct or indirect
Long Fin Squid	Egg	Inshore and offshore bottom habitats at depth in less than 50 meters	WFA and OECRC	Short-term direct Long-term indirect

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Impact
	Juvenile	Bottom depths between 6 and 160 meters	WFA and OECRC	No short or long-term direct or indirect
	Adult	Varying depths of the water column; when inshore, found at bottom depths from 6 to 200 meters	WFA and OECRC	No short or long-term direct or indirect
Pollock	Larvae	Pelagic inshore and offshore habitat	WFA and OECRC	Short-term direct Long-term indirect
Sand Tiger Shark	Neonate and Juvenile	Pelagic and coastal habitat	Potentially present within the WFA and OECRC	No short or long-term direct or indirect
Sandbar Shark	Neonate, Juvenile, and Adult	Pelagic and coastal habitat	Potentially present within the WFA and OECRC	Short-term indirect
Shortfin Mako Shark	Neonate, Juvenile, and Adult	Pelagic wasters from Southern New England though Cape Lookout, North Carolina	Potentially present within the WFA and OECRC	No short or long-term direct or indirect
Skipjack Tuna	Juvenile	Offshore and coastal pelagic habitat	WFA and OECRC	No short or long-term direct or indirect
	Adult	Pelagic habitat associated with birds, drifting objects, whales, and sharks	WFA and OECRC	No short or long-term direct or indirect
Smooth Dogfish	Neonate, Juvenile, and Adult	Coastal shelves and inshore waters	WFA and OECRC	No short or long-term direct or indirect
Swordfish	Juvenile	Middle of oceanic water column in depths from 656 to 853 feet (200 to 600 meters)	Potentially present within WFA and OECRC	No short or long-term direct or indirect
Tiger Shark	Juvenile and Adult	Offshore pelagic habitat	Potentially present within the WFA and OECRC	No short or long-term direct or indirect
White Shark	Neonate	Inshore waters out to 65 miles (105 km)	WFA and OECRC	No short or long-term direct or indirect
	Juvenile	Pelagic habitat between 82 and 328 feet (25 and 100 meters)	WFA and OECRC	No short or long-term direct or indirect
	Adult	Pelagic habitat between 82 and 328 feet (25 and 100 meters)	WFA and OECRC	No short or long-term direct or indirect

Source: Ocean Wind 2022a
IECRC = Inshore Export Cable Route Corridor; OECRC = Offshore Export Cable Route Corridor; WFA = Wind Farm Area

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10.2.7 Summary of Benthic Habitat Impacts within the Project Area

Table 10.2-6 Total Area of Benthic Habitat Types within the Wind Farm Area and Export Cable Corridors

