

ESSENTIAL FISH HABITAT ASSESSMENT FOR SUNRISE WIND
OFFSHORE WIND PROJECT

FOR THE NATIONAL MARINE FISHERIES SERVICE

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Acronyms and Abbreviations

ACCOL	Anderson Cabot Center for Ocean Life
AELs	adult equivalent losses
AIS	automatic identification system
AMSL	Above Mean Sea Level
BACI	Before-After-Control-Impact
BOEM	Bureau of Ocean Energy Management
CFE	controlled flow excavation
COFF	Coonamessett Farm Foundation
CFR	Code of Federal Regulations
CFRF	Commercial Fisheries Research Foundation
cm	centimeter
CMECS	Coastal and Marine Ecological Classification Standard
COP	Construction and Operations Plan
CORMIX	Cornell Mixing Zone Expert System
CPA	Connecticut Port Authority
CPS	cable protection system
CRs	conservation recommendations
CT	Connecticut
CTV	crew transfer vessel
CVs	coefficient of variations
CWIS	cooling water intake system
dB	decibels
DC	direct current
DEEP	Department of Energy and Environmental Protection
DIF	Design Intake Flow
EcoMon	Ecosystem Monitoring
EFH	essential fish habitat
EMF	electro-magnetic field
EPA	Environmental Protection Agency
EPM	environmental protection measure
FMP	fishery management plan
ft	foot or feet
Ft/s	feet per second
g	grams

gal	gallons
HAPC	habitat areas of particular concern
HDD	horizontal directional drilling
HMS	highly migratory species
IAC	inter-array cable
ICW	Intercoastal waterway
in	inch
kg	kilograms
kHz	kilohertz
kJ	kilojoule
km	kilometer
kV	kilovolt
L	liters
LAT	lowest astronomical tide
L_E	sound exposure level
LIE	Long Island Expressway
LIPA	Long Island Power Authority
LMSL	local mean sea level
L_p	sound pressure level
L_{pk}	peak sound pressure level
m	meter
$m\ s^{-1}$	meter(s) per second
$m\ s^{-2}$	meter(s) per squared second
m/s	meters per second
MA	Massachusetts
MAFMC	Mid-Atlantic Fisheries Management Council
MARMAP	marine resource monitoring, assessment, and prediction
MBES	multibeam echo sounding
MD	Maryland
MEC	munition and explosives of concern
MGD	million gallons per day
MHHW	mean higher high water
mi	mile
mm	millimeter
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NCCW	non-contact cooling water

NCEI	National Centers for Environmental Information
NEAMAP	Northeast Area Monitoring and Assessment Program
NEFMC	New England Fishery Management Council
NEPA	National Environmental Policy Act
Nj	New Jersey
nm	nautical mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NY	New York
O&M	operations and maintenance
OCS	Outer Continental Shelf
OCS-DC	offshore converter station-DC
OECC	offshore export cable corridor
OnCS-DC	onshore converter station
OSS	offshore substation
PSO	protected species observer
PTS	permanent threshold shift
RARMS	risk assessment with risk mitigation strategy
RI	Rhode Island
RIMA	Rhode Island-Massachusetts
ROV	remotely operated vehicle
RWF	Revolution Wind Farm
SAV	submerged aquatic vegetation
SCADA	supervisory control and data acquisition
SHPO	State Historic Preservation Office
SMAST	University of Massachusetts Dartmouth School for Marine Science and Technology
SOV	service operating vessel
SPI/PV	sediment profile and plan view imaging
SPL	sound pressure level
SPL _{peak}	peak sound pressure level
SPL _{RMS}	root-mean-square sound pressure level
SRWEC	Sunrise Wind Export Cable
SRWF	Sunrise Wind Farm
TJB	Transition Joint Bay
TP	transition piece

TTS	temporary threshold shift
US	United States
USACE	United State Army Corp of Engineers
UXO	unexploded ordinances
VA	Virginia
WDA	wind development area
WEA	wind energy area
WTG	wind turbine generator
ΔT	temperature differential
μPa	microPascal
$^{\circ}\text{C}$	degrees Celsius
$^{\circ}\text{F}$	degrees Fahrenheit

1.0 Introduction

In the Magnuson-Stevens Fishery Conservation and Management Act (MSA), Congress recognized that one of the greatest long-term threats to the viability of commercial and recreational fisheries is the continuing loss of marine, estuarine, and other aquatic habitats. Congress also determined that habitat considerations should receive increased attention for the conservation and management of fishery resources of the United States. As a result, one of the purposes of the MSA is to promote the protection of Essential Fish Habitat (EFH) in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat.

The MSA requires Federal agencies to consult with the Secretary of Commerce, through the National Marine Fisheries Service (NMFS), with respect to “any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any essential fish habitat identified under this Act,” 16 U.S.C. § 1855(b)(2). This process is guided by the requirements of the EFH regulation at 50 CFR 600.905. The Bureau of Ocean Energy Management (BOEM) will be the lead Federal agency for the consultation and will coordinate with any other Federal agencies that may be issuing permits or authorizations for this project, as necessary, for one consultation that considers the effects of all relevant Federal actions (e.g., issuance of permits by the U.S. Army Corps of Engineers and/or the U.S. Environmental Protection Agency).

Pursuant to the MSA, each Fishery Management Plan (FMP) must identify and describe EFH for the managed fishery, and the statute defines EFH as “those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity” 16 U.S.C. § 1853(a)(7) and § 1802(10). NOAA’s regulations further define EFH adding, “waters” include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; “substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities; “necessary” means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and “spawning, breeding, feeding, or growth to maturity” covers a species' full life cycle.

The EFH final rule published in the Federal Register on January 17, 2002, defines an adverse effect as: “any impact which reduces the quality and/or quantity of EFH.” The rule further states that:

An adverse effect may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat and other ecosystems components, if such modifications reduce the quality and/or quantity of EFH. The EFH final rule also states that the loss of prey may have an adverse effect on EFH and managed species. As a result, actions that reduce the availability of prey species, either through direct harm or capture, or through adverse impacts to the prey species' habitat may also be considered adverse effects on EFH. Adverse effects to EFH may result from action occurring within EFH or outside EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

2.0 Proposed Action

BOEM is evaluating the potential environmental effects of approval of the Construction and Operations Plan (COP) for the Project by Sunrise Wind. The proposed Project would allow Sunrise Wind to construct, operate, maintain, and eventually decommission a wind energy facility with an operating capacity ranging between 924 megawatts (MW) and 1,034 MW in scale. The Project would be located on the Outer Continental Shelf (OCS), offshore of Rhode Island and Massachusetts, with a cable landing on Long Island, New York, within the range of design parameters outlined in Section 1.2 of the COP (Sunrise Wind 2022)(Proposed Action). The Project would include up to 94 wind turbine generators (WTGs) at 102 potential locations, one Offshore Converter Station (OCS-DC), offshore export cable routes, onshore cable landfall sites, onshore cable routes, and onshore substation locations.

2.1 Project Area

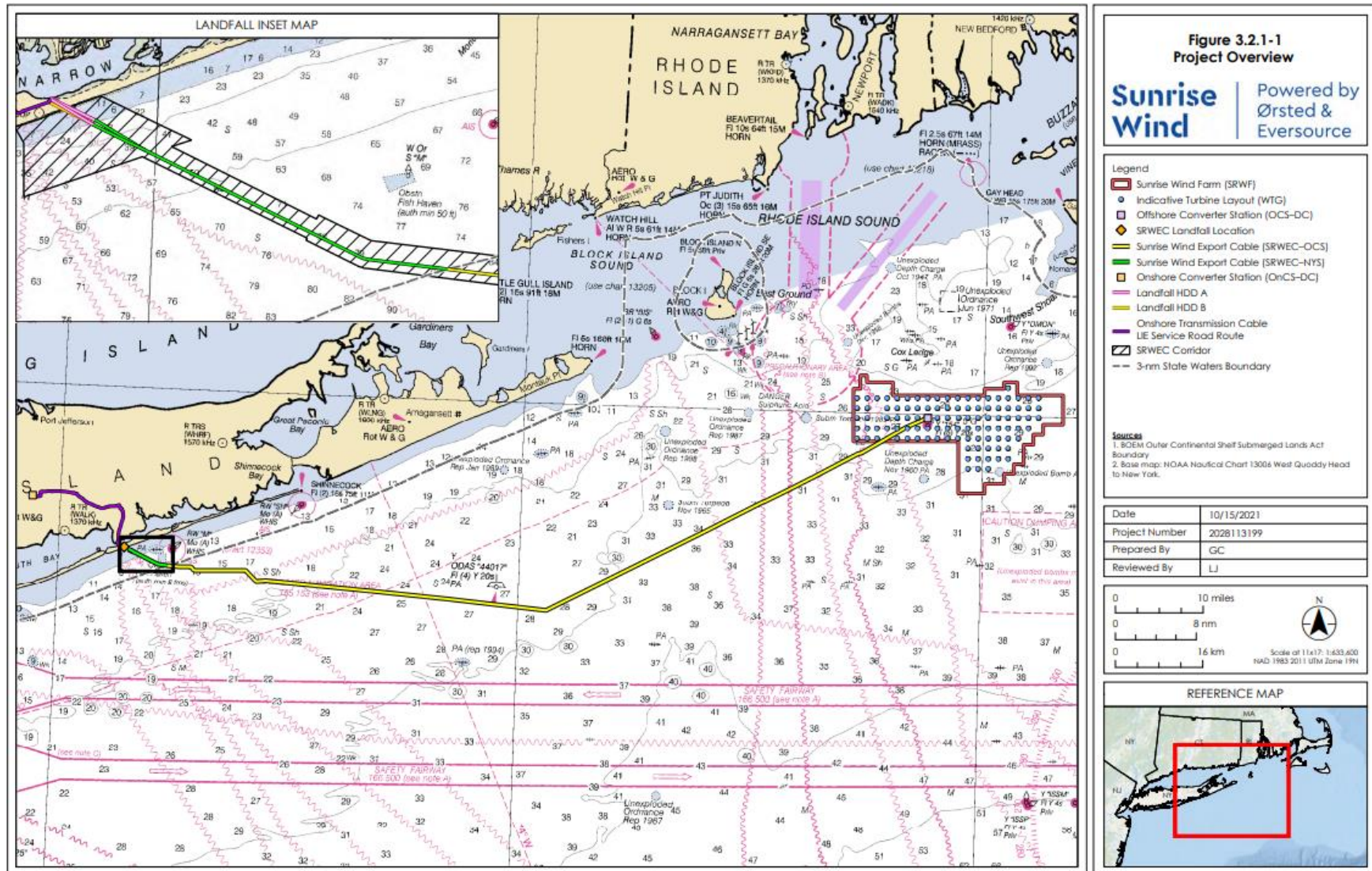


Figure 2-1. Project Overview of the SRWF and SWFEC

The proposed Project area would be located on the OCS in the designated BOEM Lease Area OCS-A 0487. The Project area comprises the Sunrise Wind Farm (SRWF); Sunrise Wind Export Cable (SRWEC), inclusive of offshore export cable (SRWEC-OCS) and export cable in New York state waters (SRWEC-NYS); and onshore transmission cable, onshore interconnection cable, and an Onshore Converter Station (OnCS-DC). The Lease Area contains portions of areas that were originally awarded through the BOEM competitive renewable energy lease auctions of the Wind Energy Area (WEA) off the shores of Rhode Island and Massachusetts. Other components of the Project would be located on the OCS, in state waters of New York, and onshore in the Town of Brookhaven, Long Island, New York (COP, Sunrise Wind 2022). The SRWF would be constructed in ocean habitats in the Rhode Island and Massachusetts WEA on the Atlantic Ocean OCS, state waters of New York, and tidal wetlands and coastal inshore habitats of Long Island, New York. 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 cable within state waters.

2.2 Construction and Installation

The proposed Project would result in the construction and installation of up to 94 WTGs within 102 positions and their monopile foundations; one OCS-DC and its piled jacket foundation; inter-array and export cables; scour protection for WTG and OCS-DC foundations, and inter-array and export cables. Collectively, these elements comprise the offshore Project area.

Construction and installation would include transportation and installation of foundations, installation of cable systems, installation of WTGs and installation of the OCS-DC. The Project would involve temporary construction laydown areas and ports utilized by construction vessels. The Project would use existing port facilities located in New York, Rhode Island, Connecticut, Massachusetts, Maryland, New Jersey, and/or Virginia for offshore construction, staging and fabrication, crew transfer, and logistics support. It is not anticipated that modifications of these ports would be needed. These ports would not be solely dedicated to the Project and Project specific construction is not anticipated at the port locations.

The Project's export cables would include both offshore and onshore segments. The SRWEC would be located in federal and New York state waters and would be one 320-kilovolt (kV) DC export cable bundle buried to a target depth of 3 to 7 feet (ft) (1 to 2 meters [m]). The SRWEC would connect to the Onshore Transmission Cable within the Transition Joint Bay (TJB) and link boxes located at Smith Point County Park on Fire Island in the Town of Brookhaven, New York. The onshore portion of the SRWEC, up to 339 ft (4,080 m) would be buried underground. The Onshore Facilities have been largely located within existing developed areas including parking lots and paved roadways. The Onshore Transmission Cable ICW HDD will cross under Great South Bay-East SCFWH before reaching the ICW HDD Work Area at Smith Point Marina. Potential land disturbance to coastal habitats and wetlands will be avoided by using HDD methods. To allow for the transportation of equipment and materials from Long Island to the construction site on Fire Island, a temporary pile-supported pier would be constructed on the inshore side of Fire Island. The pier would extend approximately 240 feet (73 m) offshore and be approximately 16-feet (4.9-m) wide. The precise pier design and type of piles have not yet been determined, but it is anticipated that up to 24 production piles would be used. Production piles would be either a 14 x 14-inch (36.5 x 36.5 cm) H-shaped pile or a 16-inch (40.6-cm) diameter round steel pile. In addition, up to 24 temporary piles (of the same size as the production piles) may be used to support the installation of the production piles and may be installed and removed during construction activities.

From the Landfall site, the Onshore Transmission Cable would carry the power from the TJB to the OnCS-DC. The Onshore Transmission Cable route has been sited within existing disturbed ROW to the

extent practicable, travelling from the eastern portion of Smith Point County Park, following the Long Island Expressway (LIE) Service Road Route to the OnCS-DC at the Union Avenue Site. The Onshore Transmission Cable will cross the Carmans River via HDD. The Onshore Interconnection Cable would carry the power from the OnCS-DC to the existing grid at the Holbrook Substation, also located in the Town of Brookhaven, New York. The Onshore Transmission Cable route intersects with tidal wetlands in a few limited points and runs parallel to or intersects with delineated tidal wetlands. The Onshore Transmission cable route would be installed with trenchless construction methods to avoid or minimize impacts to wetlands.

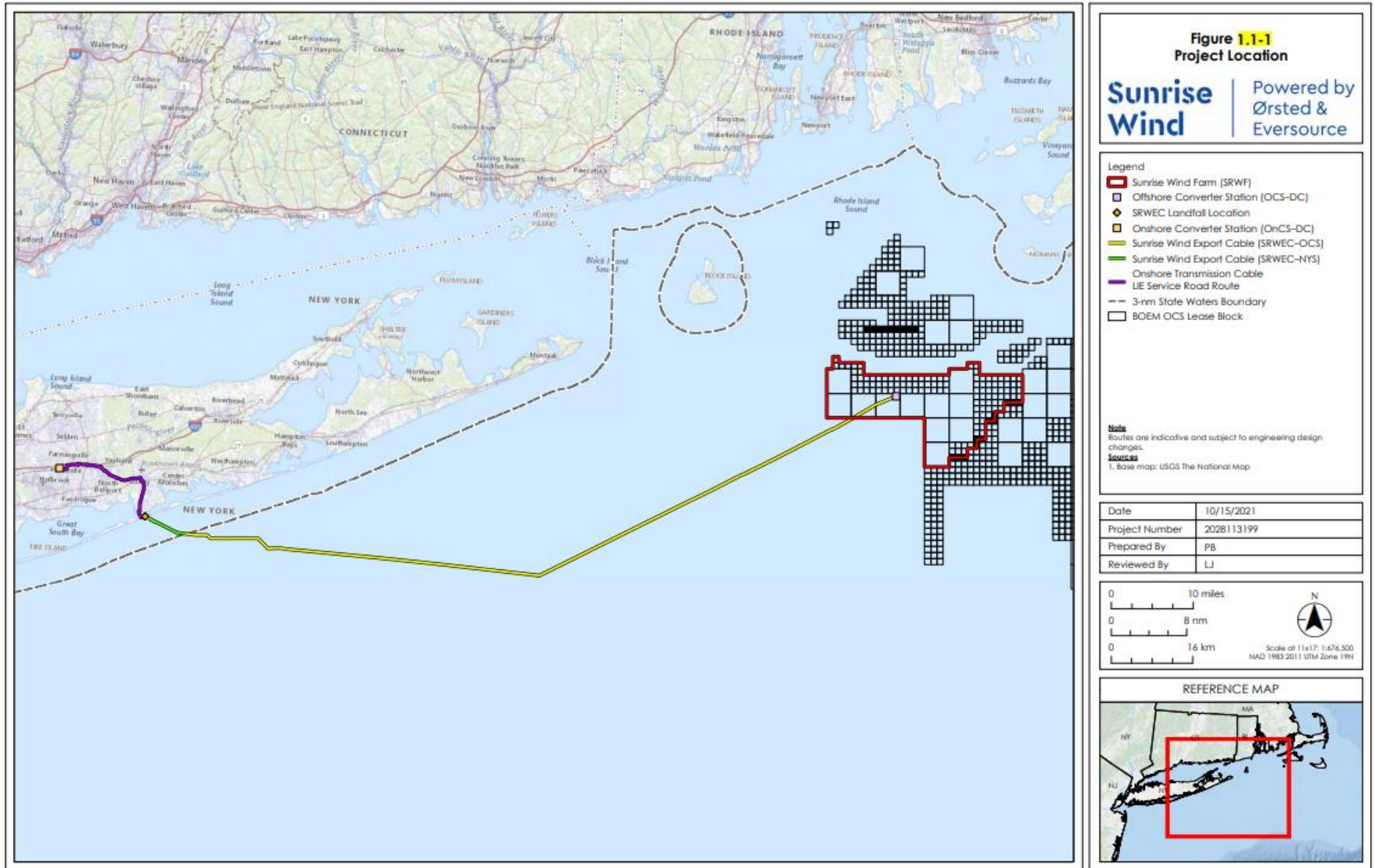


Figure 2-2. Sunrise Wind Farm and Export Cable Location

Table 2-1: Summary of SRWF and SRWEC Construction and O&M Effect Mechanisms by Project Stage and Location

Project Stage/Location	Design Element	Effect Mechanism	Measurement Parameter	Component	Effect Measurement	Options (if applicable)		
SRWF Construction	Turbine selection/spacing	Installation disturbance area	WTG size		39 ft (12 m)	-		
			Number of turbines		94 within 102 positions	-		
			Rotor height above mean sea level		Upper blade tip height of 787 ft (240 m)	-		
			Spacing		1.15 mi (1 nm, 1.8 km) spacing	-		
	Foundation installation	Habitat alteration, physical disturbance	Number of piles	39-foot (12 m) WTG monopiles		Up to 94 (1 per WTG)	-	
				OCS-DC		Up to 8	4 legs with up to two piles per leg	
			Footprint area total (with scour protection)	39-foot (12 m) monopile foundation		1.06 acres (0.43 hectares) per monopile		
				OCS-DC (piled jackets, scour protection in entire OCS-DC footprint)		(2.14 acres (0.87 hectares))		
								Vibratory pile driving is possible.
					39-foot (12 m) monopile		Impact pile driving: 4,000 kJ hammer, 32 strikes/minute, 1-4 hours per foundation	Drilling is not anticipated but is a contingency option. Drill spoil volume is unknown and noise from drilling would likely not exceed 107 dB re 1 $\mu\text{Pa}_{0-\text{pk}}$ at 24.6 ft (7.5 m).
Duration		Piled jacket		Impact pile driving: 4,000 kJ hammer, 32 strikes/minute, with a pile penetration range of 90 m and up to 17088 strikes per pile, 8.9 hours per pile	Vibratory pile driving is possible.			

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Project Stage/Location	Design Element	Effect Mechanism	Measurement Parameter	Component	Effect Measurement	Options (if applicable)
	Inter-array cable	Physical disturbance, turbidity, entrainment	Total Length	All	Up to 180 miles (290 km)	-
			Installation depth	All	Cable trenching/burial 3 to 7 ft (1 to 2 m) depth	-
			Short-term disturbance	All	2,150 acres (870.1 hectares)	-
			Long-term habitat conversion (exposed cable protection)	All	129 acres (52.2 hectares)	-
			Installation Method	All	Jet Plow	Cable trenching/burial could also be utilized
			Max Distance to TSS Plume >50 mg/L Above Ambient	All	7,815 ft (2,382 m)	-
			Max Distance of Sediment Deposition	All	220 ft (67.1 m)	-
			Area of Sediment Deposition	All	7.4 acres (3.0 hectares)	-
			Construction vessels	Physical disturbance, noise	Number of vessels	All
Number of Trips per Vessel Type	WTGs	4 trips for the scour protection vessel, 5 trips for the installation vessel, 15 trips for support vessels, 102 trips for transport/feeder vessels (including tugs)			-	
Number of Trips per Vessel Type	Structure Installation	26 trips for installation vessels, feeder/commissioning vessels: 28 trips for SOV, 392 trips for CTVs, 9 trips for other support vessels, and 24 trips for helicopters			-	
Number of Trips per Vessel Type	Array Cable Installation	3 trips for main laying vessels, 3 trips for main burial vessels, 5 trips for support vessels			-	

Project Stage/Location	Design Element	Effect Mechanism	Measurement Parameter	Component	Effect Measurement	Options (if applicable)
			Anchoring distance	All	Vessels would not be anchored during these activities; dynamic positioning vessels would generally be used	Dynamic positioning vessels would be used to the extent practicable. If anchoring vessels are needed, anchor dimensions would be: 9 ft (2.7 m) x 9 ft (2.7 m) with 2 to 7 anchors per vessel
			Jack-Up Vessels	All	4-leg jack-up vessels: 1,850 sq ft (171.9 m ²) per spudcan; 6-leg jack-up vessels: 1,027 sq ft (95.4 m ²) per spudcan	
			Vessel noise	All	SPL 150 to 180 dB re 1 µPa for dynamically positioned vessels (BOEM 2014), SPL 177 to 180 dB re 1 µPa for large shipping vessels (McKenna et al. 2012) during construction	-
SRWF Operation		Operational electro-magnetic field (EMF) (IAC)	Transmission voltage		Typical voltage 66 kV, maximum voltage 161 kV	-
			Magnetic Field	All	At a height of 3.3 ft (1 m) over the cables at peak loading, AC magnetic induced electric field levels = 4.5 mG and <0.09 millivolts/meter, decreasing to 1.1 mG and <0.1 mV/m or less at horizontal distance of 10 ft (3 m)	-
SRWEC	Export cable construction	Installation disturbance area	TL	SRWEC	104.6 mi (168.4 km)	
			Installation Method	SRWEC	Cable trenching/burial (3 to 7 ft [1 to 2 m]): short-term disturbance of 1,258 acres (509.5 hectares). Boulder clearance: short-term seabed disturbance = 81.5 acres (33 hectares) and long-term habitat alteration = 25.2 acres of (10.2 hectares)	-
			Full corridor with short-term seabed disturbance	SRWEC	1,259 acres (509.5 hectares)	-

Essential Fish Habitat Assessment for Sunrise Wind Offshore Wind Project

Project Stage/Location	Design Element	Effect Mechanism	Measurement Parameter	Component	Effect Measurement	Options (if applicable)	
			Number of Vessels	All	38 vessels during installation		
			Number of Trips per Vessel Type	SRWEC Installation	2 trips per main cable laying vessels, 1 trip per main cable jointing vessel, 2 trips per main cable burial vessels, 5 trips for support vessels	-	
Landfall Construction		Installation disturbance area	Area of Short-Term Disturbance	HDD Exit Pits	61.8 acres (25 hectares) of offshore seafloor	-	
	HDD Casing Pipe and Goal Posts	Physical disturbance area	Area of Disturbance	Casing Pipes	Up to two 3.9-foot (1.2-meter) diameter, 450-foot (137.2-meter) length casing pipes	Alternative to the casing pipes, a containment structure of similar size and impacts could be used during landfall construction.	
		Noise	Duration	Casing Pipe Installation	Impact pile driving: 18 kJ hammer of up to 3 hours of hammering per day on each of days of installation per pipe. For two casing pipes, this would mean a total of 12 hours of hammering and a total of four days of installation.		
				Casing Pipe Removal	Up to 3 hours of pneumatic hammering on each of 2 days per pipe. For two casing pipes this would mean a total of 12 hours of hammering and a total of four days of removal.		
				Area of Disturbance	Sheet Pile Goal Posts	Up to six goal posts may be installed to support installation of the casing pipe. Each goal post would be composed of two vertical sheet piles and a horizontal cross beam. Sheet piles would be up to 100 feet (30 m) long, 2 feet (0.6 m) wide, and 1 inch thick.	
				Area of Disturbance	Sheet Pile Supports	In addition to the goal posts, up to 20 additional support sheet piles 100 feet (30 m) long, 2 feet (0.6 m) wide, and 1 inch thick may be installed to help anchor the barge and support construction activities.	
				Installation Method	Sheet Pile Goal Posts and Sheet Pile Supports	Up to two hours of vibratory piling per sheet. Up to 4 sheet piles may be installed per day, resulting in up to 12 total days of vibratory	

Essential Fish Habitat Assessment for Sunrise Wind Offshore Wind Project

Project Stage/Location	Design Element	Effect Mechanism	Measurement Parameter	Component	Effect Measurement	Options (if applicable)
					piling for both the sheet pile goal posts and supports.	
	Temporary Pier	Installation disturbance area	Area of Disturbance	Production Piles	Up to 24 H-shaped production piles 35.6 x 35.6 cm (14 x 14 inch)	The production piles could also be 40.6 cm (16 inch) diameter round steel piles.
			Installation Method	Production Piles	The piles will first be driven using a vibratory hammer followed by an impact hammer.	
			Duration of Pile Driving	Production Piles	Installation would include up to 324 minutes (5 hours 24 minutes) of vibratory pile driving (24 x 13.5 minutes) and 36 minutes of impact pile driving (24 x 1.5 minutes). Removal of the production piles would use a vibratory hammer for a total duration of up to 360 minutes (6 hours; 24 x 15 minutes).	
			Area of Disturbance	Temporary Piles	Up to 24 H-shaped temporary piles 35.6 x 35.6 cm (14 x 14 inch) may be installed, and in some cases removed, during construction	The temporary piles could also be 40.6 cm (16 inch) diameter round steel piles
			Duration of Pile Driving	Temporary Piles	Installation and removal may require up to 720 minutes (16 hours) of vibratory pile driving (2 x 24 x 15 minutes)	
	Onshore Construction Area		Length of Onshore Cable Route	Cable Route	17.5 miles	
Onshore Transmission Cable and Onshore Interconnection Cable	HDD		Approximate Crossing Length	Tidal Wetlands Crossings	2,660 ft (811 m)	
			Area of Short-Term Disturbance	Tidal Wetlands Crossings	1.83 acre (0.74 hectare)	-

The proposed Project 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 SRWF and SRWEC. Components in these areas would be the WTGs (including foundations and scour protection), OCS-DC (including foundations and scour protection), inter-array cables (IAC) (including scour and protection), and offshore export cables (including scour protection) (Figure 2-3). Construction activities would begin in Q3 of 2023 and would be completed in Q4 of 2025. Sunrise Wind anticipates beginning land-based construction before the offshore components. An approximate schedule is shown in Table 2-2.

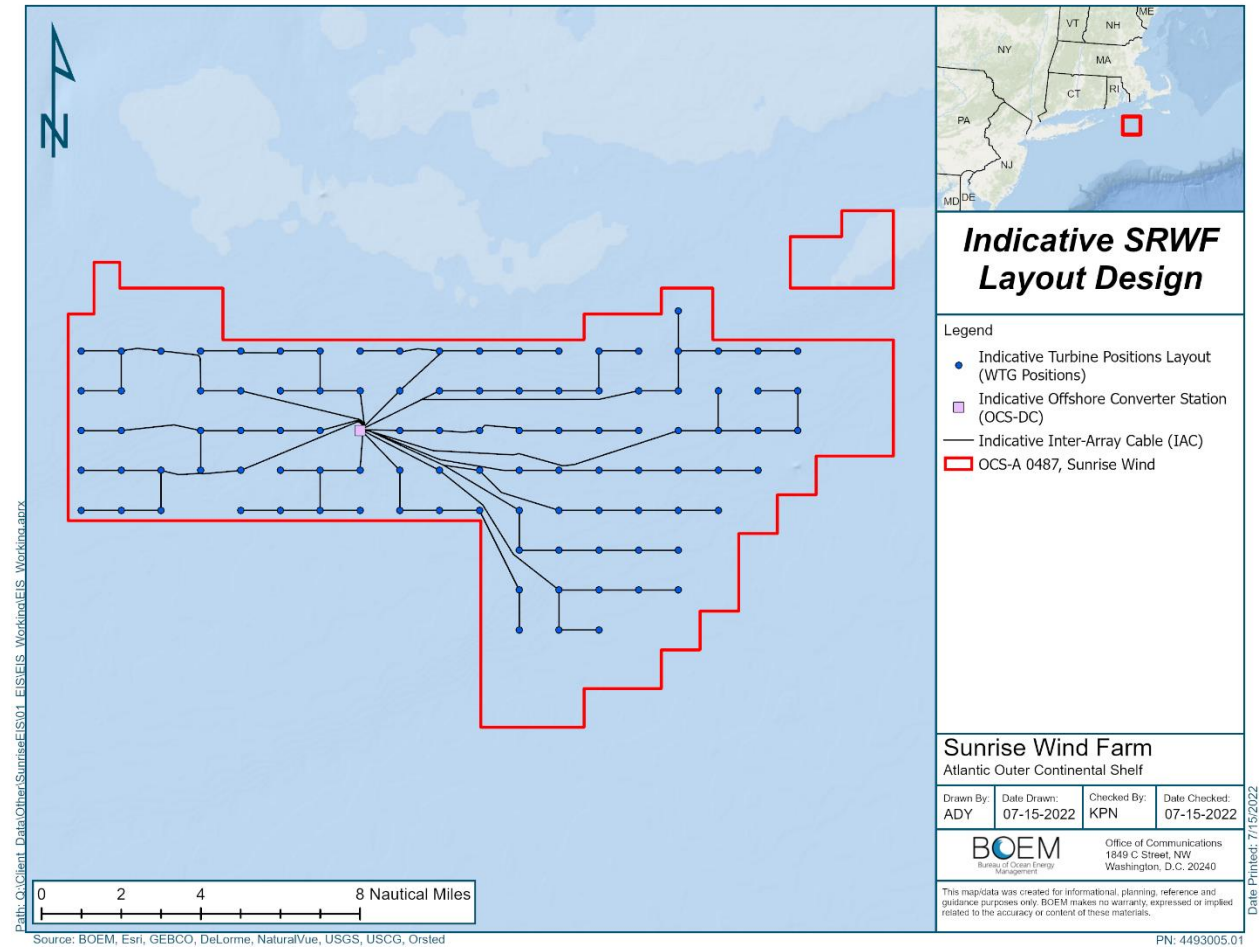


Figure 2-3. Sunrise Wind Proposed Project WTG Layout

Table 2-2: Project Schedule

Event	Schedule
Onshore Facilities (OnCS-DC and Onshore Transmission Cables)	Q3 of 2023 to Q3 of 2025
SRWEC	Q4 of 2024 to Q2 of 2025
Offshore Foundations	Q3 of 2024 to Q4 of 2024
Inter-Array Cables	Q2 to Q3 of 2024 and Q2 to Q4 of 2025
WTGs	Q3 of 2024 to Q2 of 2025 and Q4 of 2025
OCS-DC	Q4 of 2024 to Q4 of 2025

2.2.1 Installation of WTG/OSS Structures and Foundations

Proposed offshore Project components include WTGs and their foundations, an OCS-DC and its foundation, scour protection for foundations, inter-array cables, and offshore export cables (these elements collectively compose the Offshore Project area). The proposed offshore Project elements would be 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 and state lands.

Sunrise Wind proposes the installation of up to 94 WTGs within 102 potential positions extending up to 787 ft (240 m) above mean sea level (AMSL). Turbines would be sited in a uniform east-west/north-south grid with 1.15 by 1.15-mile (mi) (1 by 1-nautical mile [nm]; 1.85 by 1.85 kilometer [km]) spacing. Sunrise Wind would maintain diagonal lanes between 0.7 and 0.9 mi (0.6 to 0.8 nm; 1.1 and 1.5 km) wide when micro-siting foundations. Sunrise Wind would mount the WTGs on monopile foundations. The WTG foundations as proposed in the COP would be 39 ft (12 m) in diameter at the seabed and 23 ft (7 m) in diameter at the sea surface (Sunrise Wind 2022). A monopile foundation typically consists of a single steel tubular section, with several sections of rolled steel plate welded together. For a WTG monopile foundation, a Transition Piece (TP) may be fitted over the top of the monopile and secured via a bolted connection. Secondary structures on each WTG monopile foundation would include a boat landing or alternative means of safe access, a crane, and other ancillary components. The OCS-DC would be placed on an up to four-legged piled jacket foundation. A piled jacket foundation is formed of a steel lattice construction (comprising tubular steel members and welded joints) secured to the seafloor by means of hollow steel pin piles attached to the jacket. Schematic drawings and renderings of the conceptual monopile foundation with secondary structure after installation and the piled jacket foundations are included in COP Section 3.3.5 (Sunrise Wind 2022). When 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 approximately 1,850 gallons (gal) (7,000 liters [L]) of transformer oil, 159 gal (600 L) of hydraulic oil, and 79 gal (300 L) of gear oil. Use of other chemicals would include nitrogen (104 cubic yd, 80 m³), diesel fuel (793 gal, 3,000 L), and glycol/coolants (3,434 gal, 13,000 L). The OCS-DC would contain approximately 105,700 gal (400,000 L) of transformer oil and 700 gal (2,650 L) of general oil for hydraulics and lube oil. Use of other chemicals would include diesel fuel (24,304 gal, 92,000 L), SF₆, grease (3,960 lbs, 1,796 kg), high pressure nitrogen (52,834 gal (200,000 L at 300 bar), inert gas (TBD), refrigerant (40 gal, 150 L), battery acid (TBD), and glycol/water mix (13,748, 50,000 L).

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 SRWF. During installation of array and substation interconnection cables, Sunrise Wind anticipates a maximum of 33 vessels operating during a typical workday in the SRWF. Many vessels would remain in the SRWF and along the export cable route for days or weeks at a time, potentially only making infrequent trips to port for bunkering or provisioning as needed.

Sunrise Wind would install foundations and WTGs using dynamic positioning heavy lift vessels or up to two jack-up vessels with up to four spudcans for foundation installation. Jack-up would occur within the Seafloor Preparation Area. Additionally, a scour protection vessel, and 4 transport/feeder vessels would be necessary to support the two installation vessels. 6 support vessels, including 1 completion vessel, 1 noise mitigation vessel, and 4 protected species observe (PSO) vessels would be anticipated to be needed during installation and commissioning. It is anticipated that none of these vessels would be anchored during foundation installation. The OCS-DC is anticipated to have 1 primary installation vessel present with 5 support vessels, including 3 transport vessels and 2 planned support vessels (Sunrise Wind 2022).

2.2.1.2 Pile Driving

Each WTG would require one monopile foundation. Installation of piles is anticipated to normally require 1 to 4 hours (6 to 12 hours maximum) of pile driving. Installation of a single monopile at a minimum would include a 1-hour pre-clearance period, 4 hours of piling, and 4 hours to move to the next piling location where the process would begin again. This results in an estimated 9 hours of installation time per pile, or 846 total hours for 94 WTG monopile foundations under ideal conditions for all installations. Up to three monopile foundations would be installed in a 24-hour period, using one installation vessel. It is possible that two separate vessels may work simultaneously to install up to four total monopiles per day (assuming two monopiles per day, per vessel), assuming 24-hour pile driving operations (COP Section 3.3.5.2; Sunrise Wind 2022). Should nighttime pile driving occur, the best currently available technology will be used to mitigate the potential impacts and result in the least practicable adverse impacts. If pile driving were only allowed from sunrise to sunset, and no pile driving was conducted from January 1 to April 30, then approximately 2,940 hours would initially be available for pile driving (this assumes an average of 12 hours of daylight per day for 245 days). Based on prior experience, it is reasonable to assume that approximately 30 percent of the time would be unavailable due to weather conditions, bringing the available time down to 2,058 hours and leaving a buffer of approximately 1,200 hours between the minimum time required to install the foundations and the time available.

After the seabed has been prepared for foundations, including boulder clearance and removal of any obstructions within the Seafloor Preparation Area at each foundation location, monopiles would be driven until the target embedment depth is met. The maximum embedment depth for WTG monopile foundations would be up to 164 ft (50 m). Then, the pile hammer is removed and the monopile is released from the pile gripper. Once the monopile is installed to the target depth, the TP or separate secondary structures will be lifted over the pile by the installation vessel. If used, the TP will be bolted to the monopile.

The OCS-DC would have a four-legged piled jacket OCS-DC foundation. Installation of a single piled jacket foundation for the OSC-DC is estimated to require approximately 48 hours maximum of pile driving, with actual impact pile driving likely to occur within a 3-day period (72 hours). If one monopile

vessel and one piled jacket vessel are working simultaneously, installation of up to six piles may be installed (two monopiles and four pile piles). At a maximum, the Project expects up to two vessels working simultaneously (i.e., two monopile vessels or one monopile foundation vessel and one piled jacket foundation vessel). This approach assumes 24/7 piling in addition to simultaneous piling operations among the up to two pile installation vessels (COP Section 3.3.5.2; Sunrise Wind 2022). The typical sequence of piled jacket foundation installation includes pre-installation surveys, seafloor preparation, scour protection, foundation setup and piled jacket installation, pin pile driving, drilling (optional), grouting, and completion.

The OCS-DC would consist of a topside structure with one or more decks on a piled jacket foundation. An up to four-legged piled jacket foundation would be used for the proposed OCS-DC. A piled jacket foundation would be formed of a steel lattice construction secured to the seafloor by means of hollow steel pin piles attached to the jacket. Monopile foundations or pin piles for the piled jacket foundation would be driven to target embedment depths using impact pile driving and/or vibratory filing driving. The installation of a single piled jacket foundation for the OCS-DC is estimated to require approximately 48 hours maximum of pile driving, A single monopile foundation is estimated to normally require 1 to 4 hours (6 to 12 hours maximum) of pile driving (COP Section 3.3.5; Sunrise Wind 2022). Array cables would transfer electrical energy generated by the WTGs to the OCS-DC. The OCS-DC would include step-up transformers and other electrical equipment needed to connect the 66-kV inter-array cables to the ± 320 direct current (DC) voltage per circuit offshore export cable.

2.2.1.3 Seabed Preparation/Boulder Relocation/Dredging

Prior to foundation installation, a number of operations would be completed. Geophysical surveys would be conducted to identify seafloor debris; geotechnical surveys would be conducted to identify the geological, archaeological, and cultural resource conditions; Munition and Explosives of Concern (MEC)/Unexploded Ordnances (UXO) Clearance surveys would be conducted to identify and confirm MEC/UXO targets for removal/disposal; and seafloor debris clearance would occur. Seafloor debris clearance would consist of removing seafloor debris and boulders where necessary to ensure the seafloor is suitable for safe foundation installation. Boulder clearance would occur within a 722-ft (220-m) radius centered on the foundations (COP Section 3.3.5; Sunrise Wind 2022).

Seafloor preparation, including boulder relocation and sand wave leveling would result in temporary sediment suspension and deposition within the SRWF. Seafloor Preparation Area would occur within a 722 ft (220 m) radius centered on the foundations to ensure safe foundation installation as well as safe vessel jack-up. For each WTG foundation, a seafloor preparation area per foundation of 37.6 acres (152,053 m³ would be anticipated). For each foundation, a seafloor footprint area of 1.06 acres (4,290 m³) would be anticipated with 1.03 acres (4,168 m³) of scour protection and cable protection system (CPS) stabilization per foundation. For WTG installation, the total area of seafloor disturbance would be 3,855 acres (1,552 hectares). This area accounts for up to 8 potential positions where seafloor disturbance activities would be initiated, but where WTG installation is unable to be completed due to environmental or engineering constraints (COP Section 3.3.5; Sunrise Wind 2022).

Additional information on seabed preparation and boulder relocation activities are discussed below 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 6.5 ft (2 m) in height, would extend around the foundation as far as 66-yards (60 m) in diameter, and would cover an area of 1.03 acres (0.41 hectares) per monopile.

Several types of scour protection for monopiles are being considered. These include rock protection, rock bags or concrete mattresses. Scour protection 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 (pre-installed) or afterwards (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.

2.2.2 Inter-Array and Offshore/Onshore Cable Installation

The SRWEC would occur in both federal and New York state waters and have a segment, up to 1,575 ft (480m), located onshore and underground. The onshore transmission cable would convey energy from the SRWF to the OnCS-DC. The onshore transmission cable would connect to the SRWEC at the landfall site within TJB and link boxes. Installation of the onshore transmission cable would result in the crossing of two waterways, which would require additional temporary disturbance areas. In these crossings, the installation would involve using a horizontal directional drill. The first crossing, the Intracoastal Waterway (ICW) would involve an approximate crossing length of 2,660 ft (811) and have a temporary disturbance area of approximately 80,000 ft (7,432 m²). The second waterway crossing would occur at the Carmans River Crossing, would have an approximate crossing length of 1,990 ft (607 m) and result in an area of temporary disturbance of approximately 75,000 ft (6,968 m²).

The SRWEC would be spliced together with the onshore transmission cable at the TJB and link boxes located at the landfall site at Smith Point County Park in the Town of Brookhaven, New York. A transit barge will be deployed during construction activities in Smith Point County Park. Temporary equipment during construction activities will include a temporary pile-supported trestle which will be located within the Project Corridor (Figure 2-4). The trestle will be supported by piles, which will be installed by barge-based installation equipment. It is estimated that approximately 21 driven steel piles will be required. The barge used for installation of the piles and trestle will require two to four temporary spuds to hold its station during installation. The spuds associated with the installation barge will have a diameter of approximately 30 inches. Once the temporary pile-supported trestle is installed, a transit barge will require up to four spuds to hold its station during equipment transfer to shore. For HDD activities, the contractor will primarily utilize vessels that do not require the use of anchors to maintain position (e.g., dynamic positioning vessels), which will avoid impacts to existing buried assets. Two of the vessels that support HDD activities will need to touchdown at several locations within the work area, meaning that the pads will contact the seafloor in these locations. The touchdown locations for the pads will depend on the task being performed.

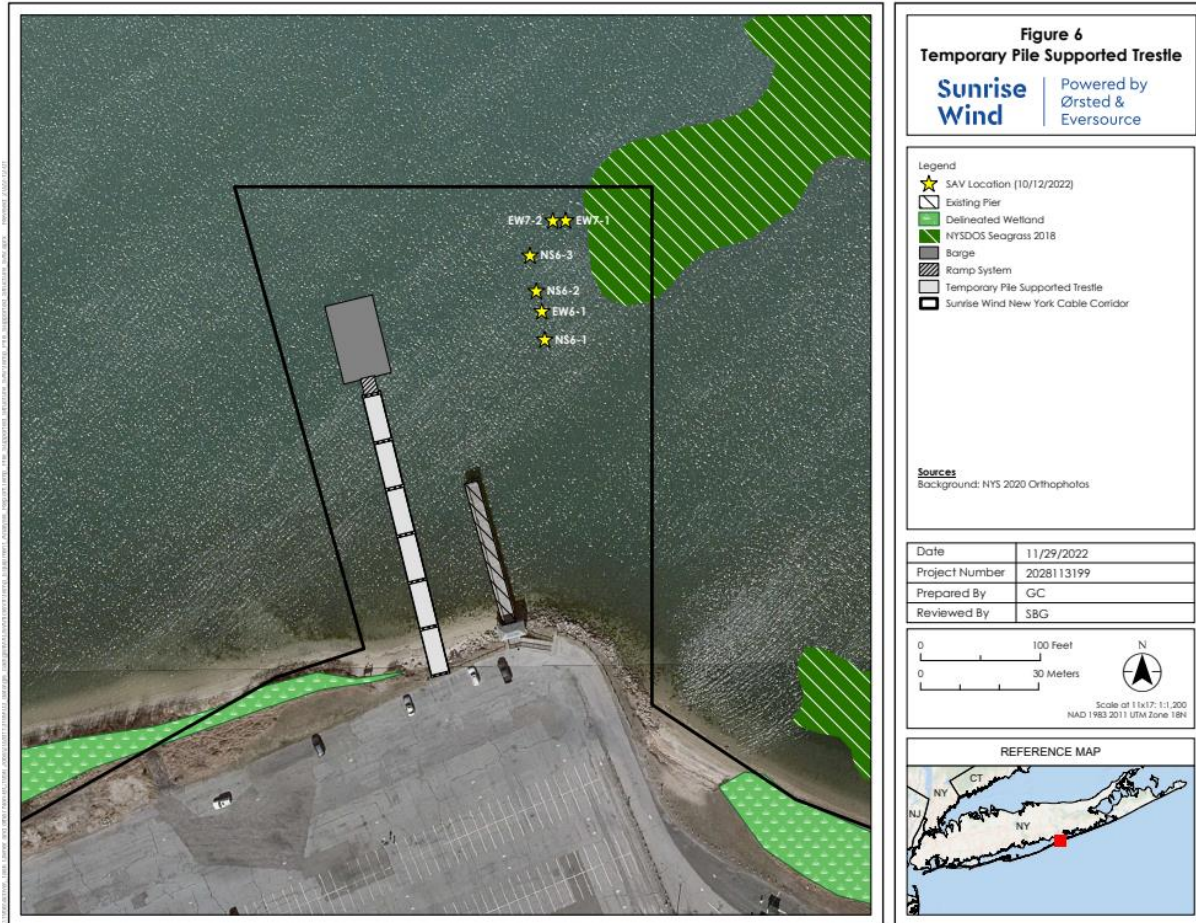


Figure 2-4. Temporary Pile and Trestle and SAV Locations at Smith Point Landing Area

Landfall construction would occur via horizontal directional drilling (HDD) methodology. Up to two HDDs would be installed to support the landfall of the SRWEC. The HDD installation method involves drilling a horizontal bore underneath the seafloor surface and the intertidal area using a drilling rig located onshore. A passage would be created using drilling heads and reaming tools that would be wide enough to accommodate the cable duct. Drilling fluid, comprised of bentonite, drilling additives, and water would be used to stabilize the hole preventing collapse. If the site is suitable, a casing pipe would be used to contain and collect drilling fluid within the casing to minimize dispersal into the marine environment. The casing pipe would be installed using pneumatic impact equipment. Additional stability, including an anchor wall and the installation of sheet piles (also referred to as goal posts) using a vibratory hammer, may be necessary to aid in anchoring of work vessels and in stabilization of the excavated area. Up to six goal posts made up of two sheet piles and a horizontal beam may be installed through vibratory pile driving. The goal posts would be located adjacent to the casing pipe at the borehole installation point the HDD exit pits to connect the SRWEC to the Onshore Transmission Cable. Up to 10 additional sheet piles may be installed per borehole to help anchor the barge and support construction activities. Sheet piles used for the goal posts and supports would be up to 30 m (100 ft) long, 0.6 m (2 feet) This results in a total of up to 22 sheet piles per borehole and two boreholes, bringing the total to 44 sheet piles. There would be a total of 6 HDD cable ducts with a target burial depth of 5 to 75 ft (1.5 to 25 m). The ducts would have a maximum length of 0.9 mi (1.5 km) and a

diameter of 3 ft (0.9 m). The maximum area of seafloor disturbance for the SRWEC landfall would be 61.8 acres (25 hectares) (COP Section 3.3.3; Sunrise Wind 2022).