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Coarse Sediment				Sand and Muddy Sand									Mud and Sandy Mud								Total[6]
				Coarse Sediment	Coarse Sediment (interpolated)	Coarse Sediment -Mobile	Coarse Sediment- Mobile (Interpolated)	Sand and Muddy Sand with Low Density Boulder Field	Sand and Muddy Sand-Mobile	Sand and Muddy Sand-Mobile (Interpolated)	Sand and Muddy Sand with SAV	Sand and Muddy Sand with SAV (Interpolated)	Sand and Muddy Sand with Historical SAV	Sand and Muddy Sand with Historical SAV (Interpolated)	Sand and Muddy Sand	Sand and Muddy Sand (Interpolated)	Mud and Sandy Mud with Low Density Boulder Field	Mud and Sandy Mud with SAV	Mud and Sandy Mud with SAV (Interpolated)	Mud and Sandy Mud with Historical SAV	Mud and Sandy Mud with Historical SAV (Interpolated)	Mud and Sandy Mud	Mud and Sandy Mud (Interpolated)	Anthropogenic	
Wind Farm Area - Alternative A, Proposed Action																									
Wind Turbine Generators	Permanent	Foundations[1]	Acres	0.02	-	0.36	-	0.05	1.88	-	-	-	-	-	0.02	-	-	-	-	-	-	-	-	-	2.34
			%	1%	0%	15%	0%	2%	81%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	0.37	-	5.59	-	0.71	28.72	0.2	-	-	-	-	0.40	-	-	-	-	-	-	-	-	-	35.89
			%	1%	0%	16%	0%	2%	80%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	38.91	-	599.84	1.79	54.16	3,886.47	63.22	-	-	-	-	56.16	-	-	-	-	-	-	-	-	-	4,700.55
			%	1%	0%	13%	0%	1%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Offshore Substation Foundations	Permanent	Foundations[1]	Acres	-	-	1.22	-	-	2.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.67
			%	0%	0%	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	-	-	0.20	-	-	0.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.59
			%	0%	0%	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	-	-	10.73	-	-	24.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.96
			%	0%	0%	31%	0%	0%	69%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Inter-Array Cables	Permanent	Cable Protection[4]	Acres	1.96	-	23.53	0.01	0.75	140.25	1.46	-	-	-	-	1.53	-	-	-	-	-	-	-	-	-	169.48
			%	1%	0%	14%	0%	0.4%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	16.11	0.11	195.37	0.09	6.25	1,167.88	12.13	-	-	-	-	12.74	-	-	-	-	-	-	-	-	-	1,410.67
			%	1%	0.01%	14%	0%	0.4%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
OSS Link Cable	Permanent	Cable Protection[4]	Acres	-	-	0.30	-	-	4.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.10
			%	0%	0%	6%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	2.57	-	-	40.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42.72
			%	0%	0%	6%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**2.35**	**-**	**31.20**	**0.01**	**1.51**	**178.49**	**1.66**	**-**	**-**	**-**	**-**	**1.95**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**217.17**
			%	**1%**	**0%**	**14%**	**0%**	**1%**	**82%**	**1%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**55.03**	**0.11**	**808.51**	**1.88**	**60.41**	**5,118.72**	**75.35**	**-**	**-**	**-**	**-**	**68.90**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**6,188.90**
			%	**1%**	**0%**	**13%**	**0%**	**1%**	**83%**	**1%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Wind Farm Area - Alternative B1, No Surface Occupancy at Select Locations to Reduce Visual Impacts																									
Wind Turbine Generators	Permanent	Foundations[1]	Acres	0.02	-	0.29	-	0.05	1.74	-	-	-	-	-	0.02	-	-	-	-	-	-	-	-	-	2.13
			%	1%	0%	14%	0%	2%	82%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	0.37	-	4.86	-	0.71	26.21	-	-	-	-	-	0.39	-	-	-	-	-	-	-	-	-	32.54
			%	1%	0%	15%	0%	2%	81%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	35.05	-	587.14	0.09	54.28	3,538.98	11.51	-	-	-	-	56.48	-	-	-	-	-	-	-	-	-	4,283.53
			%	1%	0%	14%	0%	1%	83%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Offshore Substation Foundations	Permanent	Foundations[1]	Acres	-	-	1.22	-	-	2.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.67
			%	0%	0%	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	-	-	0.20	-	-	0.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.59
			%	0%	0%	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	-	-	10.73	-	-	24.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.96
			%	0%	0%	31%	0%	0%	69%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Inter-Array Cables	Permanent	Cable Protection[4]	Acres	1.96	-	23.53	0.01	0.75	140.25	1.46	-	-	-	-	1.53	-	-	-	-	-	-	-	-	-	169.48
			%	1%	0%	14%	0%	0.4%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	16.11	0.11	195.37	0.09	6.25	1,167.88	12.13	-	-	-	-	12.74	-	-	-	-	-	-	-	-	-	1,410.67
			%	1%	0.01%	14%	0%	0.4%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
OSS Link Cable	Permanent	Cable Protection[4]	Acres	-	-	0.30	-	-	4.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.10
			%	0%	0%	6%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Coarse Sediment				Sand and Muddy Sand									Mud and Sandy Mud								Total[6]
				Coarse Sediment	Coarse Sediment (interpolated)	Coarse Sediment -Mobile	Coarse Sediment- Mobile (Interpolated)	Sand and Muddy Sand with Low Density Boulder Field	Sand and Muddy Sand-Mobile	Sand and Muddy Sand-Mobile (Interpolated)	Sand and Muddy Sand with SAV	Sand and Muddy Sand with SAV (Interpolated)	Sand and Muddy Sand with Historical SAV	Sand and Muddy Sand with Historical SAV (Interpolated)	Sand and Muddy Sand	Sand and Muddy Sand (Interpolated)	Mud and Sandy Mud with Low Density Boulder Field	Mud and Sandy Mud with SAV	Mud and Sandy Mud with SAV (Interpolated)	Mud and Sandy Mud with Historical SAV	Mud and Sandy Mud with Historical SAV (Interpolated)	Mud and Sandy Mud	Mud and Sandy Mud (Interpolated)	Anthropogenic	
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	2.57	-	-	40.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42.72
			%	0%	0%	6%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**2.35**	**-**	**30.40**	**0.01**	**1.51**	**175.84**	**1.46**	**-**	**-**	**-**	**-**	**1.95**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**213.52**
			%	**1%**	**0%**	**14%**	**0%**	**1%**	**82%**	**1%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**51.16**	**0.11**	**795.81**	**0.18**	**60.53**	**4,771.24**	**23.64**	**-**	**-**	**-**	**-**	**69.21**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5,771.88**
			%	**1%**	**0%**	**14%**	**0%**	**1%**	**83%**	**0%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Wind Farm Area - Alternative B2, No Surface Occupancy at Select Locations to Reduce Visual Impacts																									
Wind Turbine Generators	Permanent	Foundations[1]	Acres	0.02	-	0.29	-	0.05	1.50	-	-	-	-	-	0.02	-	-	-	-	-	-	-	-	-	1.89
			%	1%	0%	16%	0%	3%	79%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	0.37	-	4.66	-	0.71	22.75	-	-	-	-	-	0.39	-	-	-	-	-	-	-	-	-	28.88
			%	1%	0%	16%	0%	2%	79%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	35.04	-	540.91	0.00	54.28	3,104.71	10.81	-	-	-	-	56.48	-	-	-	-	-	-	-	-	-	3,802.23
			%	1%	0%	14%	0%	1%	82%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Offshore Substation Foundations	Permanent	Foundations[1]	Acres	-	-	1.22	-	-	2.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.67
			%	0%	0%	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	-	-	0.20	-	-	0.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.59
			%	0%	0%	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	-	-	10.73	-	-	24.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.96
			%	0%	0%	31%	0%	0%	69%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Inter-Array Cables	Permanent	Cable Protection[4]	Acres	1.96	-	23.53	0.01	0.75	140.25	1.46	-	-	-	-	1.53	-	-	-	-	-	-	-	-	-	169.48
			%	1%	0%	14%	0%	0.4%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	16.11	0.11	195.37	0.09	6.25	1,167.88	12.13	-	-	-	-	12.74	-	-	-	-	-	-	-	-	-	1,410.67
			%	1%	0.01%	14%	0%	0.4%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
OSS Link Cable	Permanent	Cable Protection[4]	Acres	-	-	0.30	-	-	4.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.10
			%	0%	0%	6%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	2.57	-	-	40.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42.72
			%	0%	0%	6%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**2.35**	-	**30.21**	**0.01**	**1.51**	**72.14**	**1.46**	**-**	**-**	**-**	**-**	**1.95**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**209.62**
			%	**1%**	0%	**14%**	**0%**	**1%**	**82%**	**1%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**51.16**	**0.11**	**749.58**	**0.09**	**60.53**	**4,336.97**	**22.94**	**-**	**-**	**-**	**-**	**69.21**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5,290.58**
			%	**1%**	**0%**	**14%**	**0%**	**1%**	**82%**	**0%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Wind Farm Area - Alternative C1, Wind Turbine Layout Modification to Establish a Buffer Between Ocean Wind and Atlantic Shores																									
Wind Turbine Generators	Permanent	Foundations[1]	Acres	0.02	-	0.32	-	0.05	1.91	-	-	-	-	-	0.02	-	-	-	-	-	-	-	-	-	2.33
			%	1%	0%	14%	0%	2%	82%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	0.37	-	5.32	-	0.71	29.04	-	-	-	-	-	0.39	-	-	-	-	-	-	-	-	-	35.83
			%	1%	0%	15%	0%	2%	81%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	44.49	-	651.95	0.37	54.27	3,888.77	19.96	-	-	-	-	56.90	-	-	-	-	-	-	-	-	-	4,716.71
			%	1%	0%	14%	0%	1%	82%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Offshore Substation Foundations	Permanent	Foundations[1]	Acres	-	-	1.22	-	-	2.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.67
			%	0%	0%	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	-	-	0.20	-	-	0.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.59
			%	0%	0%	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	-	-	10.73	-	-	24.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.96
			%	0%	0%	31%	0%	0%	69%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Inter-Array Cables	Permanent	Cable Protection[4]	Acres	1.96	-	23.53	0.01	0.75	140.25	1.46	-	-	-	-	1.53	-	-	-	-	-	-	-	-	-	169.48
			%	1%	0%	14%	0%	0.4%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	16.11	0.11	195.37	0.09	6.25	1,167.88	12.13	-	-	-	-	12.74	-	-	-	-	-	-	-	-	-	1,410.67
			%	1%	0.01%	14%	0%	0.4%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Coarse Sediment				Sand and Muddy Sand									Mud and Sandy Mud								Total[6]
				Coarse Sediment	Coarse Sediment (interpolated)	Coarse Sediment -Mobile	Coarse Sediment- Mobile (Interpolated)	Sand and Muddy Sand with Low Density Boulder Field	Sand and Muddy Sand-Mobile	Sand and Muddy Sand-Mobile (Interpolated)	Sand and Muddy Sand with SAV	Sand and Muddy Sand with SAV (Interpolated)	Sand and Muddy Sand with Historical SAV	Sand and Muddy Sand with Historical SAV (Interpolated)	Sand and Muddy Sand	Sand and Muddy Sand (Interpolated)	Mud and Sandy Mud with Low Density Boulder Field	Mud and Sandy Mud with SAV	Mud and Sandy Mud with SAV (Interpolated)	Mud and Sandy Mud with Historical SAV	Mud and Sandy Mud with Historical SAV (Interpolated)	Mud and Sandy Mud	Mud and Sandy Mud (Interpolated)	Anthropogenic	
OSS Link Cable	Permanent	Cable Protection[4]	Acres	-	-	0.30	-	-	4.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.10
			%	0%	0%	6%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	2.57	-	-	40.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42.72
			%	0%	0%	6%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**2.35**	**-**	**30.89**	**0.01**	**1.51**	**178.84**	**1.46**	**-**	**-**	**-**	**-**	**1.95**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**217.00**
			%	**1%**	**0%**	**14%**	**0%**	**1%**	**82%**	**1%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**60.60**	**0.11**	**860.62**	**0.46**	**60.53**	**5,121.02**	**32.09**	**-**	**-**	**-**	**-**	**69.64**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**6,205.07**
			%	**1%**	**0%**	**14%**	**0%**	**1%**	**83%**	**1%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Wind Farm Area - Alternative C2 (405nm), Wind Turbine Layout Modification to Establish a Buffer Between Ocean Wind and Atlantic Shores																									
Wind Turbine Generators	Permanent	Foundations[1]	Acres	0.02	-	0.32	-	0.05	1.93	-	-	-	-	-	0.02	-	-	-	-	-	-	-	-	-	2.34
			%	1%	0%	14%	0%	2%	82%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	0.37	-	5.18	-	0.71	29.16	-	-	-	-	-	0.39	0.03	-	-	-	-	-	-	-	-	35.83
			%	1%	0%	14%	0%	2%	81%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	40.25	-	603.42	1.80	54.24	3,907.13	50.45	-	-	-	-	56.44	2.97	-	-	-	-	-	-	-	-	4,716.70
			%	1%	0%	13%	0%	1%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Offshore Substation Foundations	Permanent	Foundations[1]	Acres	-	-	1.22	-	-	2.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.67
			%	0%	0%	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	-	-	0.20	-	-	0.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.59
			%	0%	0%	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	-	-	10.73	-	-	24.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.96
			%	0%	0%	31%	0%	0%	69%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Inter-Array Cables	Permanent	Cable Protection[4]	Acres	1.96	-	23.53	0.01	0.75	140.25	1.46	-	-	-	-	1.53	-	-	-	-	-	-	-	-	-	169.48
			%	1%	0%	14%	0%	0.4%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	16.11	0.11	195.37	0.09	6.25	1,167.88	12.13	-	-	-	-	12.74	-	-	-	-	-	-	-	-	-	1,410.67
			%	1%	0.01%	14%	0%	0.4%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
OSS Link Cable	Permanent	Cable Protection[4]	Acres	-	-	0.30	-	-	4.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.10
			%	0%	0%	6%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	2.57	-	-	40.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42.72
			%	0%	0%	6%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**2.34**	**-**	**30.74**	**0.01**	**1.51**	**178.98**	**1.46**	**-**	**-**	**-**	**-**	**1.95**	**0.03**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**217.03**
			%	**1%**	**0%**	**14%**	**0%**	**1%**	**82%**	**1%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**56.36**	**0.11**	**812.09**	**1.89**	**60.49**	**5,139.38**	**62.58**	**-**	**-**	**-**	**-**	**69.18**	**2.97**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**6,205.05**
			%	**1%**	**0%**	**13%**	**0%**	**1%**	**83%**	**1%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Wind Farm Area - Alternative C2 (540 nm), Wind Turbine Layout Modification to Establish a Buffer Between Ocean Wind and Atlantic Shores																									
Wind Turbine Generators	Permanent	Foundations[1]	Acres	-	-	0.27	0.02	0.02	1.85	0.12	-	-	-	-	0.06	-	-	-	-	-	-	-	-	-	2.34
			%	0%	0%	11%	1%	1%	79%	5%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	-	-	4.29	0.32	0.33	28.13	1.89	-	-	-	-	0.82	0.03	-	-	-	-	-	-	-	-	35.83
			%	0%	0%	12%	1%	1%	79%	5%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	27.26	-	525.77	32.09	25.66	3,595.32	415.67	-	-	-	-	82.44	12.49	-	-	-	-	-	-	-	-	4,716.69
			%	1%	0%	11%	1%	1%	76%	9%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Offshore Substation Foundations	Permanent	Foundations[1]	Acres	-	-	1.22	-	-	2.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.67
			%	0%	0%	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	-	-	0.20	-	-	0.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.59
			%	0%	0%	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	-	-	10.73	-	-	24.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.96
			%	0%	0%	31%	0%	0%	69%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Inter-Array Cables	Permanent	Cable Protection[4]	Acres	1.96	0.11	23.53	0.01	0.75	140.25	1.46	-	-	-	-	1.53	-	-	-	-	-	-	-	-	-	169.48
			%	1%	0.01%	14%	0%	0.4%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Coarse Sediment				Sand and Muddy Sand									Mud and Sandy Mud								Total[6]
				Coarse Sediment	Coarse Sediment (interpolated)	Coarse Sediment -Mobile	Coarse Sediment- Mobile (Interpolated)	Sand and Muddy Sand with Low Density Boulder Field	Sand and Muddy Sand-Mobile	Sand and Muddy Sand-Mobile (Interpolated)	Sand and Muddy Sand with SAV	Sand and Muddy Sand with SAV (Interpolated)	Sand and Muddy Sand with Historical SAV	Sand and Muddy Sand with Historical SAV (Interpolated)	Sand and Muddy Sand	Sand and Muddy Sand (Interpolated)	Mud and Sandy Mud with Low Density Boulder Field	Mud and Sandy Mud with SAV	Mud and Sandy Mud with SAV (Interpolated)	Mud and Sandy Mud with Historical SAV	Mud and Sandy Mud with Historical SAV (Interpolated)	Mud and Sandy Mud	Mud and Sandy Mud (Interpolated)	Anthropogenic	
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	16.11	-	195.37	0.09	6.25	1,167.88	12.13	-	-	-	-	12.74	-	-	-	-	-	-	-	-	-	1,410.67
			%	1%	0%	14%	0%	0.4%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
OSS Link Cable	Permanent	Cable Protection[4]	Acres	-	-	0.30	-	-	4.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.10
			%	0%	0%	6%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	2.57	-	-	40.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42.72
			%	0%	0%	6%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**1.96**	**-**	**29.81**	**0.35**	**1.11**	**177.88**	**3.47**	**-**	**-**	**-**	**-**	**2.41**	**0.03**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**217.02**
			%	**1%**	**0%**	**14%**	**0%**	**0%**	**82%**	**2%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	100%
Total Short-term Impacts[7]			**Acres**	**43.37**	**0.11**	**734.44**	**32.17**	**31.91**	**4,827.58**	**427.80**	**-**	**-**	**-**	**-**	**95.18**	**12.49**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**6,205.05**
			%	**1%**	**0%**	**12%**	**1%**	**1%**	**78%**	**7%**	**0%**	**0%**	**0%**	**0%**	**2%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	100%
Wind Farm Area - Alternative D, Sand Ridge and Trough Avoidance																									
Wind Turbine Generators	Permanent	Foundations[1]	Acres	-	-	0.25	-	0.05	1.66	-	-	-	-	-	0.02	-	-	-	-	-	-	-	-	-	1.99
			%	0%	0%	13%	0%	2%	84%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	-	-	4.30	-	0.71	24.94	-	-	-	-	-	0.39	-	-	-	-	-	-	-	-	-	30.34
			%	0%	0%	14%	0%	2%	82%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	13.02	-	499.11	0.09	51.21	3,363.33	11.51	-	-	-	-	56.47	-	-	-	-	-	-	-	-	-	3,994.75
			%	0%	0%	12%	0%	1%	84%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Offshore Substation Foundations	Permanent	Foundations[1]	Acres	-	-	1.22	-	-	2.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.67
			%	0%	0%	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	-	-	0.20	-	-	0.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.59
			%	0%	0%	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	-	-	10.73	-	-	24.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.96
			%	0%	0%	31%	0%	0%	69%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Inter-Array Cables	Permanent	Cable Protection[4]	Acres	1.96	-	23.53	-	0.75	140.25	1.46	-	-	-	-	1.53	-	-	-	-	-	-	-	-	-	169.48
			%	1%	0%	14%	0%	0.4%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	16.11	0.11	195.37	-	6.25	1,167.88	12.13	-	-	-	-	12.74	-	-	-	-	-	-	-	-	-	1,410.67
			%	1%	0.01%	14%	0%	0.4%	83%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
OSS Link Cable	Permanent	Cable Protection[4]	Acres	-	-	0.30	0.01	-	4.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.10
			%	0%	0%	6%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	2.57	0.09	-	40.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42.72
			%	0%	0%	6%	0%	0%	94%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**1.96**	**-**	**29.80**	**0.01**	**1.51**	**174.49**	**1.46**	**-**	**-**	**-**	**-**	**1.95**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**211.18**
			%	**1%**	**0%**	**14%**	**0%**	**1%**	**83%**	**1%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**29.14**	**0.11**	**707.78**	**0.18**	**57.46**	**4,595.59**	**23.64**	**-**	**-**	**-**	**-**	**69.21**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5,483.11**
			%	**1%**	**0%**	**13%**	**0%**	**1%**	**84%**	**0%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
BL England OECRC– OSS to Landfall at 35th Street																									
35th Street Landfall	Permanent	Cable Protection[4]	Acres	0.02	-	0.26	-	-	2.54	-	-	-	-	-	20.22	0.02	-	-	-	-	-	0.89	-	-	23.96
			%	0%	0%	1%	0%	0%	11%	0%	0%	0%	0%	0%	84%	0%	0%	0%	0%	0%	0%	4%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	0.12	-	2.18	-	-	21.32	-	-	-	-	-	169.14	0.19	-	-	-	-	-	7.40	-	-	200.36
			%	0%	0%	1%	0%	0%	11%	0%	0%	0%	0%	0%	84%	0%	0%	0%	0%	0%	0%	4%	0%	0%	100%
		HDD Exit Pit	Acres	-	-	-	-	-	-	-	-	-	-	-	0.57	-	-	-	-	-	-	-	-	-	0.57
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	1.26	-	-	-	-	-	-	-	-	-	-	20.40	1.53	-	-	-	-	-	-	-	-	23.20
			%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	88%	7%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**0.02**	**-**	**0.26**	**-**	**-**	**2.54**	**-**	**-**	**-**	**-**	**-**	**20.22**	**0.02**	**-**	**-**	**-**	**-**	**-**	**0.89**	**-**	**-**	**23.96**
			%	**0%**	**0%**	**1%**	**0%**	**0%**	**11%**	**0%**	**0%**	**0%**	**0%**	**0%**	**84%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**4%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**1.39**	**-**	**2.18**		**-**	**21.32**	**-**	**-**	**-**	**-**	**-**	**190.12**	**1.73**	**-**	**-**	**-**	**-**	**-**	**7.40**	**-**	**-**	**224.13**
			%	**1%**	**0%**	**1%**	**0%**	**0%**	**10%**	**0%**	**0%**	**0%**	**0%**	**0%**	**85%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**3%**	**0%**	**0%**	**100%**