Approximately 99.4 mi (160 km) of the SRWEC would occur in federal waters at a maximum water depth of 223 ft (68 m) and approximately 6.2 mi (10 km) would occur in New York state waters at a maximum water depth of 95 ft (29 m). The approximately 106 mi (170 km) SRWEC would occur within a surveyed corridor ranging in width from 1,312 to 2,625 ft (400 to 800 m), depending on water depth. The total width of the disturbance corridor would be up to 98 ft (30 m), inclusive of any required sand wave leveling and boulder clearance. The SRWEC would consist of one cable bundle comprised of two cables. The cable would have a target burial depth of 3 to 7 ft (1 to 2 m) but would be dependent upon an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards, and a site-specific cable burial risk assessment. Installation of the SRWEC consists of a sequence of events; including pre-lay down cable surveys, seafloor preparation, offshore cable installation, cable pull into the landfall, joint construction, cable installation surveys, cable protection, and connection to the OCS-DC (COP Section 3.3.3.4; Sunrise Wind 2022).

The inter-array cable (IAC) would carry the electrical current produced by the WTGs to the OCS-DC. The cables would be installed within a 90-ft (30-m)-wide corridor, have a total length of approximately 180 mi (289.7 km), and would have a typical target depth of 3 to 7 ft (1 to 2 m). Target burial depth of the IAC would be dependent upon the assessment of seafloor conditions, seafloor mobility, the risk of interaction with external hazards, and a site-specific Cable Burial Risk Assessment. Installation of the IAC would be anticipated to follow a similar sequence to the SRWEC, with two exceptions. After pre-lay cable surveys and seafloor preparation activities are completed, a cable-laying vessel would be pre-loaded with the IAC. The cable would either be laid on the seafloor and then trenched post-lay, or cable laying and burial would occur simultaneously using a lay and bury tool. Alternatively, a trench may be pre-cut prior to cable installation. The pull and lay operation would then be repeated for the remaining IAC lengths connecting the WTGs and OCS-DC together. The IAC would not require in-field joints. Installation of the IAC would involve seafloor preparation. Sunrise Wind assumes that up to 10 percent of the total IAC network would require boulder clearance (up to 215 acres [87 hectares]) and up to 5 percent of the total IAC network would require sand wave leveling prior to the installation of the cables (107.5 acres [43.5 hectares]) (COP Section 3.3.7; Sunrise Wind 2022). Cable protection would be necessary for the IAC, and Sunrise Wind assumes that up to 15 percent of the entire cable network may require secondary cable protection. The maximum general disturbance area corridor would be 2,150 acres (870 hectares).

2.2.2.1 Vessel Activity

For offshore cable installation, Sunrise Wind anticipates a maximum of 32 vessels required for IAC installation and 38 vessels for the installation of the SRWEC. During construction, installation vessels for array and SRWEC cable installation include main cable laying vessels, main cable jointing vessels, main cable burial vessels, and support vessels. To the extent feasible, dynamic positioning vessels would be used for cable installation. If anchoring, or a pull ahead anchor, is required during cable installation, it would occur within a corridor centered on the cable. Anchors associated with cable laying vessels would have a maximum penetration depth of 15 ft (4.6 m). Vessels would have up to seven anchors with anchor dimensions of 9 x 9 feet (2.74 m x 2.74). Support vessels would also be required (COP Section 4.2.1; Sunrise Wind 2022).

Anchoring of vessels within New York State waters will only occur during the scope of work associated with the following activities: 1) installation and use of temporary equipment to receive the transit barge

during construction activities in Smith Point County Park; 2) horizontal directional drill (HDD) and cable pull-in for the Landfall HDD; and 3) installation of temporary measurement buoys. Anchoring is not planned for 1) installation of the ICW HDD; 2) installation of the SRWEC–NYS; or 3) trials of installation equipment. Any anchoring or contact with the seafloor, is planned to occur within the areas designated within the Sunrise Wind New York Cable Project Corridor (Project Corridor). A figure and/or shape files will be provided to contractors, so that they can position to avoid anchoring or contacting the seafloor within the Fire Island National Seashore boundary or within the Moriches Reef Expansion, avoid impacts to existing buried assets, and avoid and minimize impacts to sensitive benthic habitats.

2.2.2.2 Seabed Preparation

Boulder Relocation

There is a potential to encounter boulders during construction and installation of the offshore infrastructure. During construction activities, the presence of boulders can impact exposed or shallow buried cables that may require post-lay cable protection, can obstruct cable installation equipment that could result in failure to reach target cable burial depth, equipment damage, and/or delayed cable installation, and risk of damage to cable assets.

Prior to installation, geophysical surveys would be performed to determine where boulders occur and to inform micro-siting decisions. Boulder clearance trials may be performed prior to wide-scale seafloor preparation activities to evaluate efficacy of boulder clearing techniques. Boulder removal would occur prior to construction to clear the cable corridor in preparation for cable trenching and burial. Boulder removal can be conducted using a combination of methods to optimize clearance of boulder debris of varying size and frequency. The choice of these activities would be dependent on the location, size, and density of the boulders. For cable installation to occur, Sunrise Wind anticipates that a route up to 98 ft (30 m) would need to be cleared of boulders. Boulder removal would be completed by a support vessel based on pre-construction surveys.

Boulder removal would be completed using the two following techniques described. The first technique would be to deploy boulder grabs from a dynamic positioning support vessel. Removal would be based on pre-construction surveys to identify both the location and size of the boulders. This method would generally be used to remove large boulders and is most suited in areas of boulders with low density. The typical boulder grab methodology includes the following steps:

1. A grab is lowered to the seafloor over the target boulder.
2. Once grabbed, the boulder is either relocated away from the lay corridor or recovered to deck (COP Section 3.3.3; Sunrise Wind 2022).

The second technique that would be used for boulder removal would be the use of a boulder plow. This technique would involve boulder removal using a high-bollard pull vessel. A towed plow would be configured for boulder clearance, generally forming an extended V-configuration, splaying from the rear of the main chassis. The typical boulder plow methodology includes the following steps:

1. The vessel is positioned on the cable route and the plow is launched and lowered to seafloor.
2. The vessel moves along the route dragging the plow along the seafloor.

3. The “V” shaped configuration forces boulders to the plow’s extremities, thus establishing a clear corridor for cable installation.
4. Multiple passes of the boulder plow along the cable route may be required to gain the required width.
5. Boulder grab campaign could be required afterwards to remove any remaining boulders.
6. On completion of the operation, a post clearance survey is carried out, using either Multibeam Echo Sounding (MBES) or a Side-Scan Sonar (SSS) to confirm that boulder removal has been achieved (Section 3.3.3; Sunrise Wind 2022).

Sand Wave Leveling

Sand waves are sediment features on the seabed that resemble sand dunes. Cables must be buried beneath the stable seafloor elevation to avoid cable exposure during the lifetime of the Project. Additionally, many of the cable installation tools proposed for cable installation require a relatively flat seafloor surface so that the operational criteria (pitch and roll) of the tools is not exceeded. The seafloor slope angles may be leveled to ensure burial tool maneuverability. The maximum acceptable slope angle is dependent upon the burial tool selected. Sand wave leveling may be required during seafloor preparation activities prior to cable installation.

Based on geophysical data, sand waves have not been identified along the SRWEC-OCS route, but some sand accumulation areas have been identified. Sand leveling activities along the SRWEC are considered in two parts; along the SRWEC-OCS, which occurs in federal waters, and along the SRWEC-NYS, which occurs in New York State waters. Sunrise Wind anticipates that a maximum of 10 percent of the SRWEC-OCS route, which is located in federal waters, would require sand leveling prior to cable installation. In New York State waters, Sunrise Wind assumes that a maximum of 40 percent of the route would require sand wave leveling before the cable can be installed. Along the entire route, Sunrise Wind has assumed that the 98-ft (30 m) wide construction corridor would be cleared of sand accumulation. Sand leveling can be completed through dredging using a suction hopper dredger, controlled flow excavation (CFE), or a combination of the two. The method of sand wave leveling clearance would be chosen based on the results from the geophysical surveys and cable design (COP Section 3.3.3; Sunrise Wind 2022).

MEC/UXO Risk Mitigation

During Project construction, the likelihood of munitions and explosives of concern/unexploded ordnance (MEC/UXO) encounter is low. However, prior to seafloor preparation, cable route, and micro-siting of all assets, the Project would implement an MEC/UXO Risk Assessment with Risk Mitigation Strategy (RARMS) designed to evaluate and reduce risk in accordance with As Low As Reasonably Practicable 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 risk that MEC/UXO pose to the Project, and recommends a strategy to mitigate that risk. The preferential method for MEC/UXO mitigation is avoidance, but it is anticipated that there is the potential for some instances where avoidance is not possible. In these situations, confirmed MEC/UXO may be removed through in-situ disposal or physical relocation. Selection of removal method would be made in consultation with an MEC/UXO specialist and in coordination with the proper agencies. In-situ disposal would be done with low noise methods, such as deflagration of the MEC/UXO or cutting the MEC/UXO up to extract the explosive components. Deflagration is a relatively slow process that occurs at less than the speed of sound, compared to detonation, which happens at supersonic speeds. The overpressure of deflagration

is much less than that of detonation, and the spatial extent of the shock front and energy released is much less than in a detonation. 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. The MEC/UXO could also be relocated through a “Lift and Shift” operation, where the MEC/UXO would be moved to another suitable location on the seabed. For all MEC/UXO clearance methods, safety measures such as the use of guard vessels, enforcement of safety zones, and others would be identified in consultation with an MEC/UXO specialist and the appropriate agencies and implemented as appropriate (COP Section 3.3.3; Sunrise Wind 2022).

2.2.2.3 Trenching/Cable Installation

Cable installation methodologies of offshore cables is dependent upon sediment conditions. As sediment conditions vary along the SRWEC and within the SRWF, several different cable installation methodologies may be required during installation. Geophysical surveys have been completed upon the proposed route of the SRWEC to inform preliminary routing and the most appropriate tools to reach target burial depths. The installation of the SRWEC would be completed by either having the cable bundle laid on the seafloor and then trenched post-lay or a trench may be pre-cut prior to cable installation. The SRWEC would typically be buried below the seabed. Site preparation activities would take place prior to the placement and burial of the cable. Sunrise Wind is currently considering mechanical plowing, jet plowing, mechanical cutting, CFE, pre-cut mechanical plowing, and pre-cut dredging. The offshore cable route would be 106 miles (170.6 km)-long and have a cable seabed disturbance width of 98-ft (29.9 m). There would be two cables bundled together with a fiber optic cable along the route. Up to four cable joints may be necessary per cable. Cable installation would include pulling operations. The cable would be pulled through the duct bank conduits and cut leaving a sufficient amount of cable to perform jointing operations. Once pulling has been completed, and appropriate testing of the cable performed to ensure no damage has occurred during installation. The cables would then be sealed to prevent moisture until jointing operations can be occurred (COP Section 3.3.3; Sunrise Wind 2022).

The maximum total installed array cable length is 180 miles (289.7 km). Installation of IAC would typically occur in a similar sequence to installation of the SRWEC with two exceptions. After pre-lay cable surveys and seafloor preparation activities are completed, a cable-laying vessel would be pre-loaded with the IAC. Prior to the first end-pull, the cable would be fitted with a cable protection system and the cable would be pulled into the WTG or OCS-DC. The vessel would then move towards the second WTG or the OCS-DC. Cable may be laid on the seafloor and then trenched post-lay, or alternatively, cable laying and burial may occur simultaneously using a lay and bury tool. Alternatively, a trench may be pre-cut prior to cable installation. The pull and lay operation, inclusive of fitting the cable with a cable protection system, is then repeated for the remaining inter-array cable lengths, connecting the WTGs and the OCS-DC together. Additionally, the inter-array cables would not require in-field joints, so joint construction would not be necessary (COP Section 3.3.7; Sunrise Wind 2022).

2.2.2.4 Cable Protection

In the event that cables cannot achieve proper burial depths or to avoid risk of interaction with external hazards, Sunrise Wind propose the following protection methods: (1) rock placement, (2) matting, (3) rock filter bags, or (4) grout bags. When the cable has been installed, post-lay cable surveys and depth-of-burial surveys would be conducted to determine if the cable has reached the desired depth. To

the extent feasible, cable protection solutions implemented would be the of the type that minimizes potential for gear snags, as feasible (COP Section 3.3.3; Sunrise Wind 2022).

Approximately 6 percent of the IAC and 5 percent of the SRWEC may require cable protection (Sunrise Wind 2022).

Rock Placement

Rock placement involves dumping or placing rock overtop of a cable to cover and protect it from physical damage. Rocks would most likely be placed on the seafloor via a fall pipe vessel.

Mattressing

Standard mattresses are composed of concrete blocks linked together by ropes to form a flexible, articulated map, which can be placed on the seafloor over a cable. Alternatively, Frond Mattresses incorporate aerated polyethylene fronds, which essentially mimic natural seaweed. The purpose of this arrangement is to trap sediment and mitigate scour erosion around the vicinity of the mattress. A standard mattress size is 9.8 ft x 19.6 ft x 0.9 ft (3 m x 6 m x 0.3 m).

Rock Filter Bags

Rock filter bags consist of a mesh fabric, in which rocks can be deployed subsea. Rock filter bags are suitable for low density coverage and allow more precise placement of material and limit rock mitigation relative to dumped rock.

Grout Bags

Grout bags are suitable for low density coverage.

The location of cable protection associated with the SRWEC would be provided to NOAA's Office of Coast Survey after installation is completed so that they may be marked on nautical charts (COP Section 3.3.3; Sunrise Wind 2022).

2.2.3 Port Facilities

Sunrise Wind is evaluating the use of several existing port facilities located in New York, Connecticut, and Rhode Island to support offshore construction, assembly and fabrication, crew transfer and logistics, and other activities as necessary. Of the ports being considered, several would require no upgrades or modifications at existing port facilities. To the extent that upgrades or modifications would be necessary, such work would either: (1) be permitted and undertaken by port owners/operators and/or government or quasi-government entities in conjunction with state economic development initiatives relating to the broader US offshore wind industry or (2) evaluated as part of BOEM's review of other projects being developed by Sunrise Wind's fellow subsidiaries of North East Offshore, LLC. Construction port facilities are expected to serve multiple offshore wind projects (COP Section 3.3.10; Sunrise Wind 2022). The proposed Project would not require any construction to ports. Existing ports that can support the activities will be chosen.

2.3 Operations and Maintenance

2.3.1 Overview

The proposed Project is anticipated to have an operating period of 35 years. Sunrise Wind is considering one of several ports to support O&M activities, including the Port of Brooklyn, NY, Port of Montauk, NY, Port Jefferson, NY, Port of Davisville and Quonset Point, RI, and Port of Galilee, RI. The O&M Plan for both the Project's onshore and offshore infrastructure will be finalized as a component of the FDR/FIR review process. However, a preliminary O&M plan for the plan is described in the COP (COP Section 3.5; Sunrise Wind 2022). The proposed Project would include a comprehensive maintenance program, including preventative maintenance based on statutory requirements and industry best practices. To support O&M, the Project would be controlled 24/7 via a remote surveillance system. Sunrise Wind would inspect WTGs, OCS-DC, foundations, offshore export cables, IAC, 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 the OCS-DC. Sunrise Wind would conduct annual maintenance of WTGs, including routine service & safety surveys/check, oil and high-voltage maintenance, and visual blade inspections. Other maintenance activities would be conducted as needed. Foundation inspections and maintenance would be conducted above water annually. Subsea inspections would be conducted every 3 to 5 years, based on risk. Major maintenance activities to foundations would be completed every 8 years. A seafloor survey would be completed 1 year after commissioning, 2-3 years after commissioning, and 5-8 years after commissioning, with frequency thereafter depending upon findings of the initial surveys. The original coating system on the WTGs is designed to last the lifetime of the structures. Therefore, no painting activities would be anticipated over the life of the WTGs, other than to repair minor surface damage (COP Section 4.3.3; Sunrise Wind 2022). The OCS-DC would be routinely maintained for preventative maintenance, up to 20 times per year. The offshore export cables and IAC typically have no maintenance requirements unless a failure occurs (COP Section 3.5; Sunrise Wind 2022).

Sunrise Wind expects to use a variety of vessels to support O&M, including Service Operating Vessels (SOVs) with deployable work boats, Crew Transfer Vessel (CTVs), jack-up vessels, and cable laying vessels. Annually, the proposed action would require 1 SOV, 1 offshore-based CTV, 1 daughter craft operating from SOV, and individual jack-up vessels to be chartered for individual events or annual campaigns. The type and number of vessels and helicopters would vary over the operational lifetime of the Project. For each vessel type the route plan for the vessel operation area would be developed to meet industry guidelines and best practices in accordance with International Chamber of Shipping guidelines, vessels would install operational AIS, and all vessels would operate in accordance with applicable rules and regulations.

The offshore export cables and IAC typically have no maintenance requirements unless a fault or failure occurs. Cable failures would be mainly anticipated as a result of damage from external influences, such as anchors and fishing gear. To evaluate the integrity of the assets, Sunrise Wind intends to conduct a bathymetry survey along the entirety of the cable routes immediately following installation and at 1 year after commissioning, 2-3 years after commissioning, and 5-8 years after commissioning. Survey frequency thereafter would depend on the findings of the initial surveys. A survey may also be conducted after a major storm event. Should the periodic bathymetry surveys completed during the operational lifetime of the Project indicate that the cables no longer meet an acceptable burial depth, the following actions may be taken: alert the necessary regulatory authorities, as appropriate; undertake an updated Cable Burial Risk Assessment to establish whether cable is at risk from external

threats; survey monitoring campaign for the specific zone around the shallow buried cable; and assess the risk to cable integrity. Based on the outcome of these assessments, several options may be undertaken as feasible, permitted, and practical. These options include remedial burial, installation of secondary protection, and increased frequency of bathymetry surveys to assess reburial. It is anticipated that a maximum of 10 percent of the cable protection placed during installation may require replacement/remediation over the lifetime of the Project. These activities would result in a short-term disturbance of the seafloor similar to or less than what is anticipated during construction (COP Section 3.5; Sunrise Wind 2022).

2.4 Project Decommissioning

Pursuant to 30 CFR 585 and other BOEM requirements, Sunrise Wind would be required to remove or decommission all installations and clear the seabed of all obstructions created by the Project. A separate EFH consultation would be conducted for the decommissioning phase of the Project. All facilities would need to be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 CFR § 585.910(a)). Care would be taken to handle waste in a hierarchy that prefers re-use or recycling and leaves waste disposal as the last option. Absent permission from BOEM, Sunrise Wind would complete decommissioning within two years of termination of the Lease. Sunrise Wind would develop a final decommissioning and removal plan for the facility that complies with all relevant permitting requirements. This plan would account for changing circumstances during the operational phase of the Project and would reflect new discoveries, particularly in the areas of marine environment, technological change, and any relevant amended legislation. The proposed Project is anticipated to have an operational life of 35 years, but it is possible that some installations and components may remain fit for continued service after this time. Sunrise 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 Sunrise Wind to submit a decommissioning application upon the earliest of the following dates: 2 years before the expiration of the lease, 90 days after completion of the commercial activities on the commercial lease, 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. Sunrise 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 NEPA and other federal statutes and implementing regulations.

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

3.0 Existing Environment

This section describes the existing environment within each SRWF Project component, including the lease area (SRWF), offshore export cable routes (SRWEC), the landing area and ICW-HDD crossing, and interior coastal Project components, all of which have the potential to be used by EFH-designated species. Sunrise Wind conducted detailed benthic habitat surveys of the Project area to support preparation of the COP, detailed in Appendix A of this document and COP Appendices M1– *Benthic Resources Characterization Report – Federal Waters* and Appendix M2 – *Benthic Resources Characterization Report – New York State Waters*, respectively. An additional supporting Technical Report, Appendix M3 – *Benthic Habitat Mapping Report* maps the habitats present across the marine portions of the Project Area, to inform EFH consultation (Sunrise Wind LLC, 2021). The surveys and data presented in this section represent the most current information available for characterizing existing conditions in the Project area. Supplemental information related to habitat characterization and benthic habitat mapping are provided in Section 10.2 of this document.

The Project area occurs within the Northeast U.S. Shelf Ecosystem, which extends from the Gulf of Maine to Cape Hatteras, North Carolina (Guida et al. 2017). The Wind Development Area (WDA) and offshore export cable corridor (OECC) are within the Southern New England sub-region of the Northeast U.S. Shelf Ecosystem, distinguished from other regions by differences including productivity, species assemblages and structure, and habitat features (Cook and Auster 2007). Similar to much of the Northeast U.S. Shelf Ecosystem, the southern sub-region habitat is dominated by sandy substrate, a characteristic reflected in the finfish and invertebrate species assemblages found there. Benthic habitat in the eastern portion of the Project area is predominantly sand or sand-dominated substrate and becomes increasingly coarse toward the west and northwest. The Rhode Island-Massachusetts WEA (RIMA WEA) and the Massachusetts WEA are designated offshore on the northeastern Atlantic continental shelf in Rhode Island Sound. The waters in the vicinity of the SRWF and SRWEC are transitional waters that separate Narragansett Bay and Long Island Sound from the OCS. In general, the benthic communities of these OCS areas are diverse, with lower densities of organisms than in the northern portion of the Mid-Atlantic Bight and in deeper areas of the OCS (MMS 2007). The RIMA WEA and the Massachusetts WEAs are characterized by a mix of soft and hard bottom environments defined by dominant sediment grain size and composition. These habitats are described in detail and mapped in reports that present Project-specific surveys in the OCS (Appendix B) for the Project area.

To support Sunrise Wind site investigations, high resolution multibeam echosounder (MBES) and side-scan sonar (SSS) surveys were conducted in the Project area in 2019, 2020, and 2021 (Sunrise Wind LLC 2021). An additional geophysical survey was conducted by Gardline in 2019 in the southeast portion of the SRWF. The geophysical surveys 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 (Sunrise Wind LLC 2021). Bathymetric data provide information on depth and seafloor topography and are mapped for SRWF in Figure 3-1 and for SRWEC-OCS and SRWEC-NYS waters in Figure 3-2. Backscatter data were derived from the MBES and processed to a resolution of 25 cm. These data are based on the strength of the acoustic return to the instrument so that softer, fine-grained sediments absorb more of the acoustic signal and a weaker signal is returned to the MBES, providing information on seafloor sediment composition and texture. A combination of backscatter over hill-shaded bathymetry and side-scan sonar data were used to detect large- and small-scale bedforms, such as mega-ripples and ripples, mapped for SRWF in Figure 3-3 and for SRWEC-OCS and SRWEC-NYS

waters in Figure 3-4. Seabed morphology in the vicinity of the Project area generally consists of a gently sloping seabed; within the Lease Area, the seafloor slopes are predominantly less than one degree and seabed contours are a series of low megaripples (Guida et al. 2017). Bottom temperatures in the New York lease area ranged 2-22°C between 2003 and 2016. Sand shrimp and sand dollars were reported to dominate benthic epifauna (beam trawl) samples in the lease area; little skate dominated the 14-year megafauna records year-round, joined by longfin squid and sea scallop in the warm season, and by Atlantic herring in the cold season (Guida et al. 2017). The same authors report that taxa for which there may be concern regarding possible habitat disturbance from offshore wind construction and operation activities include black sea bass and longfin squid egg mops (warm season), and sea scallop, surfclam, ocean quahog (year-round). Refer to COP Appendices M1-M3 for detailed benthic habitat analyses and mapping.

Benthic resources were characterized by assessing the physical sediment composition and the biological benthic components using Sediment Profile and Plan View Imaging (SPI/PV) analysis and using the Coastal and Marine Ecological Classification Standard (CMECS) classifications and other variables that aid in describing baseline conditions (see Appendix A for detailed CMECS classification). A total of 408 stations were surveyed, which included 252 stations at the SRWF, 107 stations along the outer continental shelf section of the export cable (SRWEC–OCS), 35 stations in the New York state section of the export cable (SRWEC–NYS), and eight stations along the path of the ICW-HDD. Additionally, 20 stations were surveyed across four reference areas to serve as a comparison. Samples were collected at intervals of 1,000 feet. Details of sampling methods are provided in COP Appendices M1-M3. Select physical and biotic characteristics of benthic habitats for each of the Project components are summarized in Table 3-1 and described in the following sections.

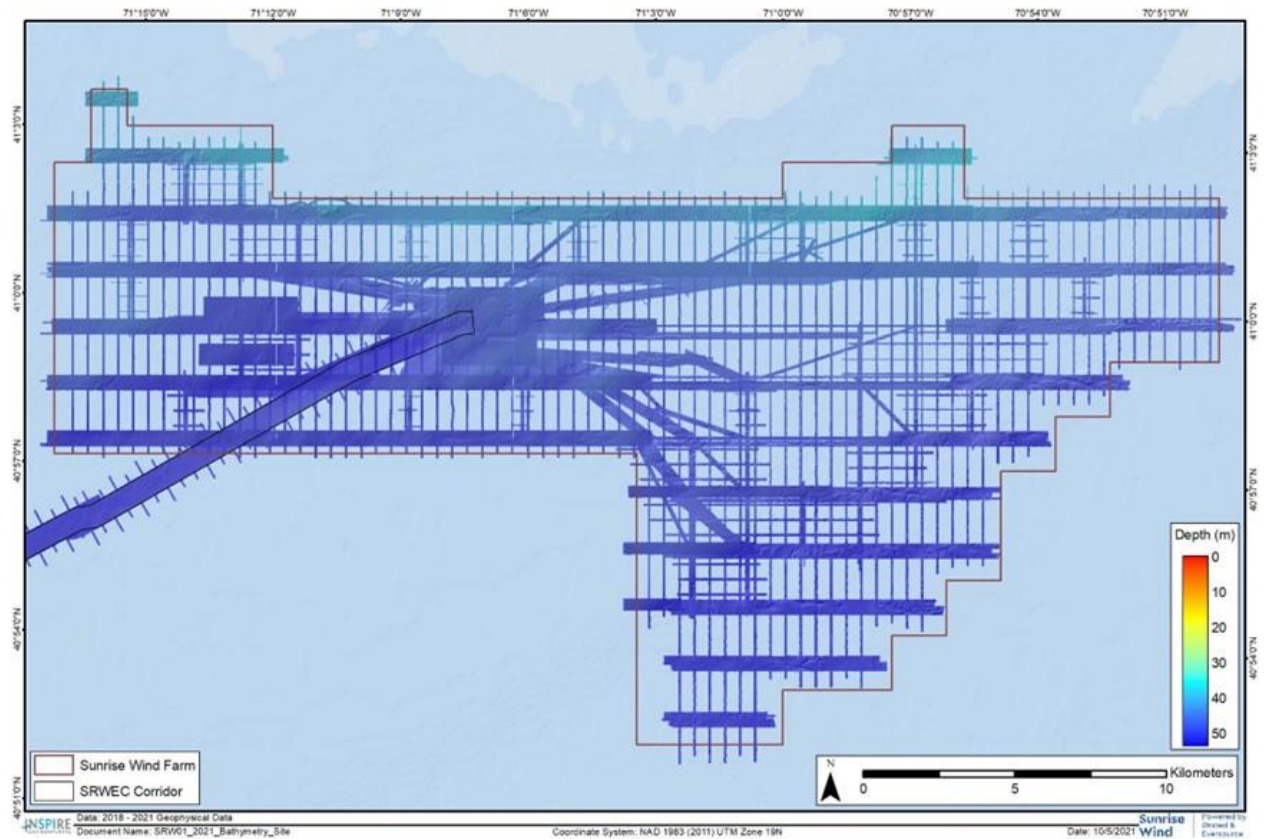


Figure 3-1. Bathymetric Data at the SRWF

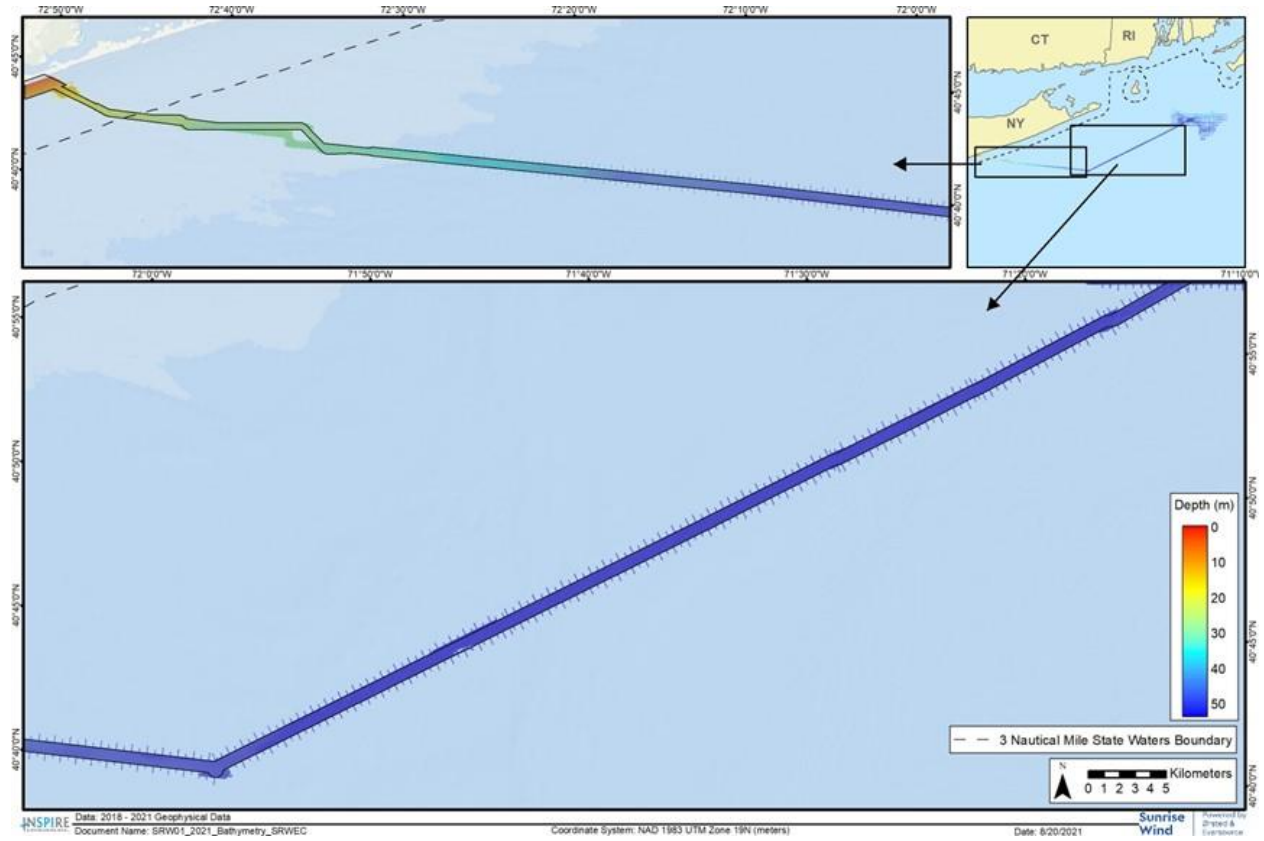


Figure 3-2. Bathymetric Data Along the SRWEC-OCS and NYS Waters

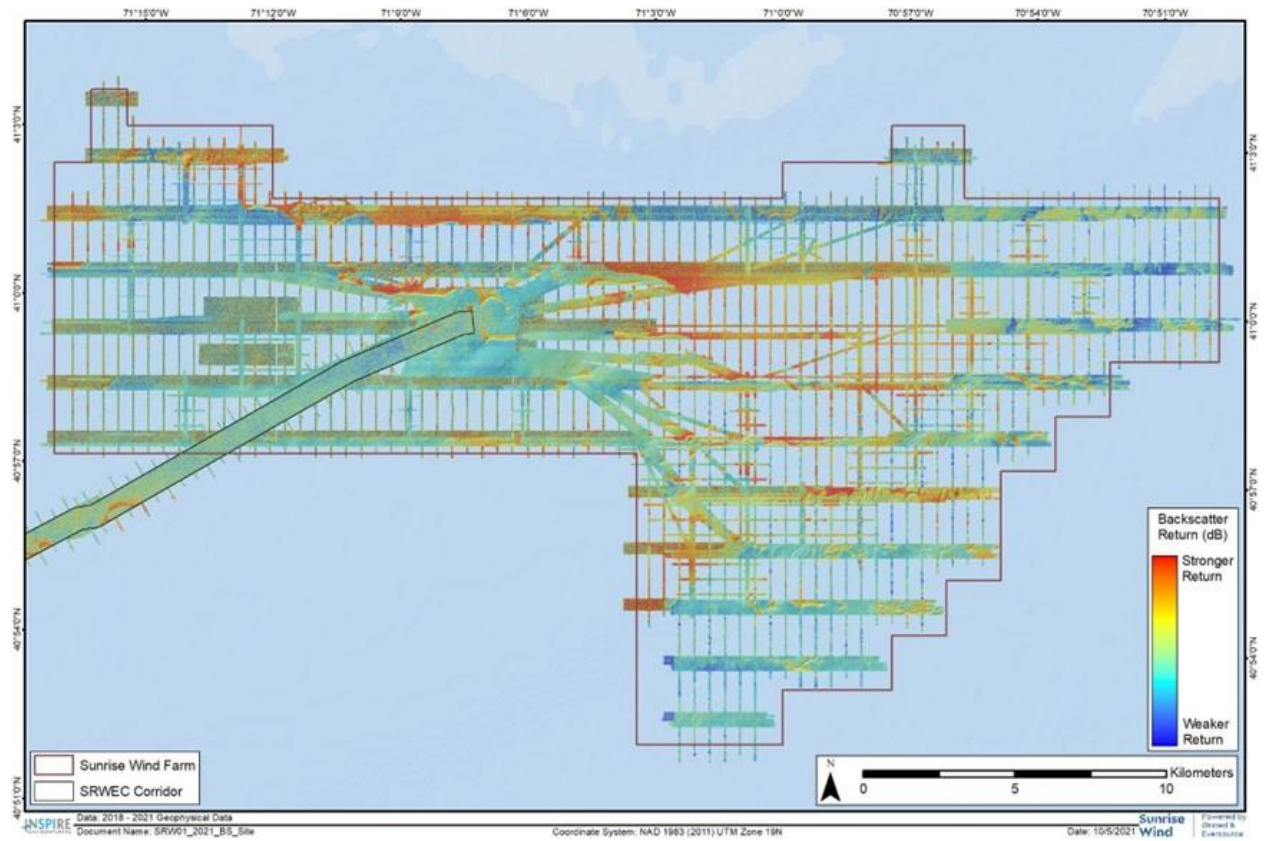


Figure 3-3. Backscatter Data Over Hill-shaded Bathymetry at the SRWF and SREC-OCS

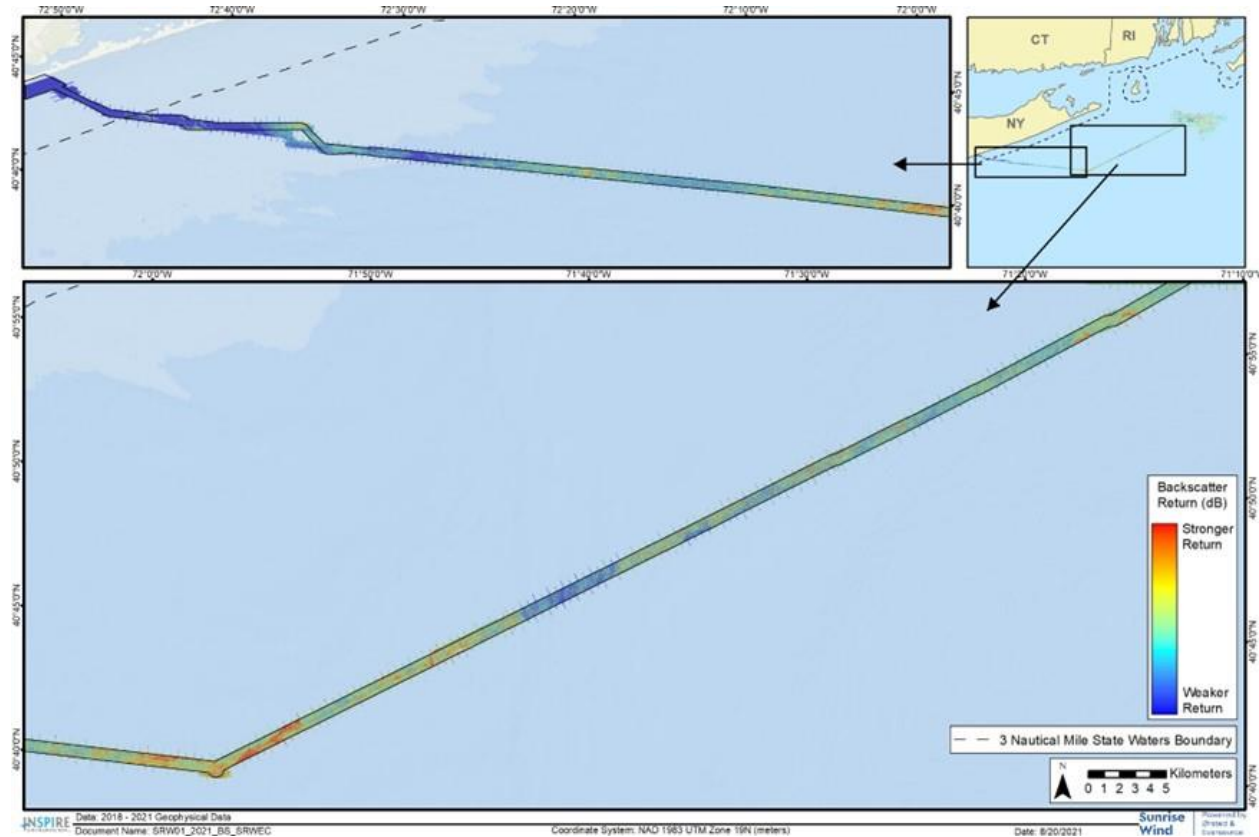


Figure 3-4. Backscatter Data Over Hill-shaded Bathymetry at the SRWEC-OCS and NYS Waters

Table 3-1. Select Physical and Biotic Characteristics of Benthic Habitats Summarized by Proposed Project Component Areas

Area	No. of Samples	Water Depth ft (m)			Dominant Substrate ¹		Biotic Subclass ¹	Common Taxa Observed (n = # Stations)
		Minimum	Maximum	Average	Group	Subgroups		
SRWF	252	128 (39.0)	259.1 (79.0)	161.7 (49.3)	Sand or finer, gravel/gravel mixes	Very fine sand, fine sand	Soft sediment fauna; attached fauna	Sabelid (n=4) Cerianthid (n=10) Sand Dollar (n=11)
SRWEC-OCS	107	89.9 (27.4)	224.1 (68.3)	161.7 (42.3)	Sand or finer, gravel/gravel mixes	Very fine sand, fine sand	Soft sediment fauna; attached fauna	Diptera (n=2) Cerianthid (n=10)

Area	No. of Samples	Water Depth ft (m)			Dominant Substrate ¹		Biotic Subclass ¹	Common Taxa Observed
		Minimum	Maximum	Average	Group	Subgroups		
								Sand Dollar (n=42)
SRWEC-NYS	35	15 (4.6)	88 (26.8)	57.1 (17.4)	Sand or finer	Very fine sand, fine sand	Soft sediment fauna	Diptera (n=7) Cerianthid (n=10) Sand Dollar (n=21)
ICW-HDD	8	NR	NR	NR	Sand or finer and gravel	Sandy gravel	Soft sediment fauna; attached fauna	None (n=8)

Notes: NR = not recorded

Sources: COP, Appendices M-1, M-2, and M-3 (Sunrise Wind, LLC 2021).

Seven benthic macrohabitat types were documented during the site-specific SPI/PV survey as characterized from the comprehensive SPI/PV analyses of selected physical and biological attributes: (1) sand and mud, (2) sand, (3) sand and mud with ripples, (4) sand with ripples, (5) sand with mobile gravel, (6) patchy cobbles and boulders on sand, and (7) cobbles and boulders on sand. The organisms found in these types of benthic habitats are typically described as infaunal species (those living in the sediment, e.g., polychaetes, amphipods, mollusks), and epifaunal species (those living on the seafloor surface (mobile), e.g., sea stars, sand dollars, sand shrimp, or attached (sessile) to substrates, e.g., barnacles, anemones, tunicates). Sediment grain size distribution is an important factor of benthic habitats and influences benthic community distributions and can be used to infer benthic taxa that are likely present in a particular environment. Linking the physical substrate characteristics with the biological functional and taxonomic composition is accomplished using the CMECS, a standard means to categorize the physical (substrate) and biological (biotic) components of environments. NOAA Habitat Complexity Categories, defined by NOAA for the purposes of EFH consultation in their 2021 recommendations (NOAA Habitat 2021), include soft bottom, complex, heterogeneous complex, and large-grained complex. NOAA has defined complex habitats as SAV, shell substrate, and sediments with >5 percent gravel of any size (pebbles to boulders; CMECS Substrate of Rock, Groups of Gravelly, Gravel Mixes, and Gravels) (NOAA Habitat 2021). Heterogeneous complex is used for habitats with a combination of soft bottom and complex features (NOAA Habitat 2021).

A crosswalk between the benthic habitat types with modifiers identified in surveys of the Project area and other descriptors (CMECS subclass, Habitat Type, and NOAA Habitat Complexity) is provided in Appendix A. A comprehensive crosswalk for habitat and CMECS (biotic indicators) is provided in Table A-3. A total of 17 benthic habitat types with modifiers were cross-walked to the “complex” category in the SRWF Project area. The sand and mud habitat types were classified as “soft bottom” habitat groups. Habitat complexity ranged from complex to large-grained complex to soft bottom. Those soft bottom habitats with low density boulder fields were categorized as complex. Not all benthic habitats were present in each portion of the Project area.

Benthic habitat groups (with modifiers) are quantified for each Project component in Table 3-2. NOAA Habitat Complexity categories included anthropogenic, large-grained complex, complex, and soft-bottom. The largest category by far was soft-bottom (sand and muddy sand habitat), making up a total of 53,133 acres (54 percent) of the total 98,220 acres, followed by 24,290 acres of complex (coarse sediment-mobile) with a total of made up 14,495 acres of soft-bottom (sand and muddy sand-mobile). Five primary benthic habitat groups were mapped in the Project area: glacial drift, mixed sediment-small gravel and sand, coarse sediment, sand and muddy sand, and mud and sandy mud (Figure 3-5). Habitats updated with modifiers resulted in a total of 22 habitat types (16 within the SRWF, 6 in the SRWEC–OCS, 10 in the SRWEC–NYS, and 7 in the vicinity of the ICW-HDD). The SRWF, SRWEC, and ICW-HDD Project components all include complex, soft-bottom, and anthropogenic Complexity categories, but only SRWF includes the glacial category (large-grained complex). A few anthropogenic features (e.g., piers) were also mapped within the ICW-HDD but not included in the counts of habitat types. Descriptions of habitat types found in each Project component are summarized below and followed by brief descriptions of each habitat type as observed for each Project component. Detailed accounts of observations are provided in COP Appendix M3.

Table 3-2. Total Area (acres) of NOAA Habitat Complexity Categories and Benthic Habitat Groups (with modifiers) within the Sunrise Wind Farm Area (SRWF), Sunrise Wind Export Cable Route Corridors in NY State Waters (SRWEC-NYS), SRWEC in Offshore Waters (SRWEC-OCS), and SRWEC in the Intracoastal Waterway (ICW-HDD)

NOAA Habitat Complexity Category	Habitat Group with Modifiers	SRWF	SRWEC-NYS	SRWEC-OCS	ICW-HDD	Total
Anthropogenic	Anthropogenic	0	0	0	1	1
Large-grained complex	Glacial Drift	684	0	0	0	684
Complex	Coarse Sediment	240	1	7	9	258
Complex	Coarse Sediment – Mobile	22,723	348	1,218	0	24,290
Complex	Coarse Sediment – Mobile with High Density Boulder Field	70	7	0	0	77
Complex	Coarse Sediment – Mobile with Low Density Boulder Field	598	0	0	0	598
Complex	Coarse Sediment – Mobile with Medium Density Boulder Field	499	13	0	0	512
Complex	Coarse Sediment – with Low Density Boulder Field	87	0	0	0	87
Complex	Coarse Sediment – with Medium Density Boulder Field	11	0	0	0	11
Complex	Mixed Sediment – Small Gravel & Sand	0	0	301	0	301
Complex	Mud and Sandy Mud – with High Density Boulder Field	2	0	0	0	2
Complex	Sand and Muddy Sand – with Benthic Macroalgae	0	0	0	1	1
Complex	Sand and Muddy Sand – with High Density Boulder Field	11	28	0	0	40
Complex	Sand and Muddy Sand – with Low Density Boulder Field	162	2	0	0	164
Complex	Sand and Muddy Sand – with Medium Density Boulder Field	24	48	0	0	72
Complex	Sand and Muddy Sand – with Potential Benthic Macroalgae-	0	0	0	8	8
Complex	Sand and Muddy Sand – with Potential SAV	0	0	0	11	11
Complex	Sand and Muddy Sand – with Potential SAV and Benthic Macroalgae	0	0	0	3	3
Complex	Sand and Muddy Sand – with SAV and Benthic Macroalgae	0	0	0	2	2
Soft bottom	Sand and Muddy Sand	33,710	1,573	17,752	98	53,133
Soft bottom	Sand and Muddy Sand – Mobile	1,375	324	12,796	0	14,495
Soft bottom	Mud and Sandy Mud	147	1	3,321	0	3,470
Soft bottom	Mud and Sandy Mud – Mobile	0	0	0	0	0
	Total	60,346	2,346	35,396	133	98,220

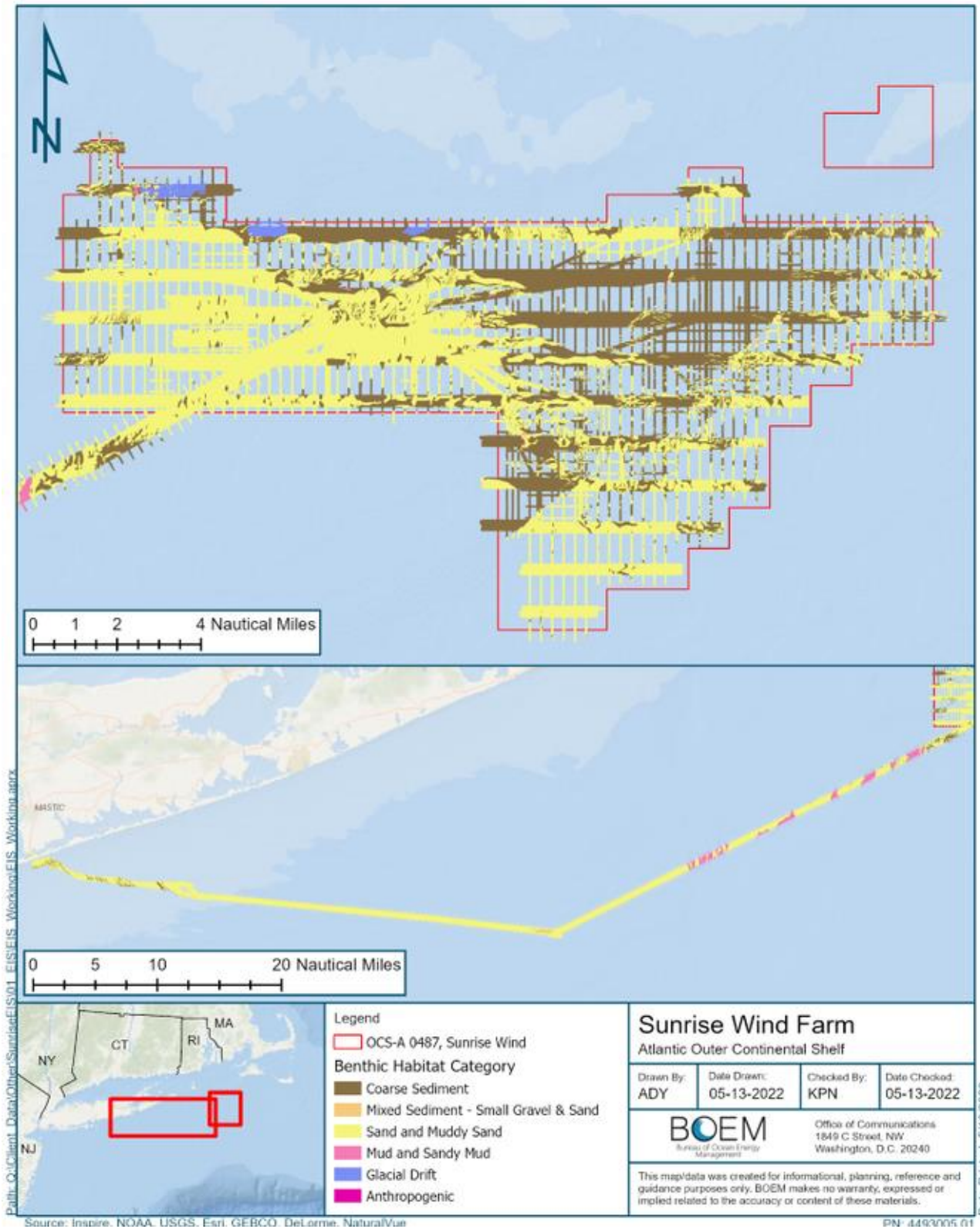


Figure 3-5. Primary Benthic Habitats for the Sunrise Wind Offshore Lease Area and Export Cable

3.1 SRWF Lease Area

Seabed slopes in the SRWF are generally very low, with an average gradient of less than 0.1 degrees (0.15 percent). Within glacially deposited boulder fields, rugosity can be high, with seabed gradients locally exceeding 5 degrees. Sediment bedforms develop in finer grained sediments as a response to hydrodynamic conditions induced by currents and wave action. Sediment bedforms identified in inner and outer shelf sandy sediments include ripples (less than 1.6 ft [0.5 m] in height), megaripples (1.6 to 5 ft [0.5 to 1.5 m] in height), and occasionally sand waves (more than 5 ft [1.5 m] in height). Water depths averaged 161.7 feet (49.3 m) and range from 128 feet (39 m) to 259 feet (79.0 m) in the SRWF. The shallower portions are along the north side of the SRWF (Figure 3-1).