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Coarse Sediment				Sand and Muddy Sand									Mud and Sandy Mud								Total[6]
				Coarse Sediment	Coarse Sediment (interpolated)	Coarse Sediment -Mobile	Coarse Sediment- Mobile (Interpolated)	Sand and Muddy Sand with Low Density Boulder Field	Sand and Muddy Sand-Mobile	Sand and Muddy Sand-Mobile (Interpolated)	Sand and Muddy Sand with SAV	Sand and Muddy Sand with SAV (Interpolated)	Sand and Muddy Sand with Historical SAV	Sand and Muddy Sand with Historical SAV (Interpolated)	Sand and Muddy Sand	Sand and Muddy Sand (Interpolated)	Mud and Sandy Mud with Low Density Boulder Field	Mud and Sandy Mud with SAV	Mud and Sandy Mud with SAV (Interpolated)	Mud and Sandy Mud with Historical SAV	Mud and Sandy Mud with Historical SAV (Interpolated)	Mud and Sandy Mud	Mud and Sandy Mud (Interpolated)	Anthropogenic	
BL England OECRC– OSS to Landfall at 13th Street																									
13th Street Landfall	Permanent	Cable Protection[4]	Acres	-	-	0.26	-	-	2.54	-	-	-	-	-	17.20	-	0.34	-	-	-	-	1.60	-	-	21.69
			%	0%	0%	1%	0%	0%	12%	0%	0%	0%	0%	0%	78%	0%	2%	0%	0%	0%	0%	7%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	2.18	-	-	21.32	-	-	-	-	-	143.80	-	2.83	-	-	-	-	13.41	-	-	183.53
			%	0%	0%	1%	0%	0%	12%	0%	0%	0%	0%	0%	78%	0%	2%	0%	0%	0%	0%	7%	0%	0%	100%
		HDD Exit Pit	Acres	-	-	-	-	-	-	-	-	-	-	-	0.57	-	-	-	-	-	-	-	-	-	0.57
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	-	-	-	-	-	-	-	-	22.69	0.52	-	-	-	-	-	-	-	-	23.20
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	98%	2%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**0.26**	**-**	**-**	**2.54**	**-**	**-**	**-**	**-**	**-**	**17.20**	**-**	**0.34**	**-**	**-**	**-**	**-**	**1.60**	**-**	**-**	**21.95**
			%	**0%**	**0%**	**1%**	**0%**	**0%**	**12%**	**0%**	**0%**	**0%**	**0%**	**0%**	**78%**	**0%**	**2%**	**0%**	**0%**	**0%**	**0%**	**7%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**-**	**-**	**2.18**	**-**	**-**	**21.32**	**-**	**-**	**-**	**-**	**-**	**167.06**	**0.52**	**2.83**	**-**	**-**	**-**	**-**	**13.41**	**-**	**-**	**207.31**
			%	**0%**	**0%**	**1%**	**0%**	**0%**	**10%**	**0%**	**0%**	**0%**	**0%**	**0%**	**81%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**6%**	**0%**	**0%**	**100%**
BL England OECRC– OSS to Landfall at 5th Street																									
5th Street Landfall	Permanent	Cable Protection[4]	Acres	-	-	0.35	-	-	2.54	-	-	-	-	-	17.36	0.04	0.28	-	-	-	-	0.81	-	-	21.38
			%	0%	0%	2%	0%	0%	12%	0%	0%	0%	0%	0%	81%	0%	1%	0%	0%	0%	0%	4%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	2.85	-	-	21.32	-	-	-	-	-	145.30	0.30	2.34	-	-	-	-	6.71	-	-	178.82
			%	0%	0%	2%	0%	0%	12%	0%	0%	0%	0%	0%	81%	0%	1%	0%	0%	0%	0%	4%	0%	0%	100%
		HDD Exit Pit	Acres	-	-	-	-	-	-	-	-	-	-	-	0.25	-	-	-	-	-	-	0.32	-	-	0.57
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	43%	0%	0%	0%	0%	0%	0%	57%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	-	-	-	-	-	-	-	-	20.64	2.36	-	-	-	-	-	0.20	-	-	23.20
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	89%	10%	0%	0%	0%	0%	0%	1%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**0.35**	**-**	**-**	**2.54**	**-**	**-**	**-**	**-**	**-**	**17.36**	**0.04**	**0.28**	**-**	**-**	**-**	**-**	**0.81**	**-**	**-**	**21.38**
			%	**0%**	**0%**	**2%**	**0%**	**0%**	**12%**	**0%**	**0%**	**0%**	**0%**	**0%**	**81%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**4%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**-**	**-**	**2.85**	**-**	**-**	**21.32**	**-**	**-**	**-**	**-**	**-**	**166.19**	**2.65**	**2.34**	**-**	**-**	**-**	**-**	**7.24**	**-**	**-**	**202.59**
			%	**0%**	**0%**	**1%**	**0%**	**0%**	**11%**	**0%**	**0%**	**0%**	**0%**	**0%**	**82%**	**1%**	**1%**	**0%**	**0%**	**0%**	**0%**	**4%**	**0%**	**0%**	**100%**
Oyster Creek OECRC – OSS to Landfall at Atlantic Side of IBSP																									
	Permanent	Cable Protection[4]	Acres	6.18	-	58.23	-	-	66.56	-	-	-	-	-	2.49	-	-	-	-	-	-	-	-	-	133.46
			%	5%	0%	44%	0%	0%	50%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	51.77	-	486.59	-	-	556.45	0.0001	-	-	-	-	20.72	-	-	-	-	-	-	-	-	-	1,115.53
			%	5%	0%	44%	0%	0%	50%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		HDD Exit Pit	Acres	-	-	-	-	-	1.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.14
			%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	-	-	27.37	0.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27.76
			%	0%	0%	0%	0%	0%	99%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**6.18**	**-**	**58.23**	**-**	**-**	**66.56**	**-**	**-**	**-**	**-**	**-**	**2.49**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**133.46**
			%	**5%**	**0%**	**44%**	**0%**	**0%**	**50%**	**0%**	**0%**	**0%**	**0%**	**0%**	**2%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**51.77**	**-**	**486.59**	**-**	**-**	**58.97**	**0.39**	**-**	**-**	**-**	**-**	**20.72**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1,144.43**
			%	**5%**	**0%**	**43%**	**0%**	**0%**	**51%**	**0%**	**0%**	**0%**	**0%**	**0%**	**2%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt E – Prior Channel to The Farm																									
	Permanent	Cable Protection[4]	Acres	-	-	-	-	-	-	-	0.23	-	0.04	-	2.18	-	-	-	-	-	-	8.94	0.73	-	12.11
			%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	18%	0%	0%	0%	0%	0%	0%	74%	6%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	-	-	-	-	1.92	-	0.29	-	17.98	-	-	-	-	-	-	75.09	5.84	-	101.11
			%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	18%	0%	0%	0%	0%	0%	0%	74%	6%	0%	100%
		Dredging width for prior channel up to 175 ft wide	Acres	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.24	0.67	-	-	5.61	2.50	-	16.02
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	45%	4%	0%	0%	35%	16%	0%	100%
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.23**	**-**	**0.04**	**-**	**2.18**	**-**	**-**	**-**	**-**	**-**	**-**	**8.94**	**0.73**	**-**	**12.11**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**2%**	**0%**	**0%**	**0%**	**18%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**74%**	**6%**	**0%**	**100%**

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Coarse Sediment				Sand and Muddy Sand									Mud and Sandy Mud								Total[6]
				Coarse Sediment	Coarse Sediment (interpolated)	Coarse Sediment -Mobile	Coarse Sediment- Mobile (Interpolated)	Sand and Muddy Sand with Low Density Boulder Field	Sand and Muddy Sand-Mobile	Sand and Muddy Sand-Mobile (Interpolated)	Sand and Muddy Sand with SAV	Sand and Muddy Sand with SAV (Interpolated)	Sand and Muddy Sand with Historical SAV	Sand and Muddy Sand with Historical SAV (Interpolated)	Sand and Muddy Sand	Sand and Muddy Sand (Interpolated)	Mud and Sandy Mud with Low Density Boulder Field	Mud and Sandy Mud with SAV	Mud and Sandy Mud with SAV (Interpolated)	Mud and Sandy Mud with Historical SAV	Mud and Sandy Mud with Historical SAV (Interpolated)	Mud and Sandy Mud	Mud and Sandy Mud (Interpolated)	Anthropogenic	
Total Short-term Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.92**	**-**	**0.29**	**-**	**17.98**	**-**	**-**	**7.24**	**0.67**	**-**	**-**	**80.69**	**8.34**	**-**	**117.13**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**2%**	**0%**	**0%**	**0%**	**15%**	**0%**	**0%**	**6%**	**1%**	**0%**	**0%**	**69%**	**7%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt A – Base Case to The Farm																									
	Permanent	Cable Protection[4]	Acres	-	-	-	-	-	-	-	0.23	-	0.50	-	2.30	-	-	1.22	-	-	-	9.06	0.20	-	13.51
			%	0%	0%	0%	0%	0%	0%	0%	2%	0%	4%	0%	17%	0%	0%	9%	0%	0%	0%	67%	1%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	-	-	-	-	1.92	-	4.15	-	19.03	-	-	10.20	-	-	-	75.97	1.79	-	113.06
			%	0%	0%	0%	0%	0%	0%	0%	2%	0%	4%	0%	17%	0%	0%	9%	0%	0%	0%	67%	2%	0%	100%
		HDD Exit Pit	Acres	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.12	-	-	-	-	-	-	1.12
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15.89	0.19	3.44	6.29	-	-	-	25.80
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	62%	1%	13%	24%	0%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.23**	**-**	**0.50**	**-**	**2.30**	**-**	**-**	**1.22**	**-**	**-**	**-**	**9.06**	**0.20**	**-**	**13.51**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**2%**	**0%**	**4%**	**0%**	**17%**	**0%**	**0%**	**9%**	**0%**	**0%**	**0%**	**67%**	**1%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.92**	**-**	**4.15**	**-**	**19.03**	**-**	**-**	**27.21**	**0.19**	**3.44**	**6.29**	**75.97**	**1.79**	**-**	**139.98**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**3%**	**0%**	**14%**	**0%**	**0%**	**19%**	**0%**	**2%**	**4%**	**54%**	**1%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt E – Prior Channel to Bay Parkway One Shot																									
	Permanent	Cable Protection[4]	Acres	-	-	-	-	-	-	-	0.04	-	-	-	1.42	-	-	-	-	0.12	-	4.56	-	-	6.14
			%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	23%	0%	0%	0%	0%	2%	0%	74%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	-	-	-	-	0.33	-	-	-	11.91	-	-	-	-	0.96	-	38.36	0.04	-	51.60
			%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	23%	0%	0%	0%	0%	2%	0%	74%	0%	0%	100%
		HDD Exit Pit	Acres	-	-	-	-	-	-	-	0.57	-	-	-	-	-	-	-	-	-	-	-	-	-	0.57
			%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	-	-	-	-	12.36	3.20	-	1.21	-	-	-	-	-	4.53	-	1.92	-	0.002	23.23
			%	0%	0%	0%	0%	0%	0%	0%	53%	14%	0%	5%	0%	0%	0%	0%	0%	20%	0%	8%	0%	0%	100%
		Dredging width for prior channel up to 175 ft wide	Acres	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.24	0.67	-	-	5.61	2.50	-	16.02
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	45%	4%	0%	0%	35%	16%	0%	100%
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**-**		**-**	**-**	**-**	**0.04**	**-**	**-**	**-**	**1.42**	**-**	**-**	**-**	**-**	**0.12**	**-**	**4.56**	**-**	**-**	**6.14**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**	**0%**	**23%**	**0%**	**0%**	**0%**	**0%**	**2%**	**0%**	**74%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**13.27**	**3.20**	**-**	**1.21**	**11.91**	**-**	**-**	**7.24**	**0.67**	**5.49**	**-**	**45.89**	**2.54**	**0.002**	**91.42**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**15%**	**3%**	**0%**	**1%**	**13%**	**0%**	**0%**	**8%**	**1%**	**6%**	**0%**	**50%**	**3%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt A – Base Case to Bay Parkway One Shot																									
	Permanent	Cable Protection[4]	Acres	-	-	-	-	-	-	-	0.04	-	0.26	-	1.50	-	-	0.57	-	0.12	-	4.38	-	-	6.87
			%	0%	0%	0%	0%	0%	0%	0%	1%	0%	4%	0%	22%	0%	0%	8%	0%	2%	0%	64%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	-	-	-	-	0.33	-	2.11	-	12.55	-	-	4.86	-	0.96	-	36.64	-	-	57.45
			%	0%	0%	0%	0%	0%	0%	0%	1%	0%	4%	0%	22%	0%	0%	8%	0%	2%	0%	64%	0%	0%	100%
		HDD Exit Pit	Acres	-	-	-	-	-	-	-	0.57	-	-	-	-	-	-	1.12	-	-	-	-	-	-	1.69
			%	0%	0%	0%	0%	0%	0%	0%	34%	0%	0%	0%	0%	0%	0%	66%	0%	0%	0%	0%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	-	-	-	-	12.36	3.20	-	1.21	-	-	-	15.89	0.19	7.97	6.29	1.92	-	0.002	49.04
			%	0%	0%	0%	0%	0%	0%	0%	25%	7%	0%	2%	0%	0%	0%	32%	0%	16%	13%	4%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.04**	**-**	**0.26**	**-**	**1.50**	**-**	**-**	**0.57**	**-**	**0.12**	**-**	**4.38**	**-**	**-**	**6.87**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**4%**	**0%**	**22%**	**0%**	**0%**	**8%**	**0%**	**2%**	**0%**	**64%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**13.27**	**3.20**	**2.11**	**1.21**	**12.55**	**-**	**-**	**21.86**	**0.19**	**8.93**	**6.29**	**38.56**	**-**	**0.00**	**108.17**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**12%**	**3%**	**2%**	**1%**	**12%**	**0%**	**0%**	**20%**	**0%**	**8%**	**6%**	**36%**	**0%**	**0%**	**100%**