The SRWF included all primary benthic habitat types except the mixed sediment- small gravel and sand (Table 3-2) but was characterized primarily by sandy and muddy sand and coarse sediments (Figure 3-5). Benthic habitats categorized by NOAA complexity category in the SRWF (Figure 3-6) indicate large grained complex habitat is restricted to the northwestern portions of the SRWF where glacial drift was mapped. Habitats cross-walked to the complex category were predominantly in the north and east portions of the SRWF and in discrete areas along the western edge of the SRWF. Habitats cross-walked to soft bottom habitats were generally found in central, west and southwestern portions of the SRWF and in the southeastern corner of the SRWF.

The central, west, southeastern tip, and southwestern portions of the SRWF were mostly sand and muddy sand habitats with small areas of coarse sediment habitats. The eastern portion of the SRWF was primarily coarse sediment habitats. With habitat biotic subclass modifiers, sand and muddy sand was the most prevalent habitat type mapped at the SRWF (56 percent), followed by coarse sediment – mobile (38 percent), and sand and muddy sand – mobile. All habitat types were dominated by soft sediment fauna biotic subclass, except for glacial drift habitats where the attached fauna biotic subclass was also recorded (Figure 3-7). The non-reef building hard coral *Astrangia poculata*, a sensitive taxon, was observed at five stations associated with glacial drift and boulders in coarse sediment – mobile habitats. Cerianthids (burrowing anemones) were observed across habitat types at the SRWF and were most prevalent in the sand and muddy sand habitat in the eastern portion of the SRWF.

Boulder fields were found coincident with and near the glacial drift habitats, which occurred at 12 of the total 213 SPI/PV ground-truth sites. A high incidence of clusters of scattered boulders were located immediately east of the center of the SRWF in habitats cross-walked to complex; scattered boulders were also present and dispersed in soft bottom habitats in the center and west of the SRWF (Figure 3-7). Sand and muddy sand benthic habitats (108 sites), the primary habitat of the SRWF, was characterized by CMECS subgroups of medium, fine, and very fine sand, and silt/clay (Figure 3-8). Coarse sediments (78 sites) included the same subgroups as sand and muddy sand habitats but also included gravelly and very coarse, sands. The remaining habitats were very minor, ranging from very fine sands to coarse sands and silt/clay.

Species that inhabit the benthic habitats of the OCS include infaunal species, those living in the sediments (e.g., polychaetes, amphipods, mollusks); and epifaunal species, those living on the seafloor surface (mobile; e.g., sea stars, sand dollars, sand shrimp) or attached to substrates (sessile; e.g., barnacles, anemones, tunicates). In addition to trophic links and biogenic structure, benthic species can also serve important roles in facilitating nutrient and carbon cycling in the sediments through functions such as water filtration, biodeposition, bioirrigation, and bioturbation.

Benthic habitats within the SRWF are described from INSPIRE (2021). The physical sediment composition and the biological benthic components were assessed through SPI/PV analysis using the CMECS classifications, as described earlier. The SRWF area includes the proposed wind turbine generators (WTGs), OCS–DC cable, and IAC. Habitats occurring in the SRWF include:

- Rocky habitat (24,913 acres)
- Soft bottom mud (149 acres)
- Soft bottom sand (35,283 acres)
- Biogenic habitat present
- Pelagic habitat (60,207 acres)
- Habitat for sensitive life stages is present

SAV (summer flounder HAPC), tidal marsh, shellfish reefs and beds, and shell accumulations were not found in the SRWF component area during benthic surveys.

Spatial trends in sediment composition were apparent in the SRWF data. For example, the northwest region had a higher frequency of stations with gravels; the southeast and west-central regions were characterized by finer substrata and limited small-scale sediment mobility; the northeast region was generally composed of Fine to Coarse Sand with sand ripples common. Boulders were infrequently observed at the SRWF but did occur at 12 of the 252 stations, all of which were in the northwest region, with the exception of Station 085, which was located along the southern border at approximate longitude of 71.1°W. The biological attributes of the SRWF followed similar spatial trends to the physical features. The northwest portion of the SRWF was the only area where gravel was observed consistently across stations. Gravel in this area ranged in size from “washed” pebbles and granules to patchy cobbles and boulders on sand, which were encrusted by epifauna (e.g., bryozoa and hydroids). CMECS biotic classes, (e.g., soft sediment fauna, attached fauna, inferred fauna) are mapped in Figure 3-7.

Stations in the southeast region of the SRWF were predominantly Very Fine Sand (CMECS Substrate Subgroup) (Figure 3-7) and sand and mud (macrohabitat type) and had high occurrences of burrowing anemones and sabellid worms. Stations in the northeast region of the SRWF, which were predominantly medium sand or fine sand (CMECS Substrate Subgroup) and sand with ripples (macrohabitat type), had high occurrences of sand dollars. The northwest region of the SRWF was more heterogenous in seabed composition than other portions but included a higher frequency of gravelly sand and sandy gravel (CMECS Substrate Subgroups) compared to the rest of the SRWF and was generally more complex in macrohabitat types (e.g., sand with mobile gravel, patchy cobbles and boulders on sand), was inhabited by attached epifauna (e.g., hydroids [*Tubularia* spp.], sea stars, and bryozoa).

Soft sediment macrohabitats (i.e., mud and sand, with and without small-scale bedforms [i.e., ripples]) were the primary benthic macrohabitats observed across the SRWF. However, sand with mobile gravel and patchy cobbles and boulders on sand were two habitat types that were generally observed in the northwest corner of the SRWF, interspersed with the soft sediment macrohabitats. A video survey was conducted in August 2020 in areas where complex bottom, specifically large gravel (i.e., boulders and cobbles), was observed during the SPI/PV survey and indicated by the high-resolution acoustic data. The results from this video survey would be used to inform habitat mapping efforts.

The northern star coral, *Astrangia poculata*, a non-reef-building hard coral, was the only sensitive taxa observed across the surveyed area, occurring at five stations, all of which were located within the SRWF (Stations 003, 085, 227, 702, and 721). The sea scallop, *Placopecten magellanicus*, a species of concern

in the region, was found at 21 stations across the surveyed area interspersed at the SRWF and along the eastern portion of the SRWEC–OCS. An ocean quahog (*Arctica islandica*), another species of concern in the region, was observed at one station (Station 130), while several stations had dead clam shell valves on the sediment surface. Additionally, the Jonah crab, a notable species given its increasing importance as a targeted species by the fishing industry, was observed at two stations within the SRWF (Stations 091 and 121), both of which were characterized by the sand and mud macrohabitat type.

Cobble and boulder habitat can serve as structure for hard and soft corals, nursery ground for juvenile lobster, and as preferable benthic habitat for squid to deposit their eggs. Taxa considered sensitive with respect to this habitat include corals, squid eggs, and American lobster. Biogenic habitats included the non-reef building hard coral and burrowing anemones. The northern star coral was found at five stations, all in the northwest corner of the SRWF. Generally, the western portion of the SRWEC–OCS was characterized by high densities of sand dollars while the eastern portion of the SRWEC–OCS was inhabited by burrowing anemones and sea stars, and 52 percent of SPI/PV stations included burrowing anemones.

3.2 Offshore/Onshore Export Cables

3.2.1 SRWEC-OCS

Primary habitats along the SRWEC-OCS were characterized primarily by sandy and muddy sand (Table 3-2, Figure 3-5). Water depths along the SRWEC-OCS range from 89.9 feet (27.4m) to 224.1 feet (68.3 m) and average 161.7 feet (42.3 m) (Figure 3-2). The average and maximum depth are very similar to those in the SRWF.

The SRWEC-OCS included large grained, complex, and soft bottom primary habitats (Figure 3-9). Coarse sediment habitats were observed along the export corridor near the SRWF and near the state water boundary but the majority of the mapped area was sand and muddy sand habitats with discrete areas of mud and sandy mud habitats and one area of mixed sediment – small gravel and sand habitat near where the corridor shifts to the west. Considering habitats with modifiers, sand and muddy sand was the most prevalent habitat type mapped at the SRWEC–OCS (50 percent), followed by sand and muddy sand – mobile (36 percent), and mud and sandy mud (9.4 percent). Coarse sediment – mobile made up 3.4 percent of the SRWEC–OCS. No boulder fields were mapped although individual boulders were identified in the portions of the corridor located further offshore.

Biotic subclasses in the SRWEC-OCS were soft sediment fauna and attached fauna (Figure 3-10). The hard coral *Astrangia poculata*, a sensitive taxon, was not observed. Cerianthids (burrowing anemones) were observed at two stations in sand and muddy sand habitat where the corridor shifts to the west.

The sand and muddy sand habitats in the SRWEC-OCS were characterized by CMECS subgroups medium, fine, and very fine sand and accounted for 40 of the 81 SPI/PV ground-truth sites (Figure 3-11). Sand and muddy sand (mobile) included a coarse sand in the subgroup and accounted for 29 of the survey sites. The subgroup of very fine sand was present intermittently (9 sites) along the OCS corridor, coincident with mud and sandy mud. Gravelly sand, very coarse and coarse sand subgroups occurred at a total of 3 survey sites.

The offshore/onshore export cable area includes the SRWEC–OCS in federal waters, the SRWEC–NYS, and the HDD. A summary of the infrastructure associated with the offshore/onshore export cables is presented in Table 3-3.

Table 3-3. Infrastructure Associated with the SRWF

SRWEC
<ul style="list-style-type: none"> • One 320-kV DC export cable bundle buried to a target depth of 3 to 7 ft (1 to 2 m) • Maximum total corridor length of up to 106 mi (170 km) • Maximum individual cable diameter of 7.8 in (200 mm) • Maximum disturbance corridor width of 98 ft (30 m) • Maximum seafloor disturbance for HDD exit pits of 61.8 ac (25 ha) • Maximum disturbance for Landfall Work Area (onshore) of up to 6.5 ac (2.6 ha)
Onshore Transmission Cable and Onshore Interconnection Cable
<ul style="list-style-type: none"> • Onshore Transmission Cable, including associated TJB and fiber optic cable, up to 17.5 mi (28.2 km) long, with a temporary disturbance corridor of 30 ft (9.1 m) and maximum duct bank target burial depth of 6 ft (1.8 m) • Maximum cable diameter of 6 in (152 mm) • Onshore Interconnection Cable to connect to Holbrook Substation
OnCS-DC
<ul style="list-style-type: none"> • An OnCS-DC with operational footprint of up to 6 ac (2.4 ha)

The SRWEC – OCS corridor is dominated by soft bottom sand habitat. Acres of habitat in the SRWEC-OCS corridor include:

- Rocky (368 acres)
- Soft bottom mud (3,321 acres)
- Soft bottom sand (30,548 acres)
- Biogenic habitat present (burrowing anemones)
- Pelagic habitat (35,396 acres)

The remaining habitats (SAV/summer flounder HAPC, tidal marsh, shellfish reefs and beds, shell accumulations, and sensitive life stage habitats, and HAPCs) were not found during surveys.

SPI/PV analysis was conducted at 107 stations along the outer continental shelf section of the export cable (SRWEC– OCS). There were two distinct regions of the SRWEC–OCS based on sediment composition and benthic community: (1) the western stations extending from the three-mile NYS waters boundary to where the planned cable corridor redirects northeastward, and (2) the eastern stations that include the remaining stations along the SRWEC–OCS extending to the SRWF (INSPIRE 2020a (COP

Appendix M1)). There were spatial trends associated with the physical features along the SRWEC–OCS, notably a transition from Medium Sand and Fine Sand (CMECS Substrate Subgroups) with ripples in the western extent to Very Fine Sand with limited small-scale bedforms along the eastern portion of the SRWEC–OCS.

The spatial distribution of seabed composition was also reflected in the biological component of the benthic environment along the SRWEC–OCS. Generally, the western portion of the SRWEC–OCS was characterized by high densities of sand dollars while the eastern portion of the SRWEC–OCS was inhabited by burrowing anemones and sea stars. Gravel was not a substantial proportion of the sediments along the SRWEC–OCS and was not greater than 5 percent cover at any station, with the exception of two stations both of which were composed of Gravelly Sand (CMECS Substrate Subgroup; i.e., 5-30 percent cover of gravel), with pebble/granule being the largest gravel at these two stations. A total of 19 percent of the SPI/PV sample stations included burrowing anemones.

3.2.2 SRWEC-NYS

SRWEC-NYS waters were characterized by soft sediments ranging from very fine sand to medium sand (Table 3-2, Figure 3-5) with evidence of generally low organic matter content and evidence of benthic microalgae at many survey stations. Macrohabitat characteristics indicated greater bedload transport nearer to shore with more distinct ripples in the sand as well as greater suspended material which contributed to higher turbidity. This trend indicates decreasing wave action effects proceeding from shallower waters out into deeper areas. Water depths ranged from 15 to 88 ft (5 to 27 m) and averaged 57.1 feet (17.4m) with shallower areas nearer to shore (Figure 3-2).

SRWEC–NYS mapping included all primary benthic habitats except glacial drift. Coarse sediment habitats were found near the point where the SRWEC–NYS portion of the Project area widens nearshore (Figure 3-9). The majority of the SRWEC–NYS was composed of sand and muddy sand habitats. Of the habitats with modifiers, sand and muddy sand was the most prevalent, followed by coarse sediment – mobile, and sand and muddy sand – mobile. Coarse sediment – mobile with medium/high density boulder fields made up < 1 percent of the SRWEC–NYS. Biotic subclasses (Figure 3-10) were dominated by soft sediment fauna. The hard coral *Astrangia poculata*, a sensitive taxon, was not observed, but cerianthids (burrowing anemones) were observed and were prevalent in sand and muddy sand habitats just inshore of the state waters boundary.

The sand and muddy sand habitat in the SRWEC-NYS waters were characterized by CMECS subgroups fine and very fine sand and accounted for 22 of the 35 SPI/PV ground-truth sites (Figure 3-11). Fine sand subgroups occurred at the single sand and muddy sand with boulder field site nearer shore and the sand and muddy sand (mobile site). Coarse sediment (mobile) habitat (7 sites) was characterized by the medium, fine, and very fine sand subgroups.

The landing (landfall) area for the SREC includes up to 6.5 ac (2.6 ha) for up to three HDD cables, temporary anchoring walls, and drilling rig, in addition to 2.5 ac (1 ha) for the beach stringing area and trenching to the ICW-HDD crossing. Coastal habitats in the landing area relevant to the EFH assessment include those located within state waters and inland to the mainland, inclusive of bays and back-barrier lagoons (USFWS 1997) that separate the barrier islands from the coastal mainland on the Long Island south shore. At landfall, the cables intercept coastal habitats associated with the landfall/ICW-HDD work

areas on Fire Island including maritime beaches, dunes, and grasslands, although the landfall/ICW work area on the mainland is primarily developed. The onshore facilities correspond with existing developed areas including parking lots and paved roadways.

The SRWEC-NYC intercepts the soft bottom sand before it reaches shore and emerges in the paved parking area at Smith Point County Park. From there, the cable corridor follows roadways and existing infrastructure until it meets the location of the ICW-HDD.

The benthic habitat delineation ends a few hundred meters from shore and the pelagic habitat was estimated based on the distance from the shore to the extent of the delineated benthic habitat. The total pelagic habitat in the export cable corridor associated with landfall totals 173 acres.

Surficial sediment characteristics along the SRWEC and in the SRWF were provided from grab samples collected in January 2020 in support of the Project in federal waters (Appendix M1, Sunrise Wind 2021). A single grab sample and the USGS East Coast Sediment Texture Database was used to define the surficial seafloor sediments along the SRWEC in NYS waters and at the HDD exit pit representative location. Sediment grab samples collected along the SRWEC–NYS were overwhelmingly dominated by sand (> 90 percent) with minor silt/clay and gravel. Small-scale mobility, as inferred from the presence of sand ripples in PV images, was more prevalent at the stations closer to shore.

Three macrohabitat types were observed along the SRWEC–NYS based on the sediment composition (CMECS Substrate Subgroup) and inferred small-scale mobility (i.e., bedforms): *sand with ripples*, *sand*, and *sand and mud*. Although considered distinct, these three macrohabitats are similar in characteristics; specifically, all three consist of sandy sediments ranging from very fine sand to medium sand (CMECS Substrate Subgroup) with no gravel. All three macrohabitats were characterized by the biotic subclass of soft sediment fauna.

The soft sediment fauna communities along the SRWEC–NYS were generally inferred by the presence of small burrows, tubes, and tracks. Sand dollars, burrowing anemones, and *Diopatra* sp. were frequently observed in the SPI and PV images along the SRWEC–NYS and a total of 26 percent of the SPI/PV stations included burrowing anemones. Benthic community analysis of the sediment grab samples showed three taxa made up the majority of individuals observed across all replicates along the SRWEC–NYS: (1) the polychaete, *Polygordiidae* (Family) *Polygordius* (Genus, LPIL), (2) the polychaete *Capitellidae* (Family) *Mediomastus* (Genus, LPIL), and (3) the amphipod *Haustoriidae* (Family) *Protohaustorius wigleyi*.

In the SRWEC–NYS area, species of ecological concern and/or concern regarding possible habitat disturbance from offshore wind construction and operation activities include black sea bass, Atlantic cod, sea scallop, and ocean quahog (Guida et al. 2017). No sensitive taxa or non-native species were observed at any of the stations along the SRWEC–NYS.

3.2.3 ICW-HDD and Interior Coastal Components

3.2.3.1 ICW-HDD

The ICW is maintained for vessel traffic to a depth of 6 feet (2 m) and dredge material redistribution occurs regularly (Figure 3-1). The ICW-HDD crossing included 133 mapped acres, comprising the two primary habitats sand and muddy sand and coarse sediment. Sand and muddy sand was the dominant habitat type mapped and coarse sediment habitats were found along the ICW west of the bridge, coincident with the dredged navigational channel, and was represented by coarse sediment (Table 3-2).

Benthic habitat complexity categories were complex and soft bottom (Figure 3-12). Complex categories included present/potential presence of benthic macroalgae and/or SAV. Of the habitats with modifiers, sand and muddy sand was the most prevalent habitat type mapped within the ICW-HDD crossing, followed by sand and muddy sand with recent and/or potential SAV and/or benthic macroalgae, and coarse sediment (7 percent). Sands were observed except in coarse sediment habitats where gravelly sand and sandy gravel was recorded. Sand and muddy sand habitats were dominated by areas of potential and occurring benthic macroalgae and SAV, primarily on the west side of the ICW bridge (Figure 3-10).

Biotic subclasses included attached and soft sediment fauna (Figure 3-13). The non-reef-building hard coral *Astrangia poculata* and the burrowing anemone ceranthids, were not observed within the ICW-HDD area. Coarse sand habitats in the ICW-HDD channel included 3 of the 8 SPI/PV ground-truth sites and were characterized by the sandy gravel, gravelly sand CMECS subgroup (Figure 3-14). Vegetated habitats (2 sites) and sand and muddy sand (3 sites) occurred along the shore were both characterized by sand or finer CMECS subgroups.

Three of eight ICW-HDD stations were more than 5 percent cover of gravel and were classified with the CMECS substrate group of either gravel mixes or gravelly. The remaining five ICW-HDD stations were classified as sand or finer. The Biotic Subclass of attached fauna occurred at stations composed of gravel (Stations 802, 805, and 808), and the mobile sand present at the other stations in the ICW-HDD were classified with the Biotic Subclass of soft sediment fauna. Habitats surveyed in the ICW-HDD included:

- Rocky (9.34 acres)
- Soft bottom (122 acres)
- Tidal marsh (< 2 acres)
- Pelagic (132 acres)
- Habitat for sensitive life stages of Bryozoa and serpulid tubes at several stations at the ICW-HDD
- SAV and macroalgae

Rocky habitat, soft bottom sand and mud, SAV, and other biogenic habitats (Bryozoa and serpulid tubes) were found in the survey area. SAV, biogenic habitat, and other biogenic habitats (Bryozoa and serpulid tubes) were observed in the ICW-HDD.

The physical seabed and sediment composition at stations sampled in the ICW-HDD were more variable than along the SRWEC–NYS. Three ICW-HDD stations contained more than 5 percent cover of gravel and were classified with the CMECS Substrate Group of either Gravel Mixes or Gravelly. The remaining five ICW-HDD stations were classified as Sand or Finer. No boulders or cobbles were observed in replicate images of the ICW-HDD. The sediment grab grain size analysis corroborated the Substrate Subgroup classifications of Sandy Gravel at the stations where grabs were collected (Stations 802 and 805); sediment grab replicates were composed mainly of sand mixed with approximately 20 percent gravel and a minor fraction of silt/clay.

The variability in physical features across stations corresponded with the variability in Biotic Subclass designations. The Biotic Subclass of Attached Fauna occurred at stations composed of gravel (Stations 802, 805, and 808), and the mobile sand present at the other stations in the ICW-HDD were classified with the Biotic Subclass of Soft Sediment Fauna. The benthic community analysis of the sediment grab replicates collected at Stations 802 and 805 revealed similar community compositions between the two sites. Five taxa accounted for just over 60 percent of the total benthic infaunal abundance across all replicates at the ICW-HDD: (1) an oligochaete, Naididae (Family, LPIL), (2) the amphipod *Eobrolgus*

spinus, (3) the polychaete *Exogone dispar*, (4) the amphipod *Elasmopus levis*, and (5) the amphipod *Gammaropsis* (Genus, LPIL).

Within the estuarine environment of the ICW-HDD, seagrass beds, characterized by continuous or patchy seagrass (SAV), are considered sensitive and ecologically important benthic habitat. Attached Fauna were documented at only 4 stations (corresponded with coarser Substrate Groups/ Subgroups), all of which were during the ICW-HDD survey. SAV were documented in the cable corridor in 2018, were not found in the 2020 survey, but were found again in the 2022 survey (see section 3.3.5 Submerged Aquatic Vegetation for more detail). SAV beds are limited to shallow depths (due to light requirements) and areas with low energy (i.e., low turbidity) and thus do not occur within the SRWF or along the SRWEC. SAV beds are found in parts of Bellport Bay, the eastern part of Great South Bay, NY, near the proposed ICW-HDD of the Onshore Transmission Cable (NYS DOS 2020). Great South Bay lies between Fire Island and Long Island and is connected to the Atlantic Ocean via breaches in the barrier islands, e.g., Fire Island. Great South Bay is the largest protected, shallow, coastal bay in New York and is forage and nursery habitat for a variety of species identified as commercially or recreational important, including summer flounder (*Paralichthys dentatus*), winter flounder (*Pleuronectes americanus*), bluefish (*Pomatomus saltatrix*), and black sea bass (USFWS 1991).

Summer flounder has designated HAPC in the vicinity of the SRWF Project area (Bellport Bay). Summer flounder HAPC includes “All native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH” (MAFMC 2016). These areas have been identified as important for shelter, predation, nursery habitat, and, potentially, reproduction (MAFMC 1998a) and any loss of areas with SAV and macroalgae along the Atlantic Seaboard may negatively affect summer flounder stocks (Laney 1997). SAV and macroalgae have been shown to attract common summer flounder prey for both adults and juveniles (Packer et al. 1999) and summer flounder appear to effectively capture prey by using seagrass as a “blind” to ambush prey (Lascara 1981). Recent surveys of the Project area found no significant SAV forming patches or meadows within the proposed SRW temporary landing site, although eelgrass was identified at six different locations in the north-eastern area of the proposed temporary landing site (see section 3.3.5 Submerged Aquatic Vegetation for more detail). Four of the observed SAV locations consisted of single eelgrass shoots emerging from a dense mat of algae and did not appear rooted. The remaining two SAV observations consisted of multiple shoots of eelgrass (less than six shoots per site) emerging from an algal mat on the sediment surface, but, compared to the single eelgrass plants observed, these clusters of plants appeared more likely to be rooted. Juvenile Atlantic cod can also be found in the region and occurs between the mean high-water line and a depth of 66 ft (20 m) in rocky habitats, in SAV, or in sandy habitats adjacent to rocky and SAV habitats for foraging from Maine through Rhode Island (NEFMC 2017). Newly designated HAPC for cod spawning includes the entire lease area.

SAV beds provide important ecosystem functions in shallow marine environments. SAV beds are important sources of primary production and nitrogen fixation, the leaves provide habitat for multiple fish and invertebrate species, and their physical structure provides sediment stabilization and enhances sedimentation (Thayer and Fonseca, 1984). SAV in New York is primarily eelgrass (*Zostera marina*). Eelgrass is a marine flowering plant that lives below the surface in less than 16.4 feet (5 meters) of water. Eelgrass beds provide (1) nursery ground and refuge for commercially important organisms, such as bay scallops (*Argopecten irradians*), flounders, striped bass (*Morone saxatilis*), tautog (*Tautoga onitis*), and seahorses; (2) habitat and food for waterfowl, shellfish, and finfish; and (3) sediment and shoreline stabilization (Heck et al. 1989).

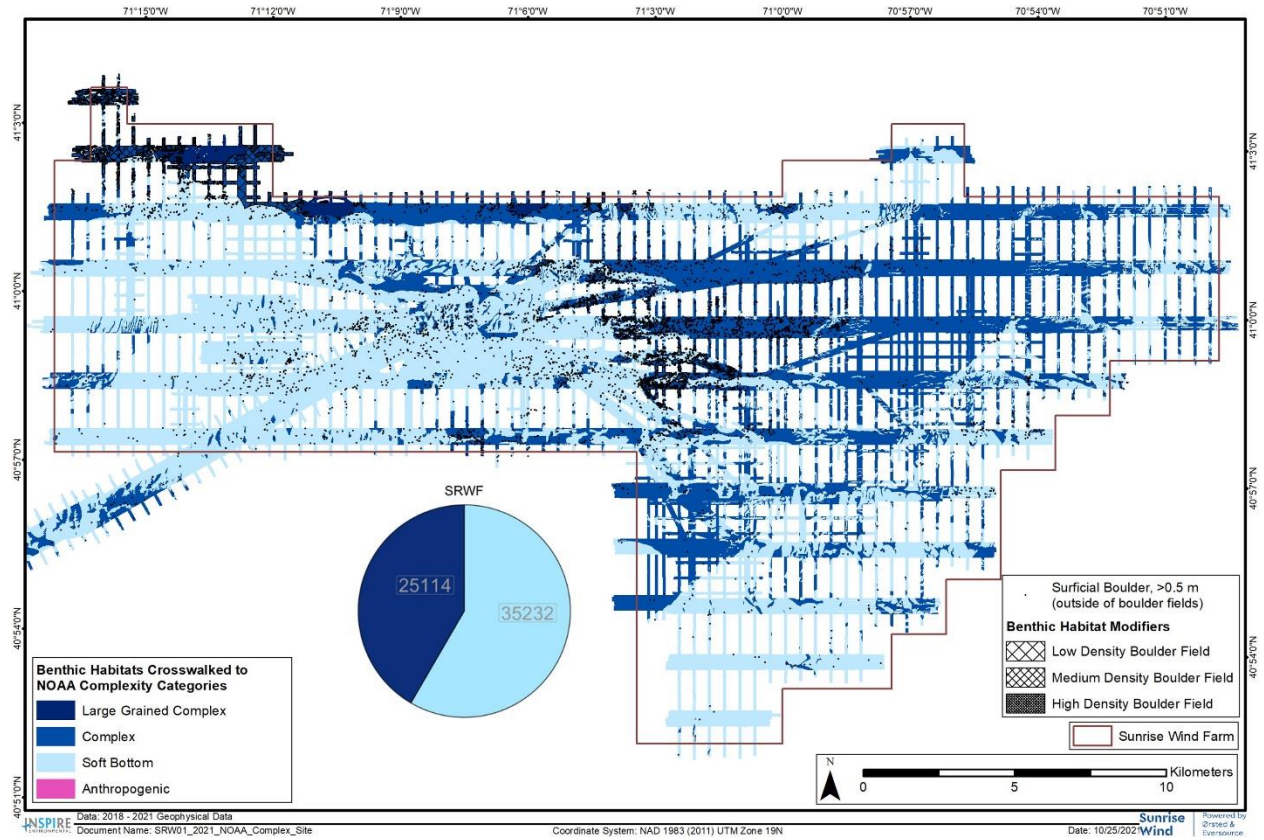


Figure 3-6. Benthic Habitats Categorized by NOAA Complexity Category at SRWF and a Pie Chart of NOAA Complexity Category Composition with Total Acres Presented as Values

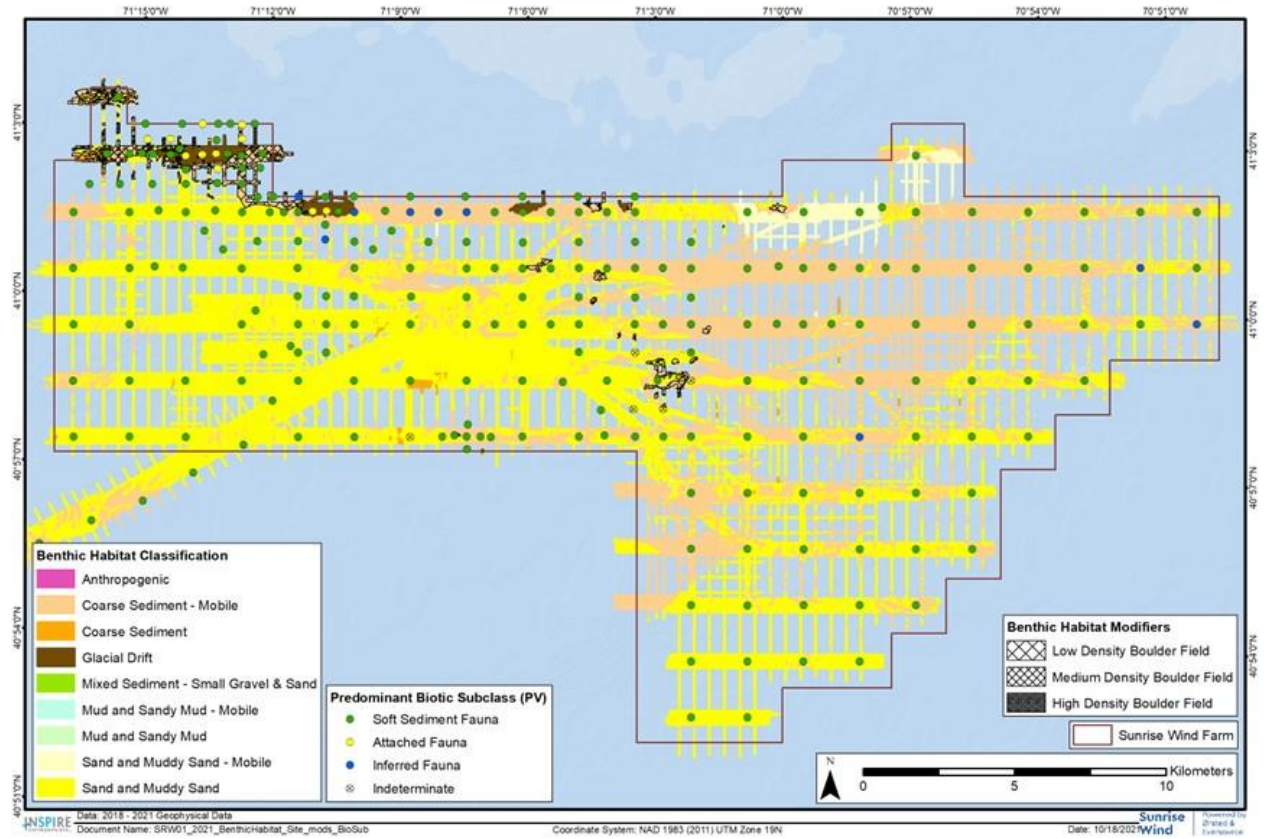


Figure 3-7. Benthic Habitat Groups with Modifiers and Ground-Truth CMECS Biotic Subclass in the SRWF

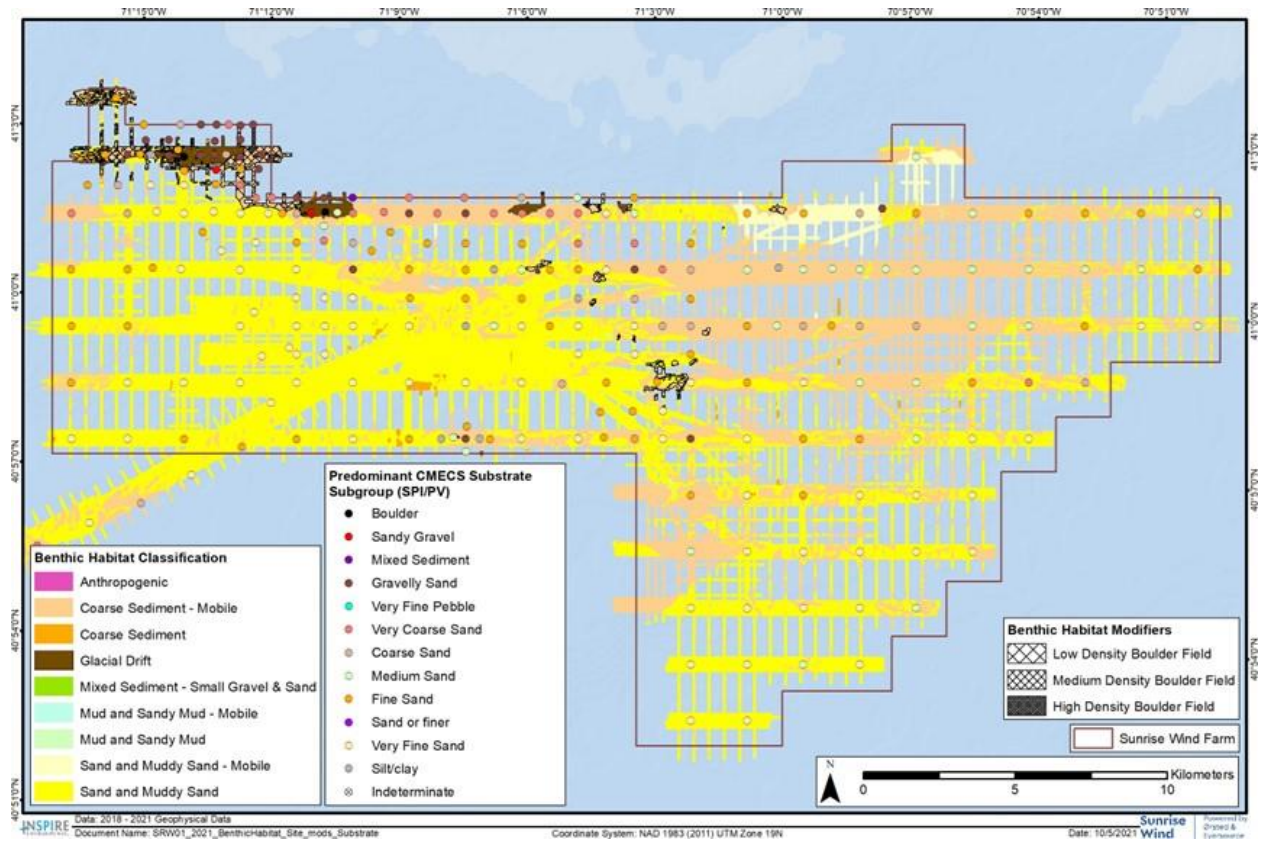


Figure 3-8. Benthic Habitat Groups with Modifiers and Ground-Truth CMECS Biotic Subgroups in the SRWF

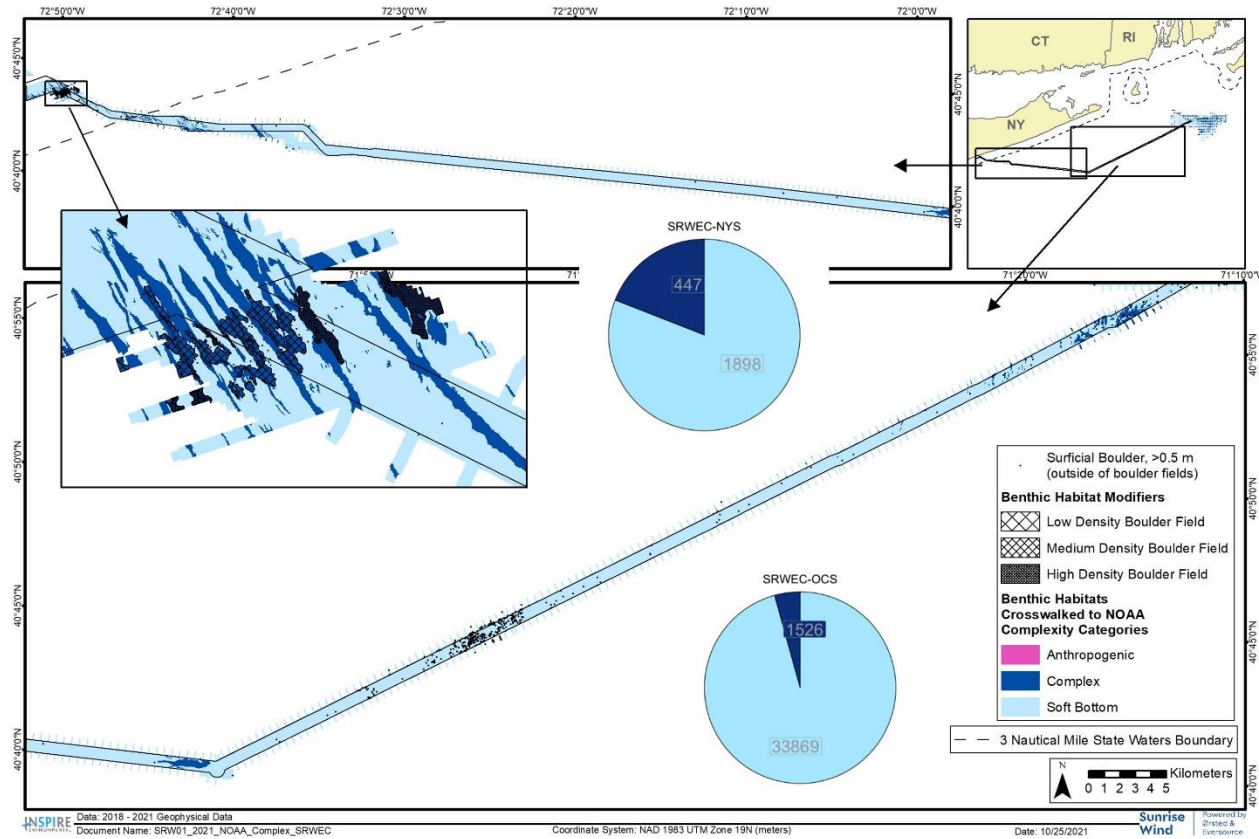


Figure 3-9. Benthic Habitats Categorized by NOAA Complexity Category at SRWEC-OCS and NYS Waters and a Pie Chart of NOAA Complexity Category Composition with Total Acres Presented as Values

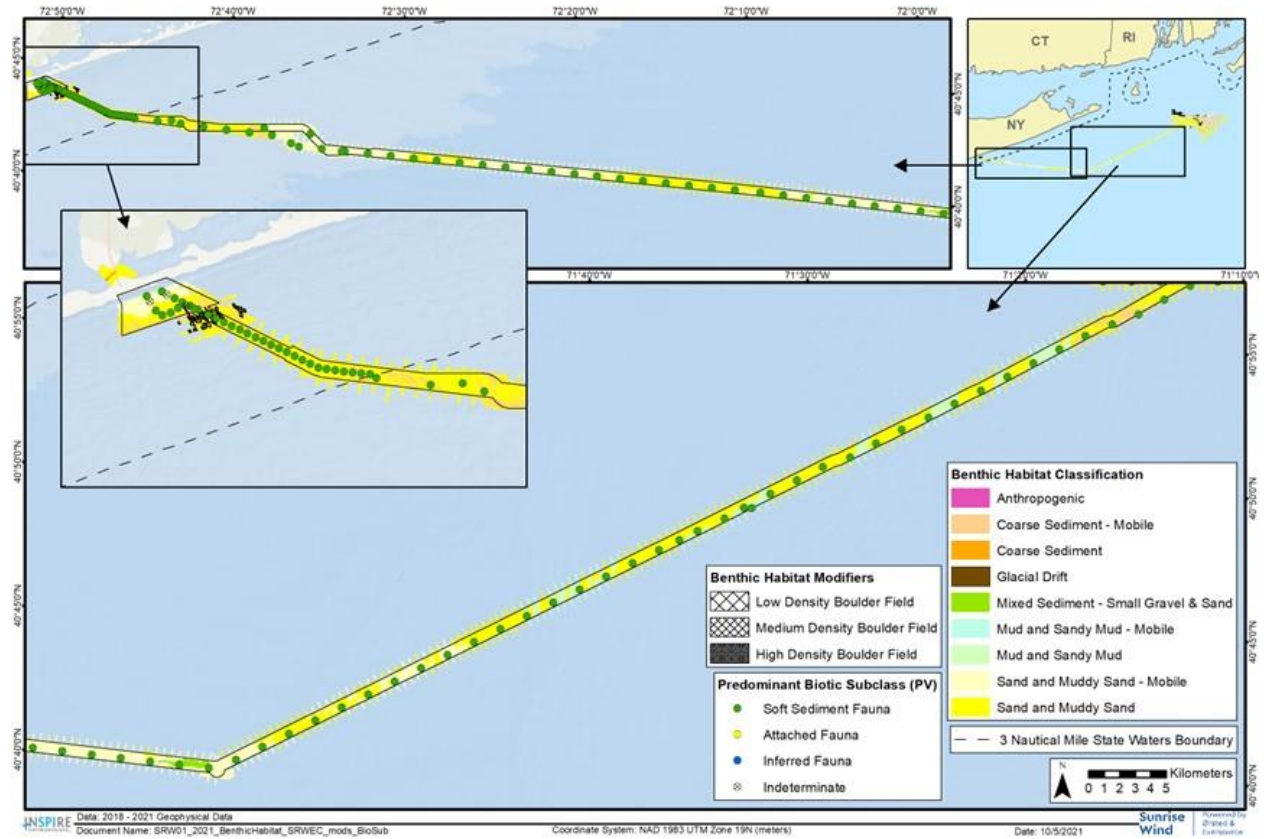


Figure 3-10. Benthic Habitat Types with Modifiers and Ground-Truth CMECS Biotic Subclass Along the SRWEC-OCS and NYS Waters

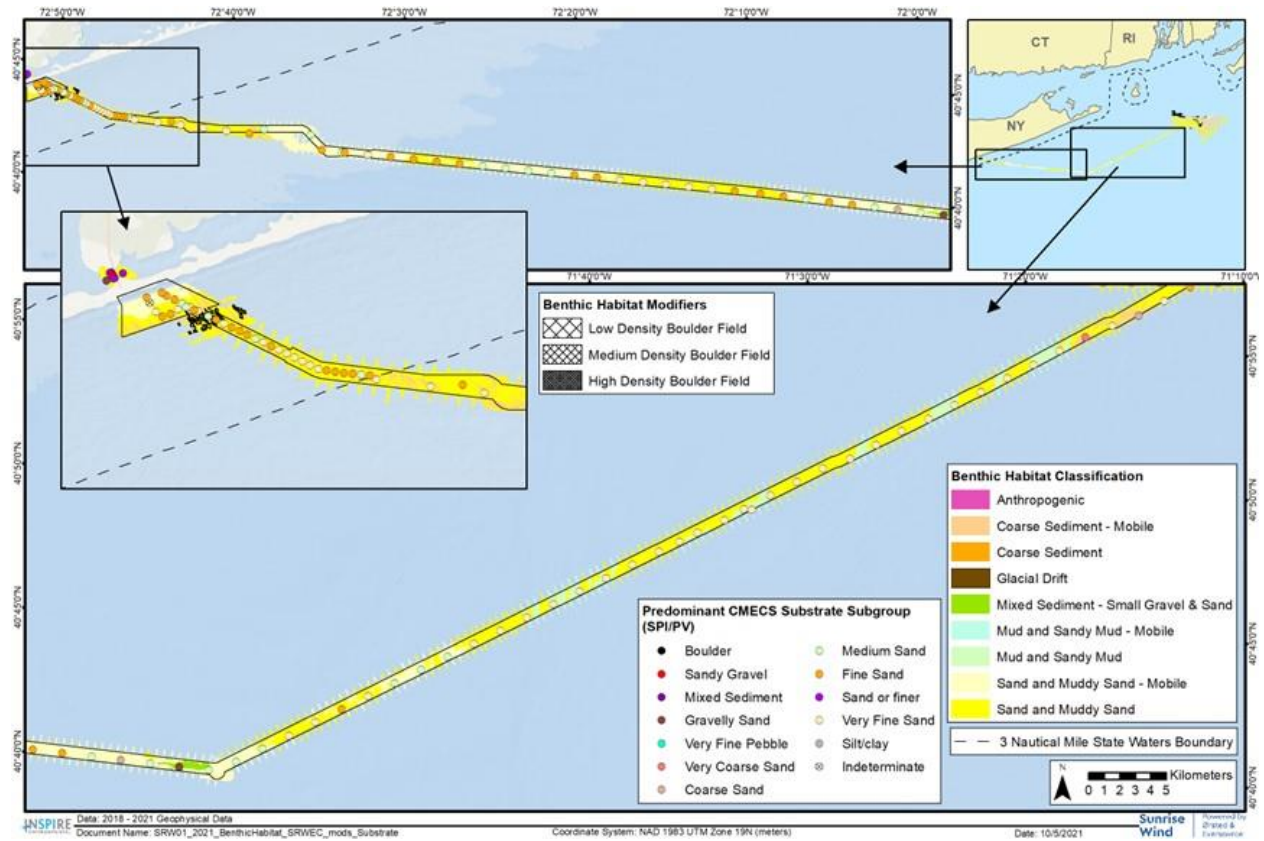


Figure 3-11. Benthic Habitat Groups with Modifiers and Ground-Truth CMECS Biotic Subgroups in the SRWEC-OCS and SRWE-NYS Waters