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Coarse Sediment				Sand and Muddy Sand									Mud and Sandy Mud								Total[6]
				Coarse Sediment	Coarse Sediment (interpolated)	Coarse Sediment -Mobile	Coarse Sediment- Mobile (Interpolated)	Sand and Muddy Sand with Low Density Boulder Field	Sand and Muddy Sand-Mobile	Sand and Muddy Sand-Mobile (Interpolated)	Sand and Muddy Sand with SAV	Sand and Muddy Sand with SAV (Interpolated)	Sand and Muddy Sand with Historical SAV	Sand and Muddy Sand with Historical SAV (Interpolated)	Sand and Muddy Sand	Sand and Muddy Sand (Interpolated)	Mud and Sandy Mud with Low Density Boulder Field	Mud and Sandy Mud with SAV	Mud and Sandy Mud with SAV (Interpolated)	Mud and Sandy Mud with Historical SAV	Mud and Sandy Mud with Historical SAV (Interpolated)	Mud and Sandy Mud	Mud and Sandy Mud (Interpolated)	Anthropogenic	
Oyster Creek IECRC – Barnegat Bay Alt E – Prior Channel to Bay Parkway																									
	Permanent	Cable Protection[4]	Acres	-	-	-	-	-	-	-	-	-	-	-	2.72	-	-	-	-	-	-	9.01	1.31	-	13.05
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	21%	0%	0%	0%	0%	0%	0%	69%	10%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	-	-	-	-	-	-	-	-	22.56	-	-	-	-	-	-	75.61	10.63	-	108.80
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	21%	0%	0%	0%	0%	0%	0%	69%	10%	0%	100%
		HDD Exit Pit	Acres	-	-	-	-	-	-	-	-	-	-	0.57	-	-	-	-	-	-	-	-	0.58	-	1.14
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	49%	0%	0%	0%	0%	0%	0%	0%	0%	51%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	-	-	-	-	5.38	3.02	-	6.50	-	-	-	0.19	-	0.31	-	0.14	11.51	-	27.06
			%	0%	0%	0%	0%	0%	0%	0%	20%	11%	0%	24%	0%	0%	0%	1%	0%	1%	0%	1%	43%	0%	100%
		Dredging width for prior channel up to 175 ft wide	Acres	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.24	0.67	-	-	5.61	2.50	-	16.02
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	45%	4%	0%	0%	35%	16%	0%	100%
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.72**	**-**	**-**	**-**	**-**	**-**	**-**	**9.01**	**1.31**	**-**	**13.05**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**21%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**69%**	**10%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5.38**	**3.02**	**-**	**7.07**	**22.56**	**-**	**-**	**7.43**	**0.67**	**0.31**	**-**	**81.36**	**25.22**	**-**	**153.02**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**4%**	**2%**	**0%**	**5%**	**15%**	**0%**	**0%**	**5%**	**0%**	**0%**	**0%**	**53%**	**16%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt A – Base Case to Bay Parkway																									
	Permanent	Cable Protection[4]	Acres	-	-	-	-	-	-	-	-	-	0.46	-	2.84	-	-	1.22	-	-	-	9.14	0.79	-	14.44
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	20%	0%	0%	8%	0%	0%	0%	63%	5%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	-	-	-	-	-	-	3.86	-	23.62	-	-	10.20	-	-	-	76.49	6.58	-	120.75
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	20%	0%	0%	8%	0%	0%	0%	63%	5%	0%	100%
		HDD Exit Pit	Acres	-	-	-	-	-	-	-	-	-	-	0.57	-	-	-	1.12	-	-	-	-	0.58	-	2.26
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	0%	0%	49%	0%	0%	0%	0%	26%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	-	-	-	-	5.38	3.02	-	6.50	-	-	-	16.07	0.19	3.75	6.29	0.14	11.51	-	52.86
			%	0%	0%	0%	0%	0%	0%	0%	10%	6%	0%	12%	0%	0%	0%	30%	0%	7%	12%	0%	22%	0%	100%
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.46**	**-**	**2.84**	**-**	**-**	**1.22**	**-**	**-**	**-**	**9.14**	**0.79**	**-**	**14.44**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**3%**	**0%**	**20%**	**0%**	**0%**	**8%**	**0%**	**0%**	**0%**	**63%**	**5%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5.38**	**3.02**	**3.86**	**7.07**	**23.62**	**-**	**-**	**27.40**	**0.19**	**3.75**	**6.29**	**76.63**	**18.67**	**-**	**175.88**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**3%**	**2%**	**2%**	**4%**	**13%**	**0%**	**0%**	**16%**	**0%**	**2%**	**4%**	**44%**	**11%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt E – Prior Channel to Nautilus Road																									
	Permanent	Cable Protection[4]	Acres	-	-	-	-	-	-	-	-	-	-	-	1.37	-	-	-	-	-	-	5.49	-	-	6.85
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	20%	0%	0%	0%	0%	0%	0%	80%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	-	-	-	-	-	-	-	-	11.52	-	-	-	-	-	-	46.03	0.04	-	57.59
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	20%	0%	0%	0%	0%	0%	0%	80%	0%	0%	100%
		HDD Exit Pit	Acres	-	-	-	-	-	-	-	-	-	-	-	0.57	-	-	-	-	-	-	-	-	-	0.57
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	-	-	-	-	0.94	-	6.04	1.70	6.31	0.001	-	-	-	-	-	6.42	1.81	-	23.23
			%	0%	0%	0%	0%	0%	0%	0%	4%	0%	26%	7%	27%	0%	0%	0%	0%	0%	0%	28%	8%	0%	100%
		Dredging width for prior channel up to 175 ft wide	Acres	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.24	0.67	-	-	5.61	2.50	-	16.02
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	45%	4%	0%	0%	35%	16%	0%	100%
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.37**	**-**	**-**	**-**	**-**	**-**	**-**	**5.49**	**-**	**-**	**6.85**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**20%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**80%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.94**	**-**	**6.04**	**1.70**	**18.41**	**0.001**	**-**	**7.24**	**0.67**	**-**	**-**	**58.05**	**4.35**	**-**	**97.41**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**6%**	**2%**	**19%**	**0%**	**0%**	**7%**	**1%**	**0%**	**0%**	**60%**	**4%**	**0%**	**100%**

Ocean Wind Offshore Wind Farm Proposed Project Design		Unit of Measure	Coarse Sediment				Sand and Muddy Sand									Mud and Sandy Mud								Total[6]
			Coarse Sediment	Coarse Sediment (interpolated)	Coarse Sediment -Mobile	Coarse Sediment- Mobile (Interpolated)	Sand and Muddy Sand with Low Density Boulder Field	Sand and Muddy Sand-Mobile	Sand and Muddy Sand-Mobile (Interpolated)	Sand and Muddy Sand with SAV	Sand and Muddy Sand with SAV (Interpolated)	Sand and Muddy Sand with Historical SAV	Sand and Muddy Sand with Historical SAV (Interpolated)	Sand and Muddy Sand	Sand and Muddy Sand (Interpolated)	Mud and Sandy Mud with Low Density Boulder Field	Mud and Sandy Mud with SAV	Mud and Sandy Mud with SAV (Interpolated)	Mud and Sandy Mud with Historical SAV	Mud and Sandy Mud with Historical SAV (Interpolated)	Mud and Sandy Mud	Mud and Sandy Mud (Interpolated)	Anthropogenic	
Oyster Creek IECRC – Barnegat Bay Alt A – Base Case to Nautilus Road																								
Permanent	Cable Protection[4]	Acres	-	-	-	-	-	-	-	-	-	0.26	-	1.45	-	-	0.57	-	-	-	5.31	-	-	7.59
		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	19%	0%	0%	8%	0%	0%	0%	70%	0%	0%	100%
Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	-	-	-	-	-	-	2.11	-	12.17	-	-	4.86	-	-	-	44.30	-	-	63.44
		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	19%	0%	0%	8%	0%	0%	0%	70%	0%	0%	100%
	HDD Exit Pit	Acres	-	-	-	-	-	-	-	-	-	-	-	0.57	-	-	1.12	-	-	-	-	-	-	1.69
		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	34%	0%	0%	66%	0%	0%	0%	0%	0%	0%	100%
	Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	-	-	-	-	0.94	-	6.04	1.70	6.31	0.001	-	15.89	0.19	3.44	6.29	6.42	1.81	-	49.03
		%	0%	0%	0%	0%	0%	0%	0%	2%	0%	12%	3%	13%	0%	0%	32%	0%	7%	13%	13%	4%	0%	100%
Total Permanent Impacts[7]		**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.26**	**-**	**1.45**	**-**	**-**	**0.57**	**-**	**-**	**-**	**5.31**	**-**	**-**	**7.59**
		%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**3%**	**0%**	**19%**	**0%**	**0%**	**8%**	**0%**	**0%**	**0%**	**70%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]		**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.94**	**-**	**8.15**	**1.70**	**19.05**	**0.00**	**-**	**21.86**	**0.19**	**3.44**	**6.29**	**50.72**	**1.81**	**-**	**114.17**
		%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**7%**	**1%**	**17%**	**0%**	**0%**	**19%**	**0%**	**3%**	**6%**	**44%**	**2%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt E – Prior Channel to Lighthouse																								
Permanent	Cable Protection[4]	Acres	-	-	-	-	-	-	-	-	-	-	-	1.35	-	-	-	-	-	-	5.10	0.52	-	6.97
		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	19%	0%	0%	0%	0%	0%	0%	73%	7%	0%	100%
Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	-	-	-	-	-	-	-	-	10.95	-	-	-	-	-	-	43.33	4.01	-	58.29
		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	19%	0%	0%	0%	0%	0%	0%	74%	7%	0%	100%
	HDD Exit Pit	Acres	-	-	-	-	-	-	-	-	-	0.32	-	0.26	-	-	-	-	-	-	-	-	-	0.57
		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	55%	0%	45%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	-	-	-	-	3.04	-	8.24	0.11	6.41	0.01	-	-	-	-	-	5.18	0.22	-	23.22
		%	0%	0%	0%	0%	0%	0%	0%	13%	0%	35%	0%	28%	0%	0%	0%	0%	0%	0%	22%	1%	0%	100%
	Dredging width for prior channel up to 175 ft wide	Acres	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.24	0.67	-	-	5.61	2.50	-	16.02
		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	45%	4%	0%	0%	35%	16%	0%	100%
Total Permanent Impacts[7]		**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.35**	**-**	**-**	**-**	**-**	**-**	**-**	**5.10**	**0.52**	**-**	**6.97**
		%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**19%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**73%**	**7%**	**0%**	**100%**
Total Short-term Impacts[7]		**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3.04**	**-**	**8.56**	**0.11**	**17.62**	**0.01**	**-**	**7.24**	**0.67**	**-**	**-**	**54.12**	**6.73**	**-**	**98.10**
		%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**3%**	**0%**	**9%**	**0%**	**18%**	**0%**	**0%**	**7%**	**1%**	**0%**	**0%**	**55%**	**7%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt A – Base Case to Lighthouse																								
Permanent	Cable Protection[4]	Acres	-	-	-	-	-	-	-	-	-	0.20	-	1.38	-	-	0.65	-	-	-	5.40	0.00002	-	7.63
		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	18%	0%	0%	8%	0%	0%	0%	71%	0.0002%	0%	100%
Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	-	-	-	-	-	-	1.75	-	11.36	-	-	5.35	-	-	-	45.37	0.0001	-	63.82
		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	18%	0%	0%	8%	0%	0%	0%	71%	0.0002%	0%	100%
	HDD Exit Pit	Acres	-	-	-	-	-	-	-	-	-	0.32	-	0.26	-	-	1.12	-	-	-	-	-	-	1.69
		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	19%	0%	15%	0%	0%	66%	0%	0%	0%	0%	0%	0%	100%
	Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	-	-	-	-	3.04	-	8.24	0.11	6.41	0.01	-	15.89	0.19	3.44	6.29	5.18	0.22	-	49.03
		%	0%	0%	0%	0%	0%	0%	0%	6%	0%	17%	0%	13%	0%	0%	32%	0%	7%	13%	11%	0%	0%	100%
Total Permanent Impacts[7]		**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.20**	**-**	**1.38**	**-**	**-**	**0.65**	**-**	**-**	**-**	**5.40**	**0.00002**	**-**	**7.63**
		%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**3%**	**0%**	**18%**	**0%**	**0%**	**8%**	**0%**	**0%**	**0%**	**71%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]		**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3.04**	**-**	**10.31**	**0.11**	**18.03**	**0.01**	**-**	**22.35**	**0.19**	**3.44**	**6.29**	**50.55**	**0.22**	**-**	**114.54**
		%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**3%**	**0%**	**9%**	**0%**	**16%**	**0%**	**0%**	**20%**	**0%**	**3%**	**5%**	**44%**	**0.002%**	**0%**	**100%**

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Coarse Sediment				Sand and Muddy Sand									Mud and Sandy Mud								Total[6]
				Coarse Sediment	Coarse Sediment (interpolated)	Coarse Sediment -Mobile	Coarse Sediment- Mobile (Interpolated)	Sand and Muddy Sand with Low Density Boulder Field	Sand and Muddy Sand-Mobile	Sand and Muddy Sand-Mobile (Interpolated)	Sand and Muddy Sand with SAV	Sand and Muddy Sand with SAV (Interpolated)	Sand and Muddy Sand with Historical SAV	Sand and Muddy Sand with Historical SAV (Interpolated)	Sand and Muddy Sand	Sand and Muddy Sand (Interpolated)	Mud and Sandy Mud with Low Density Boulder Field	Mud and Sandy Mud with SAV	Mud and Sandy Mud with SAV (Interpolated)	Mud and Sandy Mud with Historical SAV	Mud and Sandy Mud with Historical SAV (Interpolated)	Mud and Sandy Mud	Mud and Sandy Mud (Interpolated)	Anthropogenic	
Oyster Creek IECRC – Barnegat Bay Alt E – Prior Channel to Marina																									
	Permanent	Cable Protection[4]	Acres	-	-	-	-	-	-	-	-	-	-	-	2.69	-	-	-	-	-	-	10.01	1.47	-	14.17
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	19%	0%	0%	0%	0%	0%	0%	71%	10%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	-	-	-	-	-	-	-	-	22.25	-	-	-	-	-	-	83.94	12.04	-	118.23
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	19%	0%	0%	0%	0%	0%	0%	71%	10%	0%	100%
		HDD Exit Pit	Acres	-	-	-	-	-	-	-	-	-	-	0.15	-	-	-	-	-	-	-	-	0.99	-	1.14
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	13%	0%	0%	0%	0%	0%	0%	0%	0%	87%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	-	-	-	-	-	0.03	0.88	12.60	0.88	0.01	-	-	-	-	-	0.12	14.03	-	28.56
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	44%	3%	0%	0%	0%	0%	0%	0%	0%	49%	0%	100%
		Dredging width for prior channel up to 175 ft wide	Acres	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.24	0.67	-	-	5.61	2.50	-	16.02
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	45%	4%	0%	0%	35%	16%	0%	100%
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.69**	**-**	**-**	**-**	**-**	**-**	**-**	**10.01**	**1.47**	**-**	**14.17**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**19%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**71%**	**10%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.03**	**0.88**	**12.75**	**23.12**	**0.01**	**-**	**7.24**	**0.67**	**-**	**-**	**89.68**	**29.57**	**-**	**163.96**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**1%**	**8%**	**14%**	**0%**	**0%**	**4%**	**0%**	**0%**	**0%**	**55%**	**18%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt A – Base Case to Marina																									
	Permanent	Cable Protection[4]	Acres	-	-	-	-	-	-	-	-	-	0.46	-	2.80	-	-	1.22	-	-	-	10.14	0.95	-	15.57
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	18%	0%	0%	8%	0%	0%	0%	65%	6%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	-	-	-	-	-	-	3.86	-	23.30	-	-	10.20	-	-	-	84.83	8.00	-	130.18
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	18%	0%	0%	8%	0%	0%	0%	65%	6%	0%	100%
		HDD Exit Pit	Acres	-	-	-	-	-	-	-	-	-	-	0.15	-	-	-	1.12	-	-	-	-	0.99	-	2.26
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	7%	0%	0%	0%	49%	0%	0%	0%	0%	44%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	-	-	-	-	-	0.03	0.88	12.60	0.88	0.01	-	15.89	0.19	3.44	6.29	0.12	14.03	-	54.36
			%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	23%	2%	0%	0%	29%	0%	6%	12%	0%	26%	0%	100%
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.46**	**-**	**2.80**	**-**	**-**	**1.22**	**-**	**-**	**-**	**10.14**	**0.95**	**-**	**15.57**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**3%**	**0%**	**18%**	**0%**	**0%**	**8%**	**0%**	**0%**	**0%**	**65%**	**6%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.03**	**4.74**	**12.75**	**24.18**	**0.01**	**-**	**27.21**	**0.19**	**3.44**	**6.29**	**84.95**	**23.02**	**-**	**186.81**
			%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**3%**	**7%**	**13%**	**0%**	**0%**	**15%**	**0%**	**2%**	**3%**	**45%**	**12%**	**0%**	**100%**