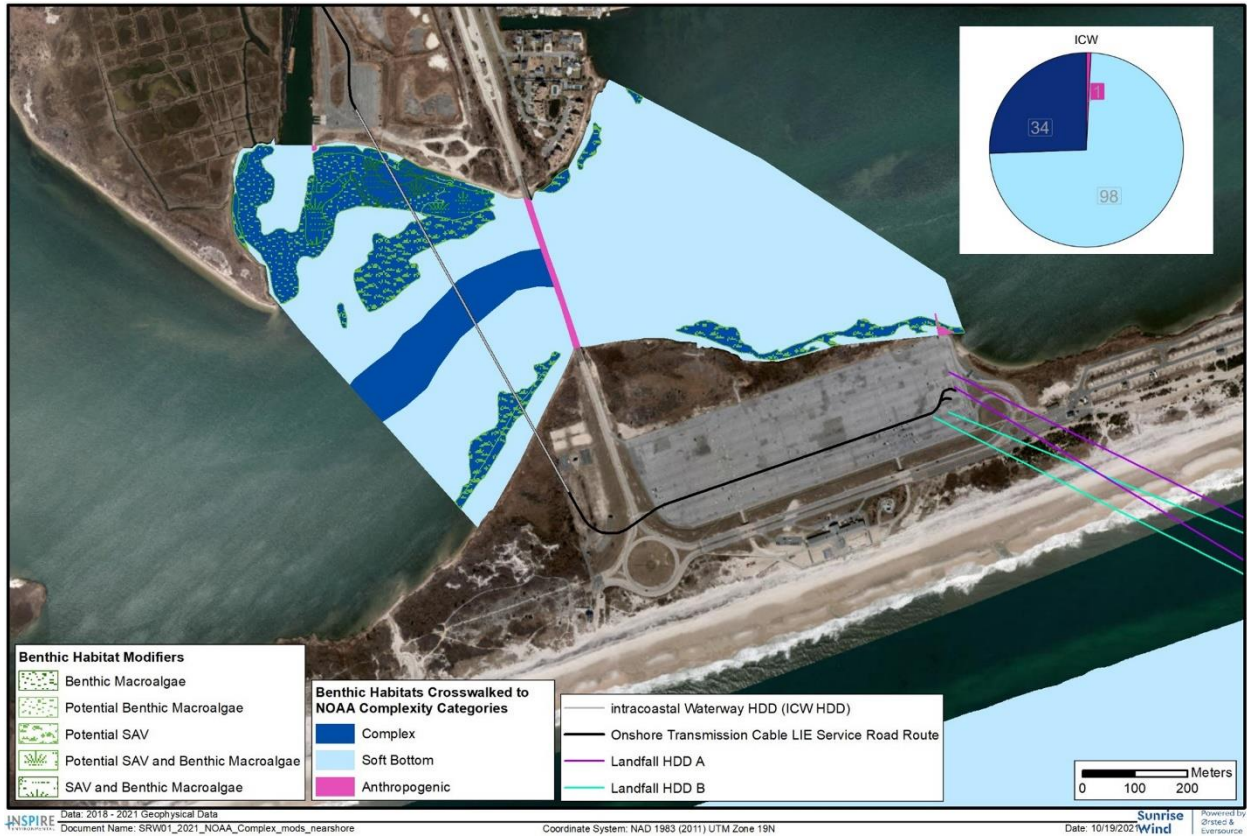


Figure 3-12. Benthic Habitats Categorized by NOAA Complexity Category at the ICW-HDD and a Pie Chart of NOAA Complexity Category Composition with Total Acres Presented as Values

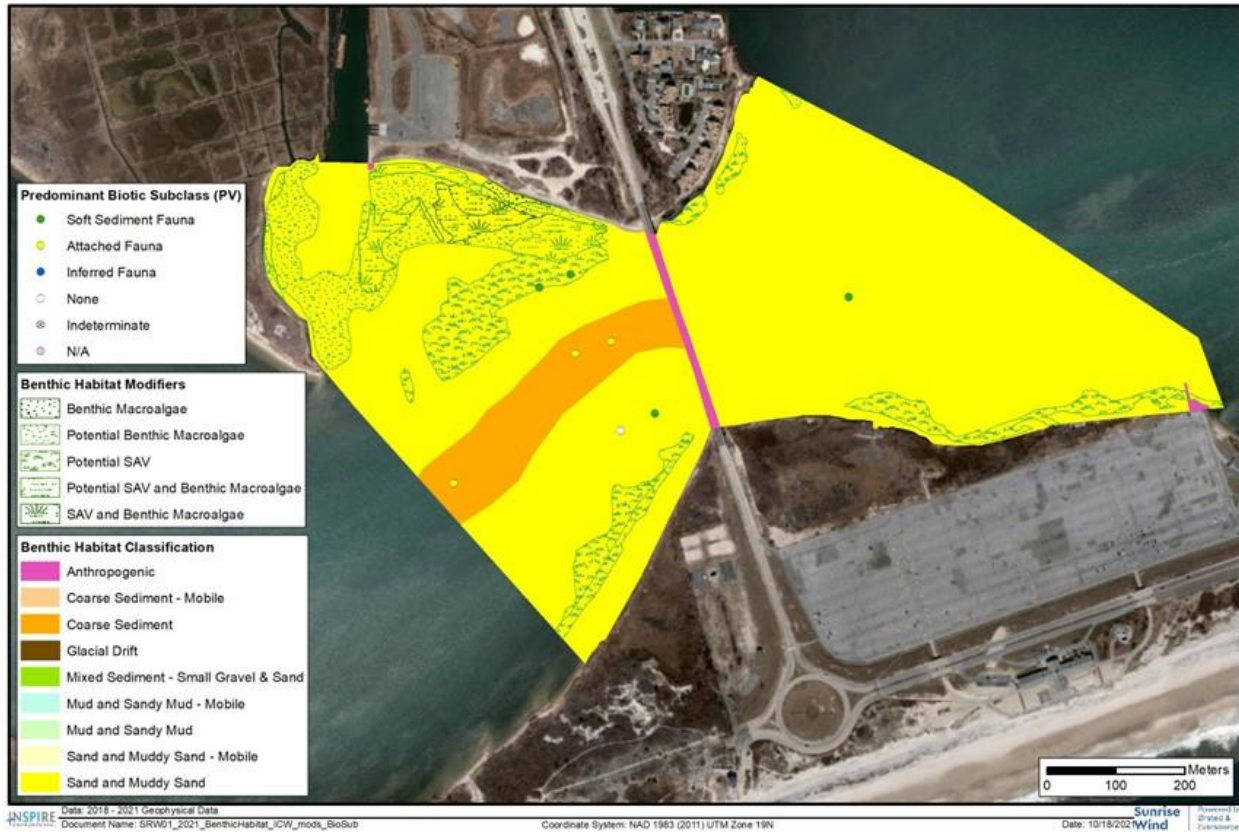


Figure 3-13. Benthic Habitat Types with Modifiers and Ground-Truth CMECS Biotic Subclass in the SRW ICW-HDD

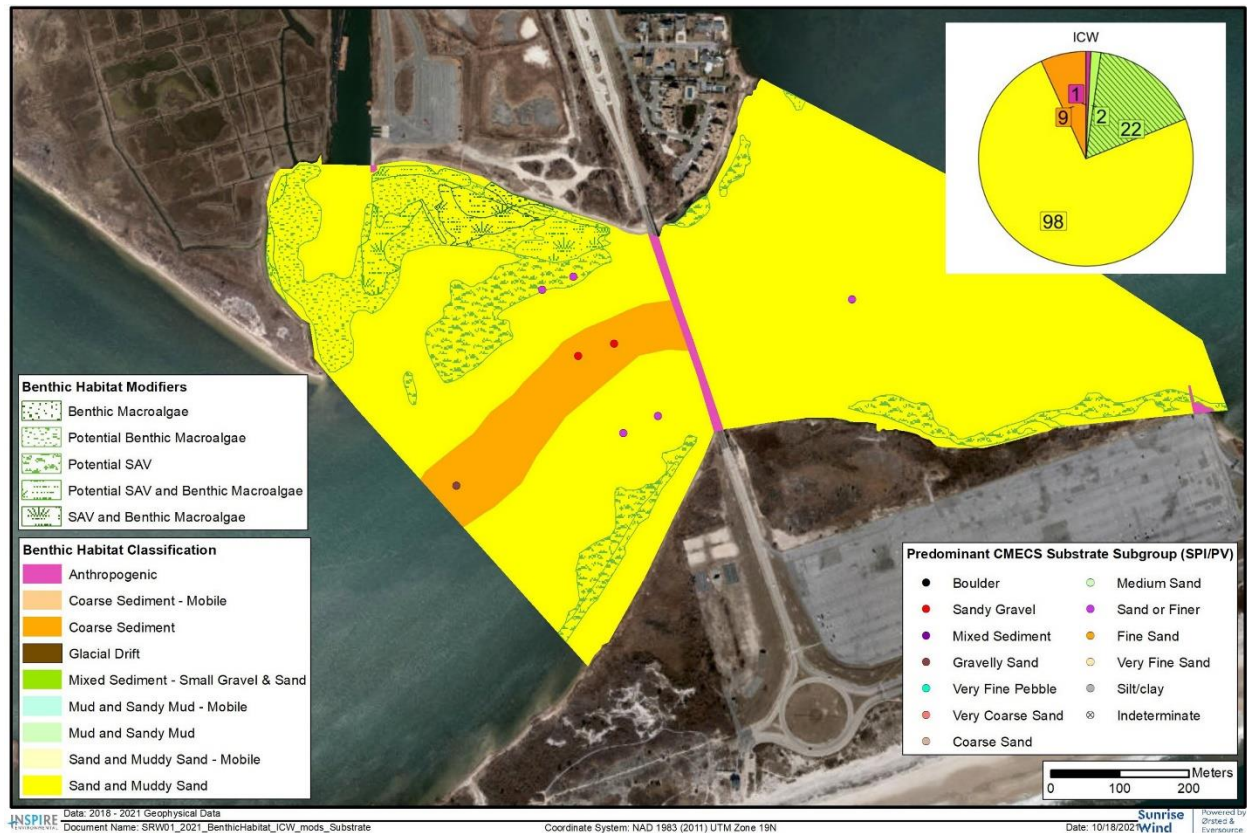


Figure 3-14. Benthic Habitat Groups with Modifiers and Ground-Truth CMECS Biotic Subgroups in the SRW ICW-HDD

3.2.3.2 Interior Coastal

The SRWEC–NYS will make landfall at the HDD TJB on the eastern portion of Smith Point County Park and then run parallel to Fire Island Beach Road within the paved Smith Point County Park parking lot, crossing under the William Floyd Parkway to a recreational area located to the west of William Floyd Parkway. The cable will then be routed across the ICW (Great South Bay) via an HDD, avoiding impacts to tidal wetlands and submerged aquatic vegetation (SAV), to a paved parking lot within the Smith Point Marina along East Concourse Drive. The Onshore Transmission Cable will also cross Carmans River; however, the onshore transmission cable will cross Carmans River in areas that are designated as freshwater and are outside of the scope of this assessment.

Great South Bay lies between Fire Island and Long Island, where it is connected to the Atlantic Ocean through breaches in the barrier beaches of Fire Island. The area of Great South Bay and Moriches Bay adjacent to the landfall/ICW work area is classified as a marine back-barrier lagoon surrounded by developed lands. The protected shores of the lagoons support grass beds, mudflats, and salt marshes. Great South Bay is the largest protected, shallow, coastal bay in New York and provides forage and nursery habitat for a variety of species identified as commercially or recreational important, including summer flounder, winter flounder, bluefish, and black sea bass (USFWS 1991). The tidal marshes, mud and sand flats, SAV, and broad shallows of this estuarine environment support finfish, shellfish, waterfowl, and other wildlife in the South Shore Estuary Reserve. Tidal marshes are present along the

low energy bay side of Fire Island in broad overwash areas and common species include saltmarsh cord grass (*Spartina alterniflora*), salt-meadow cordgrass (*S. patens*) and coastal salt grass (*Distichlis spicata*), depending on the level of tidal inundation. The trenchless construction methods currently proposed to install the Onshore Transmission Cable will avoid and minimize potential impacts to this habitat.

Interior coastal habitats associated with the SRWF include up to 17.5 mi (28.2 km) of onshore transmission cable within a corridor 30 ft (9.1 m) wide with an operational ROW of 60 ft (18.3 m), and transmission joint bays (Table 3.3.2-4 in the COP). The interior transmission cable includes an OnCS-DC with a disturbance footprint of up to 7 ac (2.8 ha) and an operational footprint of 6 acres (2.4 ha). Benthic habitat types identified in the interior coastal component of the Project area include:

- Tidal marsh (5 acres)
- Summer flounder HAPC

Tidal marsh and summer flounder HAPC were the only benthic habitat types mapped for the interior coastal component of the Project area. Tidal marshes are associated the bay side coast in the Project area. Summer flounder HAPC includes all of Long Island Sound, Great South Bay, and Great Peconic Bay within the Project area, bounded on the Atlantic side by barrier islands, including Fire Island. Relevant coastal habitats along the mainland transmission cable corridor range from salt to brackish marshes. Tidal wetlands have numerous ecological functions important to fish and shellfish, including spawning and nursery habitat, refuge for both adults and juveniles in the vegetation, water filtration, flood dampening, and habitat connectivity.

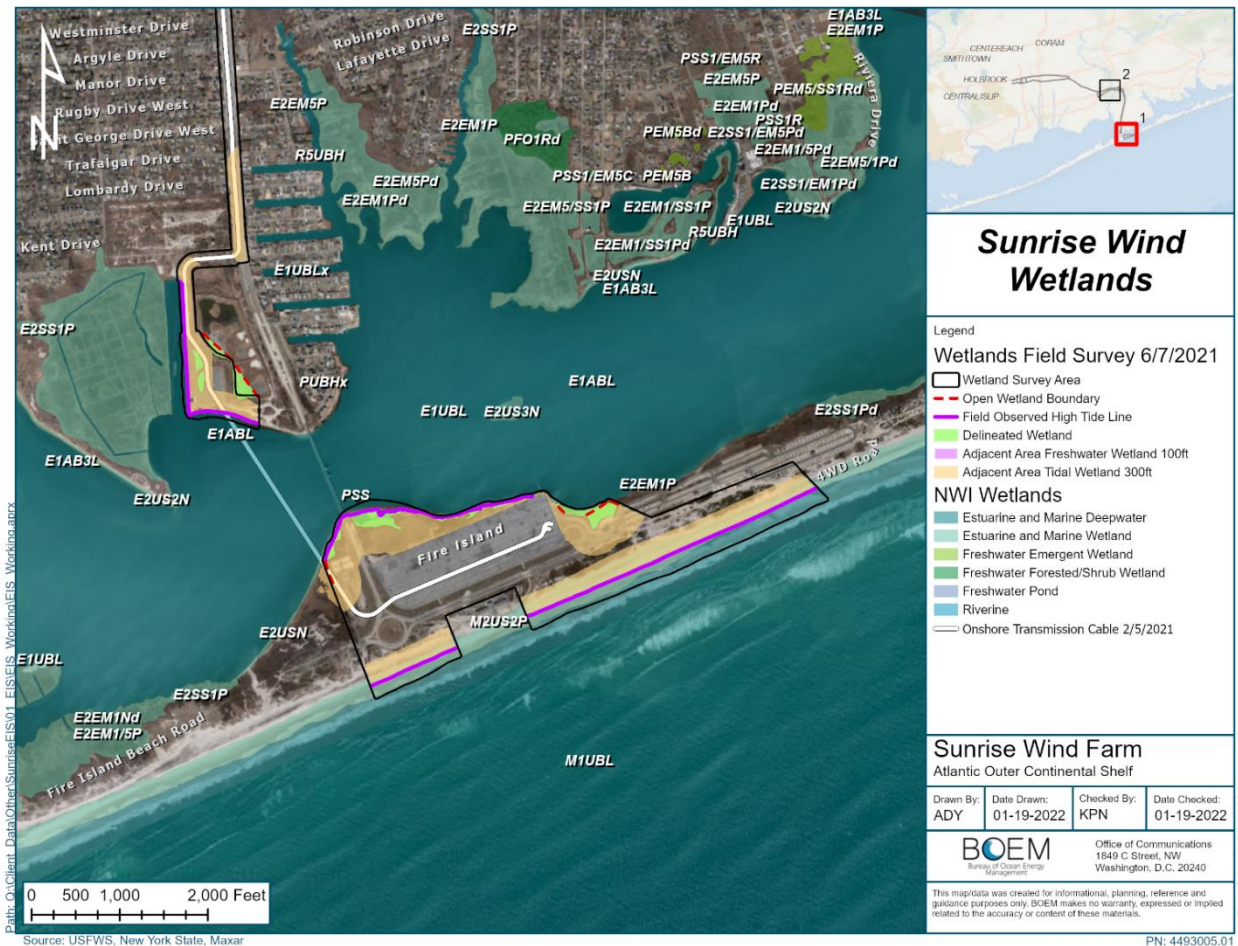
Delineated wetlands and areas of known SAV in the coastal interior coastal component of the SRWEC are mapped in Figure 3-22. These coastal habitats are important to mammals, birds, herpetofauna, and invertebrates that depend on these habitats for food, water, shelter, and reproduction. For example, flounder (e.g., summer, winter), red hake, and little skate all use intertidal habitat for at least one life stage. SAV beds provide important ecosystem functions in shallow marine environments, including primary production and nitrogen fixation, habitat for multiple fish and invertebrate species, and sediment stabilization (Thayer and Fonseca, 1984). SAV in New York is primarily eelgrass (*Zostera marina*), which provide (1) nursery ground and refuge for commercially important organisms, such as bay scallops (*Argopecten irradians*), flounders, striped bass (*Morone saxatilis*), tautog (*Tautoga onitis*), and seahorses and habitat and food for waterfowl, shellfish, and finfish (Heck et al. 1989).

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.

National Wetlands Inventory (NWI) data were used to identify the potential presence of wetlands in and near the vicinity of the Project area and are displayed in conjunction with delineated tidal wetland in Figure 3-24. Tidal wetlands include both estuarine and marine wetlands and are associated with the ICW and the Atlantic Ocean. NWI polygons indicate the presence of 23.6 acres of marine and estuarine wetland habitat, 99 percent of which are marine intertidal areas along the Atlantic coast. The project area includes 8.8 acres identified by the NWI as estuarine and marine deepwater (subtidal) areas, including 0.2 acres of submerged aquatic bed in the ICW. Field surveys identified 5 acres of tidal wetlands adjacent to the ICW within the project area, occurring along the low energy bay side of Fire Island. The three delineated tidal wetlands were estuarine, intertidal wetlands of shrub scrub (SS) and emergent (EM) vegetation (E1SS/EM). Common plant species include Jesuit's bark (*Iva frutescens*),

common reed (*Phragmites australis*), rambler rose (*Rosa multiflora*), and groundsel tree (*Baccharis halimifolia*), which occur above mean high water, and are therefore not considered EFH.

The ICW HDD will cross under several NYSDEC-designated tidal wetland categories in the Great South Bay-East SCFWH, including littoral zone and coastal shoals, bars, and mudflats before reaching the ICW HDD Work Area at Smith Point Marina. These tidal wetlands are also mapped by the NWI as estuarine wetlands (E1AB3L (estuarine, subtidal, aquatic bottom, rooted vascular, subtidal), E1UBL (estuarine, subtidal, unconsolidated bottom, subtidal), and E2USN (estuarine intertidal unconsolidated shore, regularly flooded)). EFH is designated within the tidal portions of the Carmans River; however, the onshore transmission cable will cross Carmans River in areas that are designated as freshwater, and thus do not have designated EFH.



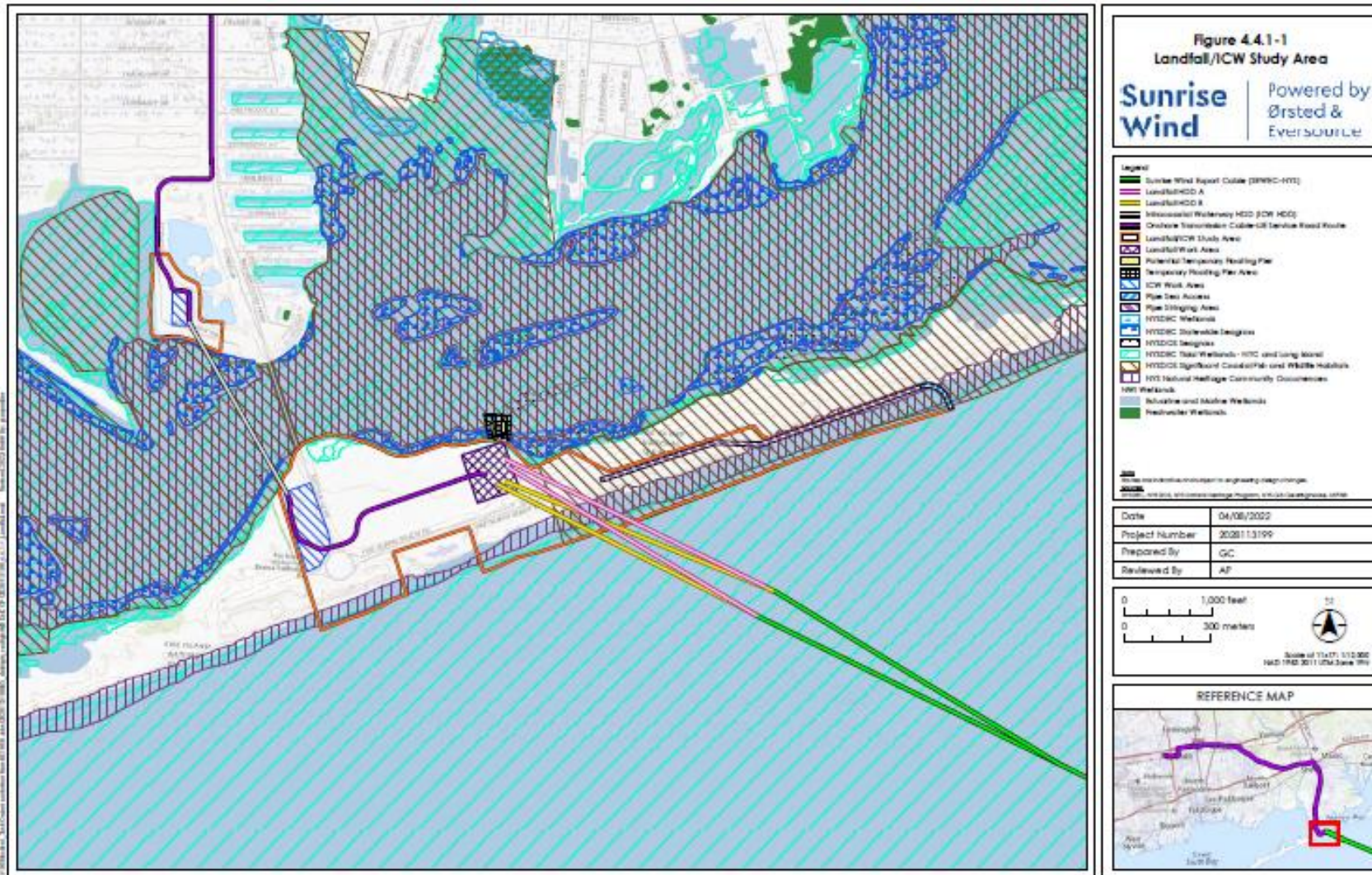


Figure 3-16. SAV, Tidal Wetlands, and Other Coastal Habitats in the Vicinity of the SRWF Onshore Export Cable

3.3 Habitat Types within the Project Area

This section provides detailed discussions of habitat types within the Project area for each project component, including the Lease Area, the offshore cable corridors of the open ocean, and the inshore cable corridors within the estuarine environment of Bellport Bay and tributary wetlands. Habitat types are listed and quantified in Table 3-4 and described in the sections that follow. Habitat Areas of Particular Concern (HAPC) are also included in Table 3-4.

Table 3-4. Habitat Areas by Project Component

Habitat Types	Project Component Area					
	Lease Area (SRWF)	Offshore / Onshore Export Cable: Export Cable Route (SRWEC – OCS)	Offshore / Onshore Export Cable: Export Cable Route (SRWEC – NYS)	Offshore / Onshore Export Cable: Landing Area	ICW-HDD	Offshore / Onshore Export Cable: Interior Coastal
Rocky (total area that is 5 percent or greater of all: granule-pebble, cobble, boulder, ledge/bedrock)	24,913 acres	368 acres	1,526 acres	Not present	9.34 acres	Not present
Soft bottom mud (intertidal, shallow-water, and deep)	149 acres	3,321 acres	1 acre	Not present	Not present	Not present
Soft bottom sand (with and without sand ripple, shoals, waves/ridges)	35,283 acres	30,548 acres	1,976 acres	Present	122 acres	Not present
Submerged Aquatic Vegetation (SAV)	Not present	Not present	Not present	Grass beds not present; 2 rooted, 4 unrooted plants found (Schott 2022)	1.69 acres with SAV; 14.3 acres with 'Potential SAV'	Not present
Tidal Marsh (e.g., saltmarsh and brackish marsh)	Not present	Not present	Not present	Not present	Not present	5 acres
Shellfish reefs and beds (e.g., hard clams, Atlantic surfclam, mussels, oysters)	Not present	Not present	Not present	Not present	Not present	Not present
Shell accumulations	Not present	Not present	Not present	Not present	Not present	Not present
Other biogenic (e.g., cerianthids, corals, emergent tubes – polychaetes)	5 SPI/PV stations with non-reef building hard coral; 52 percent of SPI/PV stations had cerianthids	19 percent of SPI/PV stations had cerianthids	26 percent of SPI/PV stations had cerianthids	Not present	Bryozoa and serpulid tubes present	Not present
Pelagic (offshore and estuarine)	60,207 acres	35,396 acres	2,346 acres	173 acres	132 acres	Not Present
Habitat for sensitive life stages (i.e., demersal eggs, spawning activity-discrete areas) –	Complex hard bottom (large gravel, i.e., boulders and cobbles) – 25,114 acres	Complex hard bottom (large gravel, i.e., boulders and cobbles) – 1,526 acres	Complex hard bottom (large gravel, i.e., boulders and cobbles) – 447 acres	Complex hard bottom (large gravel, i.e., boulders and cobbles)	SAV (1.69 acres with SAV; 14.3 acres with 'Potential SAV'), tidal marsh	Tidal marsh - (5 acres)

Habitat Types	Project Component Area					
	Lease Area (SRWF)	Offshore / Onshore Export Cable: Export Cable Route (SRWEC – OCS)	Offshore / Onshore Export Cable: Export Cable Route (SRWEC – NYS)	Offshore / Onshore Export Cable: Landing Area	ICW-HDD	Offshore / Onshore Export Cable: Interior Coastal
Habitat Areas of Particular Concern (HAPC) for summer flounder**	25,114 acres	1,526 acres	447 acres	Not present	14.3 acres	5 acres
Proposed HAPC for cod spawning***	25,114 acres	1,526 acres	447 acres	Not present	14.3 acres	5 acres

* Estimated based on distance from mean high tide out to extent of delineated benthic habitat.