Notes:
[1] Foundations are calculated using a 5.55 m radius
[2] Maximum Scour Protection are calculated using a 22.39 m radius around foundation
[3] Seafloor Disturbance are calculated using a 221.0 m radius around maximum scour protection
[4] Cable Protection are calculated using a 2.99 m total width; While removal of WTG positions is anticipated to result in a corresponding reduction in inter-array cable length and associated cable protection and cable installation and seafloor preparation impacts; the cable protection and cable installation and seafloor preparation area for the alternatives excluding WTG positions could not be calculated because the inter-array cable alignments associated with these alternatives have not been designed/engineered. Therefore, the values for these impact areas remains the same as those for the Proposed Action.
[5] Cable Installation and Seafloor Preparation are calculated using a 25 m total width; While removal of WTG positions is anticipated to result in a corresponding reduction in inter-array cable length and associated cable protection and cable installation and seafloor preparation impacts; the cable protection and cable installation and seafloor preparation area for the alternatives excluding WTG positions could not be calculated because the inter-array cable alignments associated with these alternatives have not been designed/engineered. Therefore, the values for these impact areas remains the same as those for the Proposed Action.
[6] Does not sum due to rounding
[7] Does not sum as represents the total combined footprint of impacts
[8] Cofferdam HDD Anchoring Area is calculated as 175m radius from center point of HDD Exit pit.

Key:
WTGs = Wind Turbine Generators
OSSs = Offshore Substations

Table 10.2-7 Total Area of Benthic Habitats by NOAA Complexity Category within the Wind Farm Area and Offshore Export Cable Corridors

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Complex	Complex (interpolated)	Heterogenous Complex	Soft Bottom	Soft Bottom (interpolated)	Anthropogenic	Total[6]
Wind Farm Area - Alternative A, Proposed Action										
Wind Turbine Generators	Permanent	Foundations[1]	Acres	0.38	-	0.05	1.91	0.00	-	2.34
			%	16%	0%	2%	82%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	6.0	-	0.7	29.1	0.20	-	35.98
			%	17%	0%	2%	81%	1%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	638.8	1.79	54.2	3,942.6	63.2	-	4,700.55
			%	14%	0%	1%	84%	1%	0%	100%
Offshore Substation Foundations	Permanent	Foundations[1]	Acres	1.22	0.00	0.00	2.45	0.00	0.00	3.67
			%	33%	0%	0%	67%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	0.20	0.00	0.00	0.40	0.00	0.00	0.59
			%	33%	0%	0%	67%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	10.73	0.00	0.00	24.23	0.00	0.00	34.96
			%	31%	0%	0%	69%	0%	0%	100%
Inter-Array Cables	Permanent	Cable Protection[4]	Acres	25.48	0.01	0.75	141.78	1.46	-	169.48
			%	15%	0.01%	0.4%	84%	0.9%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	211.48	0.20	6.25	1,180.61	12.13	-	1,410.67
			%	15%	0%	0.4%	84%	1%	0%	100%
OSS Link Cables	Permanent	Cable Protection[4]	Acres	0.3	0.00	0.0	4.8	0.00	-	5.10
			%	6%	0.0%	0.0%	94%	0.0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	2.57	0.00	0.00	40.15	0.00	-	42.72
			%	6%	0.0%	0.0%	94%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**33.54**	**0.01**	**1.51**	**180.44**	**1.66**	**-**	**217.17**
			%	**15%**	**0%**	**1%**	**83%**	**1%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**863.54**	**1.99**	**60.41**	**5,187.62**	**75.35**	**-**	**6,188.91**
			%	**14%**	**0%**	**1%**	**84%**	**1%**	**0%**	**100%**
Wind Farm Area - Alternative B1, No Surface Occupancy at Select Locations to Reduce Visual Impacts										
Wind Turbine Generators	Permanent	Foundations[1]	Acres	0.3	-	0.0	1.8	-	-	2.13
			%	15%	0%	2%	83%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	5.2	-	0.7	26.6	-	-	32.54
			%	16%	0%	2%	82%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	622.2	0.1	54.3	3,595.5	11.5	-	4283.53
			%	15%	0%	1%	84%	0%	0%	100%
Offshore Substation Foundations	Permanent	Foundations[1]	Acres	1.22	0.00	0.00	2.45	0.00	0.00	3.67
			%	33%	0%	0%	67%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	0.20	0.00	0.00	0.40	0.00	0.00	0.59
			%	33%	0%	0%	67%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	10.73	0.00	0.00	24.23	0.00	0.00	34.96
			%	31%	0%	0%	69%	0%	0%	100%
Inter-Array Cables	Permanent	Cable Protection[4]	Acres	25.48	0.01	0.75	141.78	1.46	-	169.48
			%	15%	0.01%	0.4%	84%	0.9%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	211.48	0.20	6.25	1,180.61	12.13	-	1,410.67
			%	15%	0.0%	0.4%	84%	1%	0%	100%
OSS Link Cables	Permanent	Cable Protection[4]	Acres	0.3	0.00	0.0	4.8	0.00	-	5.10
			%	6%	0.0%	0.0%	94%	0.0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	2.57	0.00	0.0	40.15	0.00	-	42.72
			%	6%	0.0%	0.0%	94%	0.0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**32.75**	**0.01**	**1.51**	**177.79**	**1.46**	**-**	**213.52**
			%	**15%**	**0%**	**1%**	**83%**	**1%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**846.97**	**0.29**	**60.53**	**4,840.45**	**23.64**	**-**	**5,71.88**
			%	**15%**	**0%**	**1%**	**84%**	**0%**	**0%**	**100%**
Wind Farm Area - Alternative B2, No Surface Occupancy at Select Locations to Reduce Visual Impacts										
Wind Turbine Generators	Permanent	Foundations[1]	Acres	0.3	-	0.05	1.5	-	-	1.89
			%	17%	0%	3%	81%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	5.0	-	0.7	23.1	-	-	28.88
			%	17%	0%	2%	80%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	576.0	0.0	54.3	3,161.2	10.8	-	3802.23
			%	15%	0%	1%	83%	0%	0%	100%
Offshore Substation Foundations	Permanent	Foundations[1]	Acres	1.22	0.00	0.00	2.45	0.00	0.00	3.67
			%	33%	0%	0%	67%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	0.20	0.00	0.00	0.40	0.00	0.00	0.59
			%	33%	0%	0%	67%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	10.73	0.00	0.00	24.23	0.00	0.00	34.96
			%	31%	0%	0%	69%	0%	0%	100%

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Complex	Complex (interpolated)	Heterogenous Complex	Soft Bottom	Soft Bottom (interpolated)	Anthropogenic	Total[6]
Inter-Array Cables	Permanent	Cable Protection[4]	Acres	25.48	0.01	0.75	141.78	1.46	-	169.48
			%	15%	0.01%	0.4%	84%	0.9%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	211.48	0.20	6.25	1,180.61	12.13	-	1,410.67
			%	15%	0.0%	0.4%	84%	1%	0%	100%
OSS Link Cables	Permanent	Cable Protection[4]	Acres	0.3	0.00	0.0	4.8	0.00	-	5.10
			%	6%	0.00%	0.0%	94%	0.0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	2.57	0.00	0.00	40.15	0.00	-	42.72
			%	6%	0.0%	0.0%	94%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**32.55**	**0.01**	**1.51**	**174.09**	**1.46**	**-**	**209.62**
			%	**16%**	**0%**	**1%**	**83%**	**1%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**800.74**	**0.20**	**60.53**	**4,406.18**	**22.94**	**-**	**5,290.58**
			%	**15%**	**0%**	**1%**	**83%**	**0%**	**0%**	**100%**
Wind Farm Area - Alternative C1, Wind Turbine Layout Modification to Establish a Buffer Between Ocean Wind and Atlantic Shores										
Wind Turbine Generators	Permanent	Foundations[1]	Acres	0.3	-	0.05	1.9	-	-	2.33
			%	15%	0%	2%	83%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	5.7	-	0.7	29.4	-	-	35.83
			%	16%	0%	2%	82%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	696.4	0.4	54.3	3,945.7	20.0	-	4716.71
			%	15%	0%	1%	84%	0%	0%	100%
Offshore Substation Foundations	Permanent	Foundations[1]	Acres	1.22	0.00	0.00	2.45	0.00	0.00	3.67
			%	33%	0%	0%	67%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	0.20	0.00	0.00	0.40	0.00	0.00	0.59
			%	33%	0%	0%	67%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	10.73	0.00	0.00	24.23	0.00	0.00	34.96
			%	31%	0%	0%	69%	0%	0%	100%
Inter-Array Cables	Permanent	Cable Protection[4]	Acres	25.48	0.01	0.75	141.78	1.46	-	169.48
			%	15%	0.01%	0.4%	84%	0.9%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	211.48	0.20	6.25	1,180.61	12.13	-	1,410.67
			%	15%	0.0%	0.4%	84%	1%	0%	100%
OSS Link Cables	Permanent	Cable Protection[4]	Acres	0.3	0.00	0.0	4.8	0.00	-	5.10
			%	6%	0.00%	0.0%	94%	0.0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	2.57	0.00	0.00	40.15	0.00	-	42.72
			%	6%	0.0%	0.0%	94%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**33.23**	**0.01**	**1.51**	**180.79**	**1.46**	**-**	**217.00**
			%	**15%**	**0%**	**1%**	**83%**	**1%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**921.22**	**0.57**	**60.53**	**5,190.66**	**32.09**	**-**	**6,205.07**
			%	**15%**	**0%**	**1%**	**84%**	**1%**	**0%**	**100%**
Wind Farm Area - Alternative C2 (405nm), Wind Turbine Layout Modification to Establish a Buffer Between Ocean Wind and Atlantic Shores										
Wind Turbine Generators	Permanent	Foundations[1]	Acres	0.34	-	0.05	1.95	-	-	2.34
			%	15%	0%	2%	83%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	5.54	-	0.71	29.55	0.03	-	35.83
			%	15%	0%	2%	82%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	643.67	1.80	54.24	3,963.56	53.42	-	4,716.70
			%	14%	0%	1%	84%	1%	0%	100%
Offshore Substation Foundations	Permanent	Foundations[1]	Acres	1.22	0.00	0.00	2.45	0.00	0.00	3.67
			%	33%	0%	0%	67%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	0.20	0.00	0.00	0.40	0.00	0.00	0.59
			%	33%	0%	0%	67%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	10.73	0.00	0.00	24.23	0.00	0.00	34.96
			%	31%	0%	0%	69%	0%	0%	100%
Inter-Array Cables	Permanent	Cable Protection[4]	Acres	25.48	0.01	0.75	141.78	1.46	-	169.48
			%	15%	0.01%	0.4%	84%	0.9%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	211.48	0.20	6.25	1,180.61	12.13	-	1,410.67
			%	15%	0.0%	0.4%	84%	1%	0%	100%
OSS Link Cables	Permanent	Cable Protection[4]	Acres	0.3	0.00	0.0	4.8	0.00	-	5,10
			%	6%	0.00%	0.0%	94%	0.0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	2.57	0.00	0.00	40.15	0.00	-	42.72
			%	6%	0.0%	0.0%	94%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**33.08**	**0.01**	**1.51**	**180.93**	**1.50**	**-**	**217.02**
			%	**15%**	**0%**	**1%**	**83%**	**1%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**868.45**	**2.00**	**60.49**	**5,208.56**	**65.55**	**-**	**6,205.05**
			%	**14%**	**0%**	**1%**	**84%**	**1%**	**0%**	**100%**

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Complex	Complex (interpolated)	Heterogenous Complex	Soft Bottom	Soft Bottom (interpolated)	Anthropogenic	Total[6]
Wind Farm Area - Alternative C2 (540 nm), Wind Turbine Layout Modification to Establish a Buffer Between Ocean Wind and Atlantic Shores										
Wind Turbine Generators	Permanent	Foundations[1]	Acres	0.27	0.02	0.02	1.91	0.12	0.00	2.34
			%	11%	1%	1%	82%	5%	0%	100%
		Maximum Scour Protection[2]	Acres	4.29	0.32	0.33	28.95	1.93	0.00	35.83
			%	12%	1%	1%	81%	5%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	553.03	32.09	25.66	3,677.76	428.16	0.00	4,716.69
			%	12%	1%	1%	78%	9%	0%	100%
Offshore Substation Foundations	Permanent	Foundations[1]	Acres	1.22	0.00	0.00	2.45	0.00	0.00	3.67
			%	33%	0%	0%	67%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	0.20	0.00	0.00	0.40	0.00	0.00	0.59
			%	33%	0%	0%	67%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	10.73	0.00	0.00	24.23	0.00	0.00	34.96
			%	31%	0%	0%	69%	0%	0%	100%
Inter-Array Cables	Permanent	Cable Protection[4]	Acres	25.48	0.01	0.75	141.78	1.46	-	169.48
			%	15%	0.01%	0.4%	84%	0.9%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	211.48	0.20	6.25	1,180.61	12.13	-	1,410.67
			%	15%	0.0%	0.4%	84%	1%	0%	100%
OSS Link Cables	Permanent	Cable Protection[4]	Acres	0.3	0.00	0.0	4.8	0.00	-	5.10
			%	6%	0.00%	0.0%	94%	0.0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	2.57	0.00	0.00	40.15	0.00	-	42.72
			%	6%	0.0%	0.0%	94%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**31.76**	**0.35**	**1.11**	**180.29**	**3.51**	**-**	**217.02**
			%	**15%**	**0%**	**1%**	**83%**	**2%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**777.81**	**32.28**	**31.91**	**4,922.76**	**440.29**	**-**	**6,205.05**
			%	**13%**	**1%**	**1%**	**79%**	**7%**	**0%**	**100%**
Wind Farm Area - Alternative D, Sand Ridge and Trough Avoidance										
Wind Turbine Generators	Permanent	Foundations[1]	Acres	0.3	-	0.05	1.7	-	-	1.99
			%	13%	0%	2%	85%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	4.3	-	0.7	25.3	-	-	30.34
			%	14%	0%	2%	83%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	512.1	0.1	51.2	3,419.8	11.5	-	3,994.75
			%	13%	0%	1%	86%	0%	0%	100%
Offshore Substation Foundations	Permanent	Foundations[1]	Acres	1.22	0.00	0.00	2.45	0.00	0.00	3.67
			%	33%	0%	0%	67%	0%	0%	100%
		Maximum Scour Protection[2]	Acres	0.20	0.00	0.00	0.40	0.00	0.00	0.59
			%	33%	0%	0%	67%	0%	0%	100%
	Short-term	Seafloor Disturbance[3]	Acres	10.73	0.00	0.00	24.23	0.00	0.00	34.96
			%	31%	0%	0%	69%	0%	0%	100%
Inter-Array Cables	Permanent	Cable Protection[4]	Acres	25.48	0.01	0.75	141.78	1.46	-	169.48
			%	15%	0.01%	0.4%	84%	0.9%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	211.48	0.20	6.25	1,180.61	12.13	-	1,410.67
			%	15%	0.0%	0.4%	84%	1%	0%	100%
OSS Link Cables	Permanent	Cable Protection[4]	Acres	0.3	0.00	0.0	4.8	0.00	-	5.10
			%	6%	0.00%	0.0%	94%	0.0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	2.57	0.00	0.00	40.15	0.00	-	42.72
			%	6%	0.0%	0.0%	94%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**31.76**	**0.01**	**1.51**	**176.44**	**1.46**	**-**	**211.18**
			%	**15%**	**0%**	**1%**	**84%**	**1%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**736.92**	**0.29**	**57.46**	**4,664.80**	**23.64**	**-**	**5,483.11**
			%	**13%**	**0%**	**1%**	**85%**	**0%**	**0%**	**100%**
BL England OECRC– OSS to Landfall at 35th Street										
35th Street Landfall	Permanent	Cable Protection[4]	Acres	0.28	-	-	23.65	0.02	-	23.96
			%	1.2%	0%	0%	99%	0.1%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	2.30	-	-	197.86	0.19	-	200.36
			%	1.1%	0%	0%	99%	0.1%	0%	100%
		HDD Exit Pit	Acres	-	-	-	0.57	-	-	0.57
			%	0%	0%	0%	100%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	1.26	-	-	20.40	1.53	-	23.20
			%	5%	0%	0%	88%	7%	0%	100%
Total Permanent Impacts[7]			**Acres**	**0.28**	**-**	**-**	**23.65**	**0.02**	**-**	**23.96**
			%	**1%**	**0%**	**0%**	**99%**	**0.1%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**3.56**	**-**	**-**	**218.84**	**1.73**	**-**	**224.13**
			%	**2%**	**0%**	**0%**	**98%**	**1%**	**0%**	**100%**
BL England OECRC– OSS to Landfall at 13th Street										

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Complex	Complex (interpolated)	Heterogenous Complex	Soft Bottom	Soft Bottom (interpolated)	Anthropogenic	Total[6]
13th Street Landfall	Permanent	Cable Protection[4]	Acres	0.26	-	0.34	21.35	-	-	21.95
			%	1%	0%	2%	97%	0%	0%	100%
		Cable Installation and Seafloor Preparation[5]	Acres	2.18	-	2.83	178.53	-	-	183.53
			%	1%	0%	2%	97%	0%	0%	100%
		HDD Exit Pit	Acres	-	-	-	0.57	-	-	0.57
			%	0%	0%	0%	100%	0%	0%	100%
	Short-term	Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	22.69	0.52	-	23.20
			%	0%	0%	0%	98%	2%	0%	100%
Total Permanent Impacts[7]			**Acres**	**0.26**	**-**	**0.34**	**21.35**	**-**	**-**	**21.95**
			%	**1%**	**0%**	**2%**	**97%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**2.18**	**-**	**2.83**	**201.79**	**0.52**	**-**	**207.31**
			%	**1%**	**0%**	**1%**	**97%**	**0%**	**0%**	**100%**
BL England OECRC– OSS to Landfall at 5th Street										
5th Street Landfall	Permanent	Cable Protection[4]	Acres	0.35	-	0.28	20.72	0.04	-	21.38
			%	2%	0%	1%	97%	0.2%	0%	100%
		Cable Installation and Seafloor Preparation[5]	Acres	2.85	-	2.34	173.33	0.30	-	178.82
			%	2%	0%	1%	97%	0.2%	0%	100%
		HDD Exit Pit	Acres	-	-	-	0.57	-	-	0.57
			%	0%	0%	0%	100%	0%	0%	100%
	Short-term	Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	20.85	2.36	-	23.20
			%	0%	0%	0%	90%	10%	0%	100%
Total Permanent Impacts[7]			**Acres**	**0.35**	**-**	**0.28**	**20.72**	**0.04**	**-**	**21.38**
			%	**2%**	**0%**	**1%**	**97%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**2.85**	**-**	**2.34**	**194.74**	**2.65**	**-**	**202.59**
			%	**1%**	**0%**	**1%**	**96%**	**1%**	**0%**	**100%**
Oyster Creek OECRC – OSS to Landfall at Atlantic Side of IBSP										
	Permanent	Cable Protection[4]	Acres	64.41	-	-	69.05	-	-	133.46
			%	48%	0%	0%	52%	0%	0%	100%
		Cable Installation and Seafloor Preparation[5]	Acres	538.36	-	-	577.17	0.0001	-	1,115.53
			%	48%	0%	0%	52%	0.00001%	0%	100%
		HDD Exit Pit	Acres	-	-	-	1.14	-	-	1.14
			%	0%	0%	0%	100%	0%	0%	100%
	Short-term	Cofferdam HDD Anchoring Area[8]	Acres	-	-	-	27.37	0.39	-	27.76
			%	0%	0%	0%	99%	1%	0%	100%
Total Permanent Impacts[7]			**Acres**	**64.41**	**-**	**-**	**69.05**	**-**	**-**	**133.46**
			%	**48%**	**0%**	**0%**	**52%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**538.36**	**-**	**-**	**605.68**	**0.39**	**-**	**1,144.43**
			%	**47%**	**0%**	**0%**	**53%**	**0%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt E – Prior Channel to The Farm										
	Permanent	Cable Protection[4]	Acres	0.27	-	-	11.12	0.73	-	12.11
			%	2%	0%	0%	92%	6%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	2.21	-	-	93.06	5.84	-	101.11
			%	2%	0%	0%	92%	6%	0%	100%
		Dredging width for prior channel up to 175ft wide	Acres	7.24	0.67	-	5.61	2.50	-	16.02
			%	45%	4%	0%	35%	16%	0%	100%
Total Permanent Impacts[7]			**Acres**	**0.27**	**-**	**-**	**11.12**	**0.73**	**-**	**12.11**
			%	**2%**	**0%**	**0%**	**92%**	**6%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**9.45**	**0.67**	**-**	**98.67**	**8.34**	**-**	**117.13**
			%	**8%**	**1%**	**0%**	**84%**	**7%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt A – Base Case to The Farm										
	Permanent	Cable Protection[4]	Acres	1.95	-	-	11.36	0.20	-	13.51
			%	14%	0%	0%	84%	1%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	16.27	-	-	95.00	1.79	-	113.06
			%	14%	0%	0%	84%	2%	0%	100%
		HDD Exit Pit	Acres	1.12	-	-	-	-	-	1.12
			%	100%	0%	0%	0%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	19.33	6.48	-	-	-	-	25.80
			%	75%	25%	0%	0%	0%	0%	100%
Total Permanent Impacts[7]			**Acres**	**1.95**	**-**	**-**	**11.36**	**0.20**	**-**	**13.51**
			%	**14%**	**0%**	**0%**	**84%**	**1%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**36.72**	**6.48**	**-**	**95.00**	**1.79**	**-**	**139.98**
			%	**26%**	**5%**	**0%**	**68%**	**1%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt E – Prior Channel to Bay Parkway One Shot										

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Complex	Complex (interpolated)	Heterogenous Complex	Soft Bottom	Soft Bottom (interpolated)	Anthropogenic	Total[6]
	Permanent	Cable Protection[4]	Acres	0.16	-	-	5.98	-	-	6.14
			%	3%	0%	0%	97%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	1.29	-	-	50.27	0.04	-	51.60
			%	3%	0%	0%	97%	0%	0%	100%
		HDD Exit Pit	Acres	0.57	-	-	-	-	-	0.57
			%	100%	0%	0%	0%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	16.90	4.41	-	1.92	-	0.002	23.23
			%	73%	19%	0%	8%	0%	0.01%	100%
		Dredging width for prior channel up to 175 ft wide	Acres	7.24	0.67	-	5.61	2.50	-	16.02
			%	45%	4%	0%	35%	16%	0%	100%
Total Permanent Impacts[7]			**Acres**	**0.16**	**-**	**-**	**5.98**	**-**	**-**	**6.14**
			%	**3%**	**0%**	**0%**	**97%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**26.00**	**5.08**	**-**	**57.80**	**2.54**	**0.002**	**91.42**
			%	**28%**	**6%**	**0%**	**63%**	**3%**	**0.002%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt A – Base Case to Bay Parkway One Shot										
	Permanent	Cable Protection[4]	Acres	0.99	-	-	5.88	-	-	6.87
			%	14%	0%	0%	86%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	8.26	-	-	49.19	-	-	57.45
			%	14%	0%	0%	86%	0%	0%	100%
		HDD Exit Pit	Acres	1.69	-	-	-	-	-	1.69
			%	100%	0%	0%	0%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	36.22	10.89	-	1.92	-	0.002	49.04
			%	74%	22%	0%	4%	0%	0.004%	100%
Total Permanent Impacts[7]			**Acres**	**0.99**	**-**	**-**	**5.88**	**-**	**-**	**6.87**
			%	**14%**	**0%**	**0%**	**86%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**46.17**	**10.89**	**-**	**51.11**	**-**	**0.002**	**108.17**
			%	**43%**	**10%**	**0%**	**47%**	**0%**	**0.002%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt E – Prior Channel to Bay Parkway										
	Permanent	Cable Protection[4]	Acres	-	-	-	11.74	1.31	-	13.05
			%	0%	0%	0%	90%	10%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	98.17	10.63	-	108.80
			%	0%	0%	0%	90%	10%	0%	100%
		HDD Exit Pit	Acres	-	0.57	-	-	0.58	-	1.14
			%	0%	49%	0%	0%	51%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	5.88	9.52	-	0.14	11.51	-	27.06
			%	22%	35%	0%	1%	43%	0%	100%
		Dredging width for prior channel up to 175 ft wide	Acres	7.24	0.67	-	5.61	2.50	-	16.02
			%	45%	4%	0%	35%	16%	0%	100%
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**-**	**11.74**	**1.31**	**-**	**13.05**
			%	**0%**	**0%**	**0%**	**90%**	**10%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**13.13**	**10.75**	**-**	**103.92**	**25.22**	**-**	**153.02**
			%	**9%**	**7%**	**0%**	**68%**	**16%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt A – Base Case to Bay Parkway										
	Permanent	Cable Protection[4]	Acres	1.68	-	-	11.97	0.79	-	14.44
			%	12%	0%	0%	83%	5%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	14.06	-	-	100.11	6.58	-	120.75
			%	12%	0%	0%	83%	5%	0%	100%
		HDD Exit Pit	Acres	1.12	0.57	-	-	0.58	-	2.26
			%	49%	25%	0%	0%	26%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	25.21	16.00	-	0.14	11.51	-	52.86
			%	48%	30%	0%	0%	22%	0%	100%
Total Permanent Impacts[7]			**Acres**	**1.68**	**-**	**-**	**11.97**	**0.79**	**-**	**14.44**
			%	**12%**	**0%**	**0%**	**83%**	**5%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**40.39**	**16.56**	**-**	**100.25**	**18.67**	**-**	**175.88**
			%	**23%**	**9%**	**0%**	**57%**	**11%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt E – Prior Channel to Nautilus Road										
	Permanent	Cable Protection[4]	Acres	-	-	-	6.85	-	-	6.85
			%	0%	0%	0%	100%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	57.55	0.04	-	57.59
			%	0%	0%	0%	100%	0%	0%	100%
		HDD Exit Pit	Acres	-	-	-	0.57	-	-	0.57
			%	0%	0%	0%	100%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	6.99	1.70	-	12.73	1.81	-	23.23
			%	30%	7%	0%	55%	8%	0%	100%
		Dredging width for prior channel up to 175 ft wide	Acres	7.24	0.67	-	5.61	2.50	-	16.02
			%	45%	4%	0%	35%	16%	0%	100%

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Complex	Complex (interpolated)	Heterogenous Complex	Soft Bottom	Soft Bottom (interpolated)	Anthropogenic	Total[6]
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**-**	**6.85**	**-**	**-**	**6.85**
			%	**0%**	**0%**	**0%**	**100%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**14.23**	**2.37**	**-**	**76.46**	**4.35**	**-**	**97.41**
			%	**15%**	**2%**	**0%**	**78%**	**4%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt A – Base Case to Nautilus Road										
	Permanent	Cable Protection[4]	Acres	0.83	-	-	6.75	-	-	7.59
			%	11%	0%	0%	89%	0%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	6.97	-	-	56.47	-	-	63.44
			%	11%	0%	0%	89%	0%	0%	100%
		HDD Exit Pit	Acres	1.12	-	-	0.57	-	-	1.69
			%	66%	0%	0%	34%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	26.31	8.18	-	12.73	1.81	-	49.03
			%	54%	17%	0%	26%	4%	0%	100%
Total Permanent Impacts[7]			**Acres**	**0.83**	**-**	**-**	**6.75**	**-**	**-**	**7.59**
			%	**11%**	**0%**	**0%**	**89%**	**0%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**34.40**	**8.18**	**-**	**69.77**	**1.81**	**-**	**114.17**
			%	**30%**	**7%**	**0%**	**61%**	**2%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt E – Prior Channel to Lighthouse										
	Permanent	Cable Protection[4]	Acres	-	-	-	6.45	0.52	-	6.97
			%	0%	0%	0%	93%	7%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	54.28	4.01	-	58.29
			%	0%	0%	0%	93%	7%	0%	100%
		HDD Exit Pit	Acres	0.32	-	-	0.26	-	-	0.57
			%	55%	0%	0%	45%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	11.28	0.11	-	11.60	0.23	-	23.22
			%	49%	0%	0%	50%	1%	0%	100%
		Dredging width for prior channel up to 175 ft wide	Acres	7.24	0.67	-	5.61	2.50	-	16.02
			%	45%	4%	0%	35%	16%	0%	100%
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**-**	**6.45**	**0.52**	**-**	**6.97**
			%	**0%**	**0%**	**0%**	**93%**	**7%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**18.84**	**0.78**	**-**	**71.74**	**6.74**	**-**	**98.10**
			%	**19%**	**1%**	**0%**	**73%**	**7%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt A – Base Case to Lighthouse										
	Permanent	Cable Protection[4]	Acres	0.85	-	-	6.78	0.00	-	7.63
			%	11%	0%	0%	89%	0.0002%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	7.09	-	-	56.73	0.00	-	63.82
			%	11%	0%	0%	89%	0.0002%	0%	100%
		HDD Exit Pit	Acres	1.44	-	-	0.26	-	-	1.69
			%	85%	0%	0%	15%	0%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	30.60	6.59	-	11.60	0.23	-	49.03
			%	62%	13%	0%	24%	0.5%	0%	100%
Total Permanent Impacts[7]			**Acres**	**0.85**	**-**	**-**	**6.78**	**0.00002**	**-**	**7.63**
			%	**11%**	**0%**	**0%**	**89%**	**0.0002%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**39.13**	**6.59**	**-**	**68.58**	**0.23**	**-**	**114.54**
			%	**34%**	**6%**	**0%**	**60%**	**0.2%**	**0%**	**100%**
Oyster Creek IECRC – Barnegat Bay Alt E – Prior Channel to Marina										
	Permanent	Cable Protection[4]	Acres	-	-	-	12.70	1.47	-	14.17
			%	0%	0%	0%	90%	10%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	-	-	-	106.19	12.04	-	118.23
			%	0%	0%	0%	90%	10%	0%	100%
		HDD Exit Pit	Acres	-	0.15	-	-	0.99	-	1.14
			%	0%	13%	0%	0%	87%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	0.88	12.64	-	1.00	14.04	-	28.56
			%	3%	44%	0%	4%	49%	0%	100%
		Dredging width for prior channel up to 175 ft wide	Acres	7.24	0.67	-	5.61	2.50	-	16.02
			%	45%	4%	0%	35%	16%	0%	100%
Total Permanent Impacts[7]			**Acres**	**-**	**-**	**-**	**12.70**	**1.47**	**-**	**14.17**
			%	**0%**	**0%**	**0%**	**90%**	**10%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**8.12**	**13.45**	**-**	**112.80**	**29.58**	**-**	**163.96**
			%	**5%**	**8%**	**0%**	**69%**	**18%**	**0%**	**100%**

Ocean Wind Offshore Wind Farm Proposed Project Design			Unit of Measure	Complex	Complex (interpolated)	Heterogenous Complex	Soft Bottom	Soft Bottom (interpolated)	Anthropogenic	Total[6]
Oyster Creek IECRC – Barnegat Bay Alt A – Base Case to Marina										
	Permanent	Cable Protection[4]	Acres	1.68	-	-	12.94	0.95	-	15.57
			%	11%	0%	0%	83%	6%	0%	100%
	Short-term	Cable Installation and Seafloor Preparation[5]	Acres	14.06	-	-	108.13	8.00	-	130.18
			%	11%	0%	0%	83%	6%	0%	100%
		HDD Exit Pit	Acres	1.12	0.15	-	-	0.99	-	2.26
			%	49%	7%	0%	0%	44%	0%	100%
		Cofferdam HDD Anchoring Area[8]	Acres	20.21	19.12	-	1.00	14.04	-	54.36
			%	37%	35%	0%	2%	26%	0%	100%
Total Permanent Impacts[7]			**Acres**	**1.68**	**-**	**-**	**12.94**	**0.95**	**-**	**15.57**
			%	**11%**	**0%**	**0%**	**83%**	**6%**	**0%**	**100%**
Total Short-term Impacts[7]			**Acres**	**35.39**	**19.27**	**-**	**109.13**	**23.03**	**-**	**186.81**
			%	**19%**	**10%**	**0%**	**58%**	**12%**	**0%**	**100%**

Notes:
[1] Foundations are calculated using a 5.55 m radius
[2] Maximum Scour Protection are calculated using a 22.39 m radius around foundation
[3] Seafloor Disturbance are calculated using a 221.0 m radius around maximum scour protection
[4] Cable Protection are calculated using a 2.99 m total width; While removal of WTG positions is anticipated to result in a corresponding reduction in inter-array cable length and associated cable protection and cable installation and seafloor preparation impacts; the cable protection and cable installation and seafloor preparation area for the alternatives excluding WTG positions could not be calculated because the inter-array cable alignments associated with these alternatives have not been designed/engineered. Therefore, the values for these impact areas remains the same as those for the Proposed Action.
[5] Cable Installation and Seafloor Preparation are calculated using a 25 m total width; While removal of WTG positions is anticipated to result in a corresponding reduction in inter-array cable length and associated cable protection and cable installation and seafloor preparation impacts; the cable protection and cable installation and seafloor preparation area for the alternatives excluding WTG positions could not be calculated because the inter-array cable alignments associated with these alternatives have not been designed/engineered. Therefore, the values for these impact areas remains the same as those for the Proposed Action
[6] Does not sum due to rounding
[7] Does not sum as represents the total combined footprint of impacts
[8] Cofferdam HDD Anchoring Area is calculated as 175m radius from center point of HDD Exit pit.

Key:
WTGs = Wind Turbine Generators
OSSs = Offshore Substations

Table 10.2-8 Total Area of Summer Flounder HAPC within the Inshore Export Cable Corridor

Ocean Wind Offshore Wind Farm Proposed Project Design		Short-term (acres)	Permanent (acres)
Oyster Creek Inshore - Barnegat Bay Alt E - Prior Channel to The Farm	Cable Protection[1]	-	12.11
	Cable Installation and Seafloor Preparation[2, 3]	101.11	-
	HDD Exit Pit	16.02	-
	Cofferdam HDD Anchoring Area[4]	12.11	-
	Total	**117.13**	**12.11**
Oyster Creek Inshore - Barnegat Bay Alt A - Base Case to The Farm	Cable Protection[1]	-	13.51
	Cable Installation and Seafloor Preparation[2, 3]	113.06	-
	HDD Exit Pit	1.12	-
	Cofferdam HDD Anchoring Area[4]	25.80	
	Total	**139.98**	**13.51**
Oyster Creek Inshore - Barnegat Bay Alt E - Prior Channel to Bay Parkway One Shot	Cable Protection[1]	-	6.14
	Cable Installation and Seafloor Preparation[2, 3]	51.60	-
	HDD Exit Pit	0.57	-
	Cofferdam HDD Anchoring Area[4]	23.23	-
	Dredging width for prior channel up to 175 ft wide	16.02	-
	Total	**91.42**	**6.14**
Oyster Creek Inshore - Barnegat Bay Alt A - Base Case to Bay Parkway One Shot	Cable Protection[1]	-	6.87
	Cable Installation and Seafloor Preparation[2, 3]	57.45	-
	HDD Exit Pit	1.69	-
	Cofferdam HDD Anchoring Area[4]	49.04	--
	Total	**108.17**	**6.87**
Oyster Creek Inshore - Barnegat Bay Alt E - Prior Channel to Bay Parkway	Cable Protection[1]	-	13.05
	Cable Installation and Seafloor Preparation[2, 3]	108.80	-
	HDD Exit Pit	1.14	-
	Cofferdam HDD Anchoring Area[4]	27.06	-
	Dredging width for prior channel up to 175 ft wide	16.02	-
	Total	**153.02**	**13.05**
Oyster Creek Inshore - Barnegat Bay Alt A - Base Case to Bay Parkway	Cable Protection[1]	-	14.44
	Cable Installation and Seafloor Preparation[2, 3]	120.75	-
	HDD Exit Pit	2.26	-
	Cofferdam HDD Anchoring Area[4]	52.86	-
	Total	**175.88**	**14.44**

Ocean Wind Offshore Wind Farm Proposed Project Design		Short-term (acres)	Permanent (acres)
Oyster Creek Inshore - Barnegat Bay Alt E - Prior Channel to Nautilus Rd	Cable Protection[1]	-	6.85
	Cable Installation and Seafloor Preparation[2, 3]	57.59	-
	HDD Exit Pit	0.57	-
	Cofferdam HDD Anchoring Area[4]	23.23	-
	Dredging width for prior channel up to 175 ft wide	16.02	--
	Total	**97.41**	**6.85**
Oyster Creek Inshore - Barnegat Bay Alt A - Base Case to Nautilus Rd	Cable Protection[1]	-	7.59
	Cable Installation and Seafloor Preparation[2, 3]	63.44	-
	HDD Exit Pit	1.69	-
	Cofferdam HDD Anchoring Area[4]	49.03	-
	Total	**114.17**	**7.59**
Oyster Creek Inshore - Barnegat Bay Alt E - Prior Channel to Lighthouse Dr	Cable Protection[1]	-	6.97
	Cable Installation and Seafloor Preparation[2, 3]	58.29	-
	HDD Exit Pit	0.57	-
	Cofferdam HDD Anchoring Area[4]	23.22	-
	Dredging width for prior channel up to 175 ft wide	16.02	-
	Total	**98.10**	**6.97**
Oyster Creek Inshore - Barnegat Bay Alt A - Base Case to Lighthouse Drive	Cable Protection[1]	-	7.63
	Cable Installation and Seafloor Preparation[2, 3]	63.82	-
	HDD Exit Pit	1.69	-
	Cofferdam HDD Anchoring Area[4]	49.03	-
	Total	**114.54**	**7.63**
Oyster Creek Inshore - Barnegat Bay Alt E - Prior Channel to Marina	Cable Protection[1]	-	14.17
	Cable Installation and Seafloor Preparation[2, 3]	118.23	-
	HDD Exit Pit	1.14	-
	Cofferdam HDD Anchoring Area[4]	28.56	-
	Dredging width for prior channel up to 175 ft wide	16.02	-
	Total	**163.96**	**14.17**
Oyster Creek Inshore - Barnegat Bay Alt A - Base Case to Marina	Cable Protection[1]	-	15.57
	Cable Installation and Seafloor Preparation[2, 3]	130.18	-
	HDD Exit Pit	2.26	-
	Cofferdam HDD Anchoring Area[4]	54.36	-
	Total	**186.81**	**15.57**

Notes:
[1] Cable Protection are calculated using a 2.99 m total width
[2] Cable Installation and Seafloor Preparation are calculated using a 25 m total width
[3] Open cut trench installation is within the Cable Installation and Seafloor Preparation impact area
[4] Cofferdam HDD Anchoring Area is calculated as 175m radius from center point of HDD Exit pit
Key: HDD = Horizontal Directional Drill

10.3 Benthic Habitat Mapping Methodology

Benthic habitat mapping for Ocean Wind 1 was conducted by Inspire Environmental. The following information is taken from their benthic habitat report (Appendix E, Ocean Wind COP). All tables, figures, and citations in the methodology below can be found in Appendix E.

10.3.1 Input Data and Approach

Multiple sources of geophysical and ground-truth data were used as input data sources for mapping benthic habitats within the Offshore Project Area. Brief summaries of these data sources and details pertinent to their use in the habitat mapping process are described here. Full details of geophysical and ground-truth data collection, processing, and analysis are provided in the Marine Site Investigation Report (Appendix D) appended to the Ocean Wind COP (Ocean Wind, LLC 2022), as well as in Attachments D through G of this report.

10.3.2 Input Data

10.3.2.1 Geophysical Data

To support Ocean Wind Site Investigations, multiple high-resolution MBES and side-scan sonar surveys were conducted within the Offshore Project Area (Ocean Wind, LLC 2022). Surveys were conducted in 2017 and 2018 by Gardline and Alpine Ocean Seismic Survey Inc. and by Fugro in the Lease Area; additional surveys were conducted by Gardline and Alpine in 2019 and 2020 to further characterize the Wind Farm Area and the export cable route corridors. In each of these surveys, MBES and SSS were collected using different instruments deployed from the same survey vessel (Figure 2-1 in Appendix E, Ocean Wind COP). The MBES was mounted to the vessel and provides the highest degree of positional accuracy; the MBES can be optimized either for bathymetric or backscatter data, not for both. The geophysical surveys conducted for offshore wind development are designed to support engineering and construction design and, therefore, the MBES was optimized for bathymetric data and backscatter data were collected as an ancillary data product. Bathymetric data were derived from the MBES and processed to a resolution of 50 cm (Ocean Wind, LLC 2022). Bathymetric data provide information on depth and seafloor topography (Figures 2-2 and 2-3 in Appendix E, Ocean Wind COP). Backscatter data were derived from the MBES and processed to a resolution of 50 cm (Ocean Wind, LLC 2022). Backscatter data are based on the strength of the acoustic return to the instrument and provide information on seafloor sediment composition and texture and are best interpreted in concert with hill-shaded bathymetry (Figures 2-4 and 2-5 in Appendix E, Ocean Wind COP). Backscatter returns are relative (see below) and referred to in terms of low, medium, and high reflectance rather than absolute decibel values. Nominally softer, fine-grained sediments absorb more of the acoustic signal and a weaker signal is returned to the MBES. Although backscatter data provide valuable information about sediment grain size, decibel values reflect not only sediment grain size, but also compaction, water content, and texture (Lurton and Lamarche 2015). For example, sand that is hard-packed and sand that has prominent ripples may have higher acoustic returns than sediments of similar grain size that do not exhibit these characteristics. In addition, backscatter decibel values are also influenced by water temperature and salinity, sensor settings, seafloor rugosity, and MBES operating frequency, among others (Lurton and Lamarche 2015; Brown et al. 2019). Differences in backscatter decibel values can also occur when data have been collected over a very large survey area under dynamic conditions, with different instruments, and in different years, as was the case for the Ocean Wind surveys.

This scenario is common and does not nullify the data; rather geophysicists and geographic information system (GIS) practitioners experienced at working with these data have developed methods to optimize processing (as appropriate to the sensors) and to display the data in a manner optimal for interpretation (Lurton and Lamarche 2015; Schimel et al. 2018). Backscatter data products vary based on processing

(Lucieer et al. 2017) and data display procedures. Mapping of seafloor composition and habitats, while greatly aided by backscatter data, rarely relies solely on these data (see Table 1 in Brown et al. 2011). The manner in which the suite of data collected were used for habitat delineations is described further in Section 2.2. SSS data were generated from a towed instrument and, thus, have a lower positional accuracy than MBES data. However, because the SSS is closer to the seafloor, it provides the highest resolution data on sediment textures and objects on the seafloor (boulders, debris) (Figures 2-6 and 2-7 in Appendix E, Ocean Wind COP). Thermoclines and haline variations affected the acoustic signal and resulted in data artifacts, presenting as sinuous rippling of alternating low and high returns that could not be removed from the data; they are visible when viewed at very close range. SSS data were processed to a resolution of 10 cm; this resolution permits detection of boulders but does not permit the reliable detection of individual cobbles (6.4 cm to 25.6 cm). These geophysical data were used to provide surface sediment interpretation delineations for the Project. These interpretations were performed by EGS International Ltd under the supervision of Ocean Wind's Site Investigations team. For the purposes of defining geological seabed types present at the sediment surface, the Folk classification was used, which align with CMECS Substrate classifications (Figure 2-8 in Appendix E, Ocean Wind COP). Surface seabed types present within the Offshore Project Area are based solely on this scheme and include Coarse Sediment, Sand and Muddy Sand, and Mud and Sandy Mud. Where present in densities greater than 10 boulders per 10,000 m^2, boulders were aggregated into boulder fields. All boulder fields identified within the Project were present in low (< 99 per 10,000 m^2) densities (Ocean Wind, LLC 2022); medium (100 – 99 per 10,000 m^2) and high (>199 per 10,000 m^2) density value categories have also been set by Ørsted Site Investigations. Boulder fields are defined as a geoform type CMECS (FGDC 2012), however no density values are provided in the federal standard. Isolated individual boulders greater than or equal to 50 cm (0.5 m) outside the boulder fields were identified from the MBES and SSS data. In addition to individual boulders, other solitary objects (known as "contacts" in geophysical survey terminology), such as various types of debris were identified in this manner. These data on individual boulder and debris (>0.5 m) locations were combined to generate an "individual contacts" data set to accompany the boulder field dataset (Figures 2-9 and 2-10 in Appendix E, Ocean Wind COP). Additional detail regarding processes used for the detection and identifications of boulders and debris is provided in Appendix D to the COP (Ocean Wind, LLC 2022). A combination of MBES, backscatter, and SSS data was used to detect large and small-scale bedforms, such as mega-ripples and ripples (*sensu* BOEM 2020) (Figure 2-11 in Appendix E, Ocean Wind COP).

10.3.2.2 Benthic Ground-Truth Data

As detailed above, ground-truth data were collected at a total of 362 stations using a variety of benthic sampling techniques (Figures 1-4 and 1-5 in Appendix E, Ocean Wind COP). In addition, a total of 17 transects, ranging in length from 664 m to 3,135 m, were sampled with towed video. Forty-five of the stations sampled are within Lease Area OCS-A 0532; as such, these stations are outside the area where benthic habitats were mapped for this Ocean Wind Offshore Wind Farm habitat assessment. These stations are depicted on maps to provide additional information and are included in the compiled benthic data results in Attachment C, but are not considered ground-truth stations as they do not overlap with geophysical data used for mapping and characterizing habitats within the Offshore Project Area. Imagery and grabs were analyzed for a suite of variables (Table 2-1) and were classified using the CMECS Substrate and Biotic components (Table 2-2). CMECS Substrate Group and Subgroup were particularly useful as ground-truth data for purposes of delineating seafloor sediments and benthic habitats (Figure 2-12 in Appendix E, Ocean Wind COP). CMECS Biotic Groups and notations of sessile and mobile epifauna present (Figure 2-13 in Appendix E, Ocean Wind COP) were used to provide detail about the biological communities observed within each mapped habitat type. Detailed descriptions of each variable were analyzed, and full data analysis results can be found in the Attachments D through G.

All June 2022 SPI/PV data were analyzed for variables most useful for ground-truthing habitat delineations; namely, CMECS Substrate Group and Subgroup, gravel minimum and maximum measurements, bedforms (ripples), presence of sensitive taxa, presence of species of concern, presence of non-native taxa, CMECS Biotic Subclass, Attached Fauna precent cover, and SPI grain size major mode. In addition, at the 30 stations sampled in the sand ridge area, presence of tubes, burrows, tracks, types of sessile and mobile epifauna, types of fish, and counts of sand dollars, and infaunal successional stage were recorded. Video imagery was analyzed using a video analysis software (Behavioral Observation Research Interactive Software [BORIS]). Habitat type was noted along the length of each transect and relative sand dollar abundance was recorded along transects collected in the sand ridge area.

Separate aerial (2019) and towed video surveys (2020) to map submerged aquatic vegetation (SAV) were conducted in support of Ocean Wind. These data were evaluated in combination with existing state and academic sources on historical SAV presence to map the distribution of these habitats (Ocean Wind, LLC 2021g). In addition, publicly available aerial imagery was used to assist mapping inshore waters not surveyed by geophysical data (these areas could not be surveyed by the geophysical vessel due to their shallow depth). The Oyster Creek IECRC Corridor was shifted to the north to the location of a formerly used navigation channel to avoid impacts to continuous SAV beds. This area was surveyed using underwater video and these data were combined with previous existing surveys of SAV in the area to map habitats along the new Oyster Creek IECRC Corridor. For the April 2022 revision, these habitat data along the new corridor were used to update impact calculations only; habitat delineation maps and mapped extents have not been updated.

In addition to the June 2022 survey at the Wind Farm Area, a preconstruction baseline SAV survey was conducted in Barnegat Bay in July 2022. This survey was designed to provide additional baseline SAV data to inform Project design and avoidance strategies (cable routing, designated moorings/anchoring locations) and to inform both federal and state permitting processes. The data results should be considered the most up to date data on recent SAV and macroalgae distributions and coverage within Barnegat Bay in the vicinity of the Ocean Wind export cable and potential landfall locations.

10.3.3 Habitat Mapping Approach

Geophysical and ground-truth data were reviewed in an iterative process to delineate benthic habitats. MBES data, viewed as backscatter draped over a hill-shaded bathymetric relief model, was used at a "zoomed out" scale (approximately 1:10,000) to identify large-scale facies – areas of sedimentary characteristics (reflectance, bedform, slope) distinct from those adjacent. These initial delineations are further refined at "zoomed in" scales (approximately 1:2,000 or finer) using the MBES data in combination with SSS, boulder picks, and ground-truth data (Figure 2-14 in Appendix E, Ocean Wind COP). Delineations must be of a size appropriate both to the resolution of the data and to the subject of interpretation. For these purposes, a minimum mapping unit is defined as "the smallest size areal entity to be mapped as a discrete entity" (Lillesand et al. 2015).

10.3.3.1 Delineation of Benthic Habitat Types

Geological characterizations of seabed conditions are not strictly equivalent to benthic habitats as experienced by benthic biological communities and demersal fish. To map these habitats for the purposes of assessing the potential impacts of the Project on these biotic communities, INSPIRE refined the seabed interpretations to map benthic habitats with a minimum mapping unit of 2,000 m^2. Multibeam 50 cm resolution bathymetry, 50 cm resolution backscatter, and 10 cm SSS data were examined along with benthic ground-truth data (Figure 2-15 in Appendix E, Ocean Wind COP) in order to delineate new habitat polygons as appropriate and according to the minimum mapping unit and to refine the seabed classifications for the purposes of evaluating benthic habitats (Figure 2-16 in Appendix E, Ocean Wind COP). In addition, anthropogenic features, such as docks near the shoreline in Barnegat Bay, were mapped as such. Modifiers were used to provide additional descriptive information about the benthic habitats found within the Offshore Project Area; CMECS modifier and Geoform or Substrate terms were used to the extent practicable. These modifiers include features of the seafloor that are relevant to the biota that utilize these habitats and describe the value of the habitats for these biota beyond what is provided in the geological seabed mapping. Modifiers are related to features that describe the mobility, stability, and complexity of the benthic habitats mapped. Where bedforms indicating frequent physical disturbance of the seafloor were observed, the “Mobile” modifier was used. Boulder fields mapped by Ocean Wind Site Investigations were used to refine habitat boundaries and applied as modifiers. Shell substrate (living or non-living shells) and SAV both provide unique habitats for certain species of benthic invertebrates and demersal fish; modifiers were applied for both. All habitats and their distributions within Offshore Project Area are described in more detail in Sections 3.2 and 3.3. In addition to the habitat data presented on maps in this report, the geospatial data contain separate attributes to record several other features of each habitat polygon: type of bedforms observed, area, presence of scattered boulders and debris, and refinements of Coarse Sediment habitats. In addition to the natural bedforms defined in the BOEM Geophysical Survey Guidelines (2020): mega-ripples = 5 - 60 m wavelength and 0.5 - 1.5 m height; ripples = <5 m wavelength and <0.5 m height; other bedforms such as depressions and trawl marks were noted where present. The presence of isolated boulders and debris identified by Ocean Wind Site Investigation in the geophysical analysis (individual boulder and debris contacts) were noted as “scattered boulders and debris” in the habitat data. Additionally, further characterization of Coarse Sediment habitat polygons was recorded as “coarse sediment refinements” to provide additional detail on the nature of coarse sediment (e.g., gravelly sand or sandy gravel) where such detail could be reliably determined from ground-truth geophysical data. These data are available in the interactive Popup map provided as an accompaniment to this report.

All habitat polygons within which June 2022 benthic data (SPI/PV and video) were collected were reviewed to determine if any updates to the delineations were required. No updates to delineation boundaries were needed as these new data confirmed existing delineations. The existence of the new ground-truth data permitted the addition of values for the Coarse Sediment refinement variable. These data were updated.