** Potential HAPC based on NOAA EFH Mapper includes entire Project area

***Proposed HAPC includes entire Project area.

3.3.1 Rocky Habitat

Rocky habitat types are limited on the Northwest Atlantic OCS compared to sandy and soft bottom habitats (CoastalVision and Germano and Associates 2010, Greene et al. 2010). These habitats account for approximately 26,517 acres (27 percent) of the total 98,220 acres in the survey area, second only to soft bottom sand and include coarse sediments, glacial drift, and mixed sediments. These habitats are commonly referred to as “live bottom” when encrusted by attached epifauna, typically communities of bryozoa, hydroids, tunicates, and sponges in this region. In the Project area, *Tubularia* hydroids were common at hard bottom stations. Stations with coarser sediments and gravel (boulders and cobble) tended to have more diverse epifaunal assemblages including bryozoa, sponges, barnacles, and mobile crustaceans.

These rocky habitats are structurally complex habitats and considered potentially valuable and sensitive for regionally important taxa including targeted species, such as Atlantic cod, longfin squid, and American lobster (Scott 1982; Gotceitas and Brown 1993). The structure provided by the cobbles and boulders in these habitats can serve as nursery habitat for juvenile lobster, feeding ground for fish such as cod and black sea bass, and substrate upon which squid (including longfin squid, *Doryteuthis (Amerigo) pealeii*) lay their egg “mops” (Griswold and Prezioso 1981; Roper et al. 1984). The presence of boulders in mixed bottom types is also considered important for understanding the distribution of lobsters (*Homarus americanus*) and Jonah crab (*Cancer borealis*) in the vicinity of the SRWF (Collie and King 2016). Both lobster and squid have highly specific habitat requirements and are also economically important species in New England. For these reasons, federal and state agencies consider evidence of these taxa to indicate the presence of potentially sensitive habitats (BOEM 2019).

Both juvenile and adult cod use hard bottom habitats, with juveniles preferring cobble substrates, and adults preferring structurally complex hard bottom habitats composed of gravel, cobble, and boulder substrates (Lough 2004). Cobble habitats are essential for the survival of juvenile cod in that they may assist with avoiding predation by older year classes (Gotceitas and Brown 1993) and recent studies suggest that rocky, hard bottom habitats may be important for reproduction (DeCelles et al. 2017).

The SRWF and SRWEC–OCS are located immediately south of submerged end moraines, in what was an extensive glacial outwash plain. These habitats were limited to about 1.1 percent in the SRWF and were not observed for any of the other Project component areas studied. The glacial drift is made up of

stratified deposits of glacial sediments that have been re-worked and sorted by the movement of water. Glacial drift provides a similar benthic habitat for invertebrates and demersal fish as do unconsolidated glacial moraine habitats found to the north of the SRWF. This habitat type ranged from gravelly sand to gravel, with numerous individual boulders noted in each type. Habitats also ranged from sand and mud to more continuous cover of gravel with boulders and the percent cover of attached fauna was mostly dense (70-90 percent) and a range of sessile and mobile epifauna were observed, including the sensitive taxa of the northern star coral.

Mixed sediment – small gravel and sand habitats were observed only along the OCS portion of the export cable and limited to approximately 301 acres (0.85 percent). Ripples and trawl marks were prevalent in this habitat type. At the single ground-verified station, the CMECS subgroup was gravelly sand, the CMECS biotic subclass was soft sediment fauna, and bryozoans and sand dollars were observed.

Coarse sediment habitat types are sands with 5 to 8 percent gravel surface composition. These habitats occur where the seafloor is subjected to small, frequent currents and storm events and are common on the OCS. The mobile modifier indicates ripples, which were present throughout most of the habitat. Trawl marks were observed in 35 – 50 percent of the habitat in the SRWF and SRWEC–OCS that did not intersect with boulder fields. Coarse sediment – mobile habitats made up a total of 38 percent of the mapped area at the SRWF and 15 percent of the SRWEC–NYS. Coarse sediment habitat types accounted for 41 percent of the mapped SRWF, approximately 16 percent of the habitats in the SRWEC–NYS, and approximately 3 and 7 percent in the SRWEC–OCS and ICW-HDD areas, respectively.

Ground verification stations included a range of sandy and gravelly sediments with variable cover of gravel (as expected per definition, see Section 2.2) that supported a variety of sessile and mobile epifauna, including cerianthids (burrowing anemones). The predominant percent cover of attached fauna ranged from none in coarse sediment and coarse sediment – mobile habitats to sparse (1 to <30 percent) in coarse sediment with boulder fields. Ground verification stations were characterized by the CMECS substrate subgroups very fine sand, fine sand and medium sand in New York state waters and coarse sand and very coarse sand and a mix of CMECS biotic subclasses soft sediment fauna and inferred fauna in the SRWEC–OCS.

3.3.2 Soft Bottom Mud (Mud and Sandy Mud) Habitats

The mud and sandy mud habitat types consist of relatively featureless mud and sand, except where described by modifiers for boulder fields and mobility. Mud and sandy mud habitat types had a small presence in the SRWEC–NYS and even less so in the SRWF. The CMECS biotic subclasses of soft sediment fauna and inferred fauna (epifaunal tracks and trails) were the predominant biotic subclass within the sand and muddy sand habitats. Sessile and mobile epifauna generally included amphipods, corymorpha and *Tubularia* hydroids, and mobile crustaceans and mollusks.

3.3.3 Soft Bottom Mud and Sand

Soft bottom habitats, consisting of sand and mud with less than 5 percent gravel, are the primary habitat found in the Project area and combined, account for 71,702 acres (73 percent) of the total acres included in the benthic survey. Separately, soft bottom sand accounts for 67,929 acres (69 percent) of

the survey area. Local hydrodynamic conditions largely determine sediment types in the survey area, with finer materials in low-current areas and coarser materials in high-current areas.

Soft bottom habitats in the Northwest Atlantic OCS are generally inhabited by deep burrowing polychaetes, tube-building amphipods and polychaetes, and epifaunal species such as sand, shrimp, and sand dollars (Guida et al. 2017; NYSERDA 2017; Stokesbury 2012, 2014; Deepwater Wind South Fork, LLC 2019; DWW Rev I, LLC 2020). During the site-specific SPI/PV survey, sand dollars were observed with high frequency, particularly in regions where mobile sand was documented, consistent with results from NYSERDA (2017). The region experiences strong 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. Benthic organisms are commonly characterized by size (e.g., megafauna, macrofauna, or meiofauna). In soft-bottom habitats, these organisms are also characterized by whether they live on (epifauna) or within (infauna) the substrate (Rutecki et al. 2014). Soft sediment fauna common to the Project area included mobile epifauna including hermit crabs, sand dollars, shrimp, and sea stars as well as sessile infauna including burrowing anemones (cerianthids), tube-building worms (*Diopatra* sp.), and deep burrowing worms.

3.3.4 Soft Bottom Sand (Sand and Muddy Sand) Habitats

The sand and muddy sand habitat type consists of sand that has been subjected to a wide range of oceanic processes and are common on the OCS and were widespread throughout the entire Project area. These habitats are subjected to small but frequent currents and storm events and ripples and/or mega-ripples, linear depressions, and trawl marks and were common in offshore waters. Sand and muddy sand habitats made up most of the area mapped at the SRWF (with smaller portions of sand and muddy sand and a minor component of sand and muddy sand—mobile and with boulder fields), the majority of the SRWEC—OCS, the greatest proportion of the SRWEC—NYS (followed by sand and muddy sand – mobile, and a minor component with boulder fields), and most of the ICW-HDD study area (with smaller proportions of sand and muddy sand with historical and/or recent SAV and/or benthic macroalgae). The sediments within these habitats were generally composed of very fine, fine and medium sands, with fewer ground-truth stations classified as coarse sand and as silty/clay with no gravel present. The CMECS Biotic subclass of soft sediment fauna was the predominant biotic subclass within sand and muddy sand habitats, with inferred fauna (epifaunal tracks and trails) and attached fauna present. Sessile and mobile epifauna were generally composed of amphipods, sand dollars, and mobile crustaceans and mollusks and common infauna observed included cerianthids (burrowing anemones) and, close to shore, decorator worms *Diopatra* spp.

3.3.5 Submerged Aquatic Vegetation

Sand and muddy sand habitats with potential (historical) or recently confirmed (2020) presence of SAV and/or benthic macroalgae were mapped within the area of the temporary landing structure for the ICW-HDD component of the Project area (Figure 3-17). Areas of seagrass and other coastal habitats are mapped in Figure 3-20. Eelgrass (*Zostera marina*) was generally observed as single strands or groups of strands, often among thick patches of benthic macroalgae. Dense macroalgal beds were observed across numerous transects mainly along the northern side of the channel. In 2018, SAV beds were documented

in waters adjacent to the proposed temporary landing site at Smith Point County Park (NYDOS 2020a and 2020b) (Figure 3-17). The individual SAV shoots that were observed occurred on the north side of the channel in dense macroalgal beds. For the purposes of summary and EFH crosswalk, these are considered collectively as “vegetated habitats.”

An additional SAV survey was conducted in the area of the temporary landing at Smith Point County Park by Cornell Cooperative Extension (CCE) of Suffolk County on October 12, 2022. SAV surveys were made using underwater video and a GPS-enabled Seaviewer drop camera along pre-established east-west and north-south transect lines covering the proposed temporary landing site (Figure 3-15).

No SAV-forming patches or meadows were observed during the survey. However, eelgrass (*Zostera marina*) was identified at six different locations in the north-eastern area of the proposed temporary landing site (Figure 3-18 and Figure 3-19). Four of the SAV observations (NS6-1, NS6-2, EW6-1, and EW7-1) were single eelgrass shoots emerging from a dense mat of algae and a determination of whether these plants were rooted or uprooted. Based on extensive experience with eelgrass restoration and monitoring, CCE scientists considered these plants as uprooted shoots that had drifted into the area from an eelgrass meadow in Narrow Bay and subsequently became entangled in the algal mat. The remaining two SAV observations, NS6-3 and EW7-2, were multiple shoots of eelgrass (less than six shoots per site) that also emerged from an algal mat on the sediment surface, but, compared to the single eelgrass plants observed, appeared more likely to be rooted. Due to the small number of shoots observed at both locations, these plants are not part of a larger eelgrass patch at the site, but rather they likely arose from seed that had been deposited by drifting eelgrass flower shoots. CCE staff has observed similar, isolated eelgrass growth at significant distances from existing eelgrass meadows that were generated by drifting/rafting eelgrass flower shoots.

Results from the video transects indicate no significant populations of eelgrass in the proposed temporary landing site at Smith Point County Park. Most (four of six observations) of the observed eelgrass occurred as single, unrooted shoots that were likely the result of drifting/rafted eelgrass flower shoots.

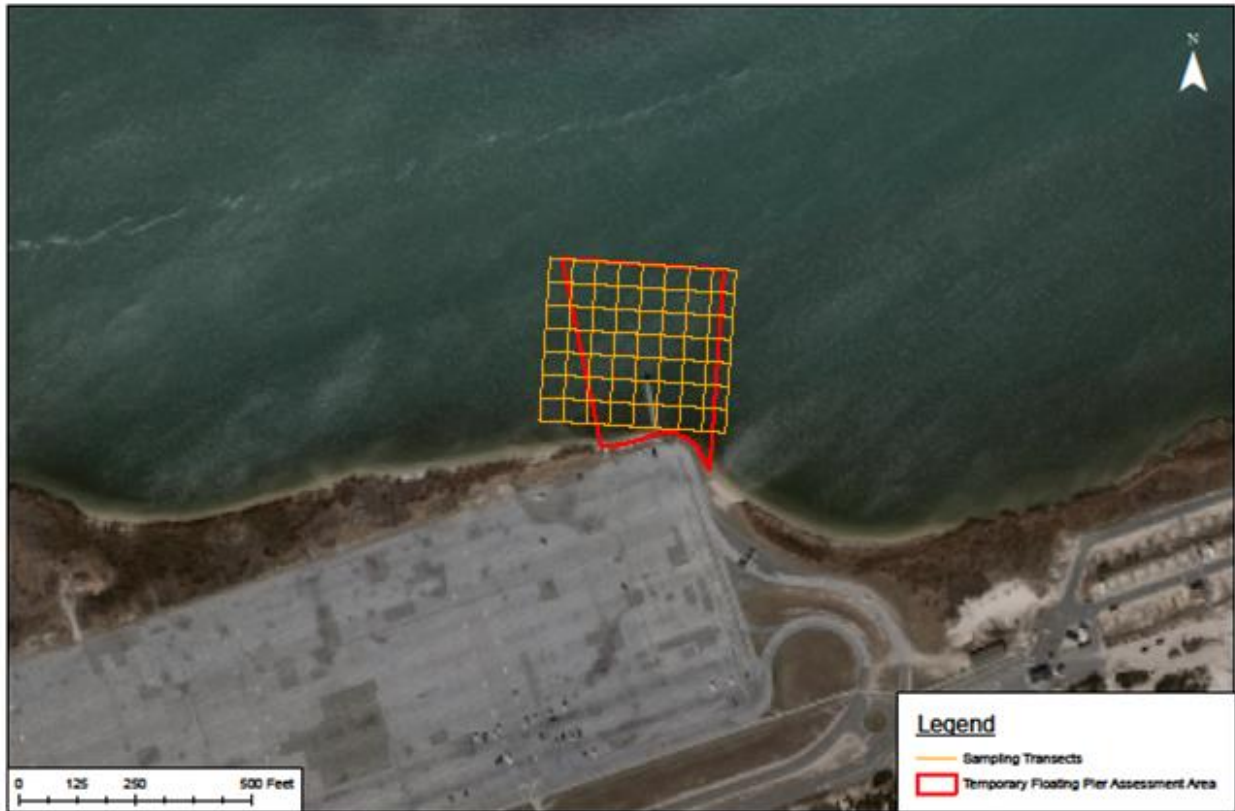


Figure 3-17. Sampling grid used for Sunrise Wind SAV survey of the proposed temporary landing structure and vicinity. Transects run east-west and north-south and are spaced approximately 50 feet apart.

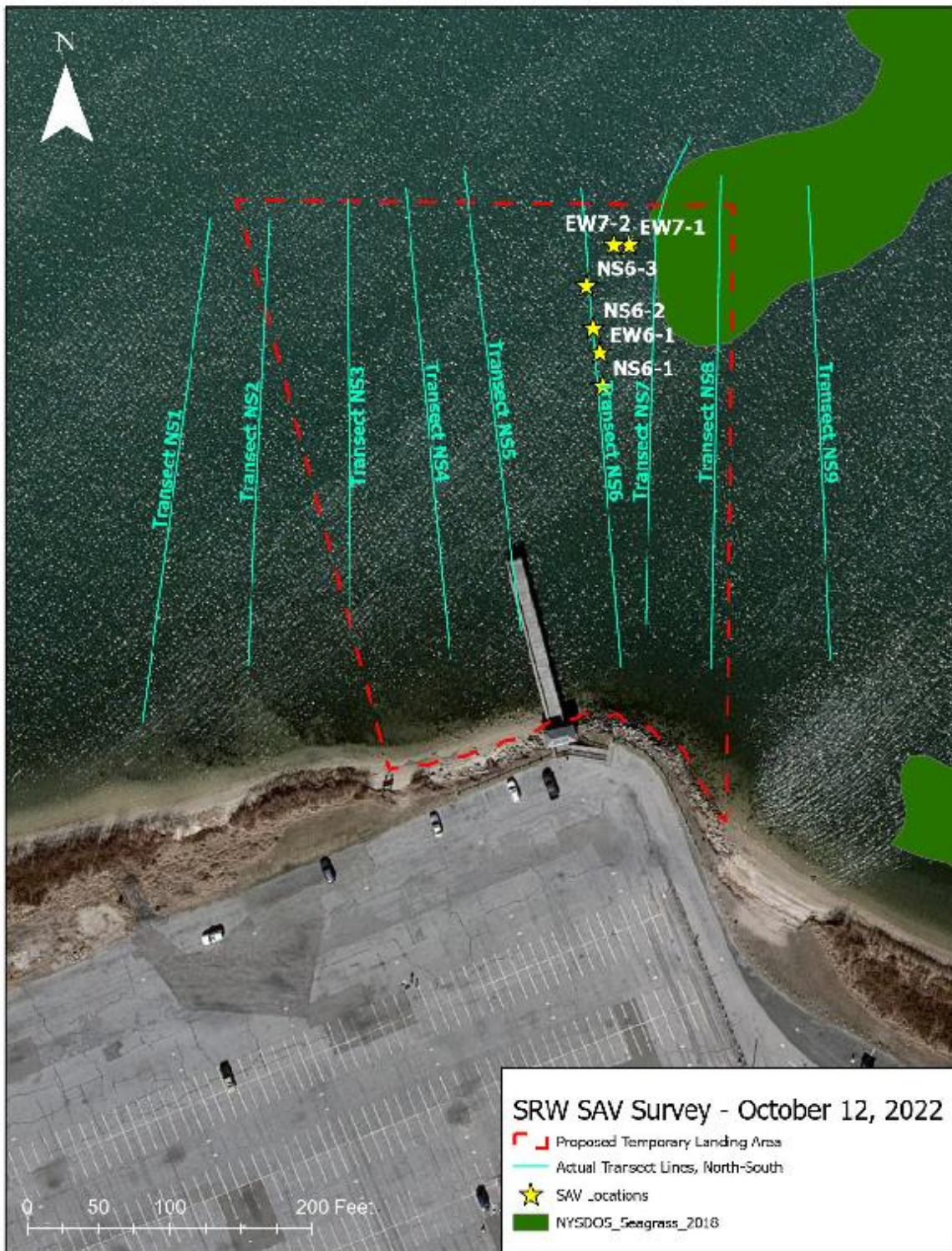


Figure 3-18. The paths of the North-South video transects that were completed on October 12, 2022 for the SRW SAV Survey at Smith Point County Park.

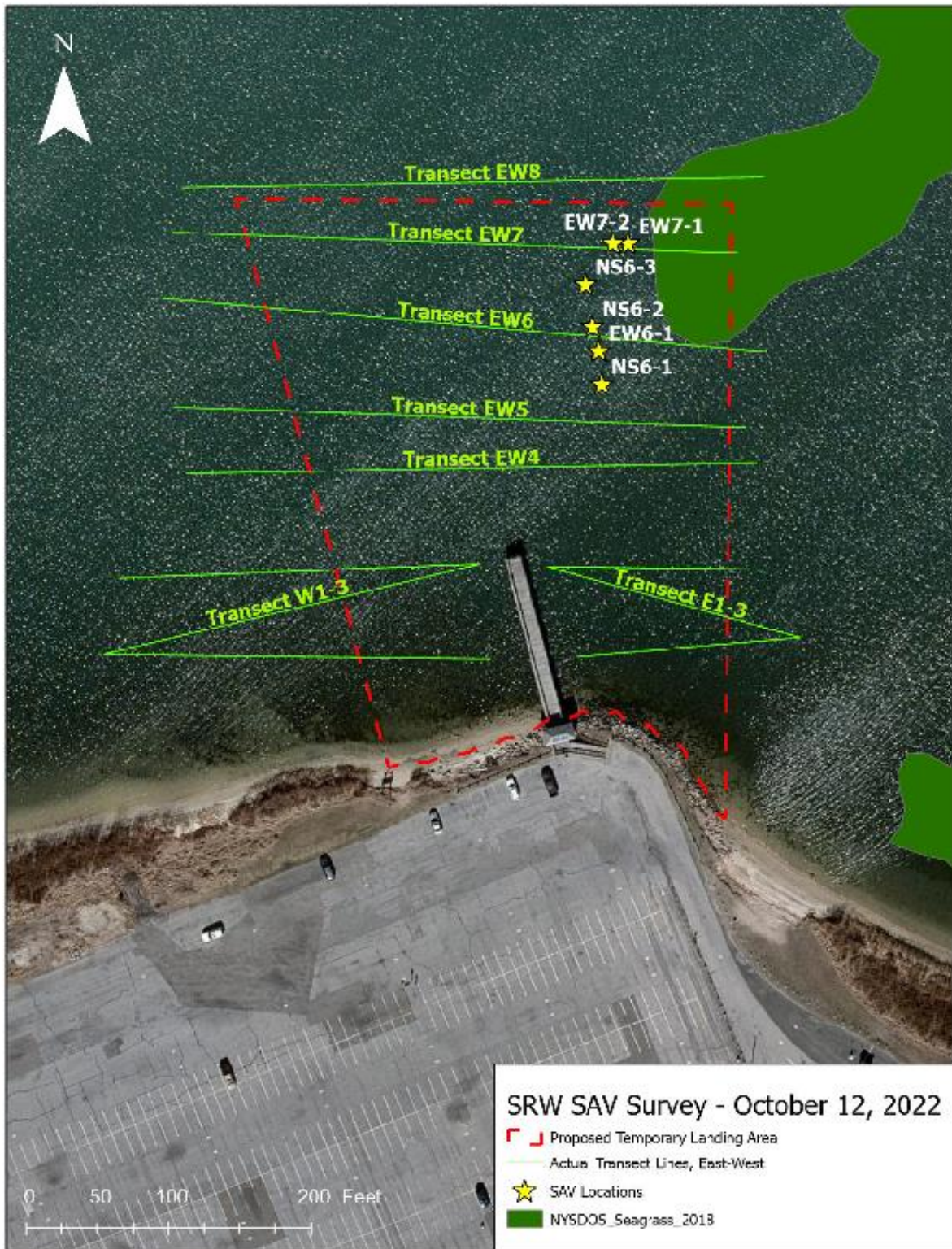


Figure 3-19. Paths of the East-West video transects that were completed on October 12, 2022 for the Sunrise Wind SAV Survey at Smith Point County Park.

3.3.6 Tidal Marsh (e.g., Saltmarsh and Brackish Marsh)

Marsh, mapped as emergent wetland, is present throughout the low tidal energy areas of South and Moriches Bays along the ICW, including in the Project area (Figure 3-20). Tidal marshes may be salt, brackish, or freshwater and are periodically to continuously inundated by salt water from tides. These marshes are characterized by emergent herbaceous vegetation (e.g., grasses, sedges, and rushes) tolerant of both salinity and saturated soil conditions. Because of their high productivity, tidal marshes provide critical spawning and nursery habitat, as well as refuge, for many different fish species. These species, in turn, are important prey for valuable commercial and recreational fish species such as striped bass, bluefish, and winter flounder. Fish species found in the tidal creeks include common mummichog (*Fundulus heteroclitus*), striped killifish (*Fundulus majalis*), sheepshead minnow (*Cyprinodon variegatus*), American eel (*Anguilla rostrata*), Atlantic silverside (*Menidia menidia*), and young-of-the-year winter flounder. Marshes provide important foraging habitat for a variety of fish species, in turn serving an important trophic link between the highly productive marsh and near shore estuarine waters.

Some species, such as summer flounder juveniles use several estuarine habitats as nursery areas, including salt marsh creeks, seagrass beds, and mudflats, as well as open bay areas. EFH for summer flounder juveniles has been identified in the SRWEC–OCS, SRWEC–NYS, and Onshore Transmission Cable (interior coastal component).

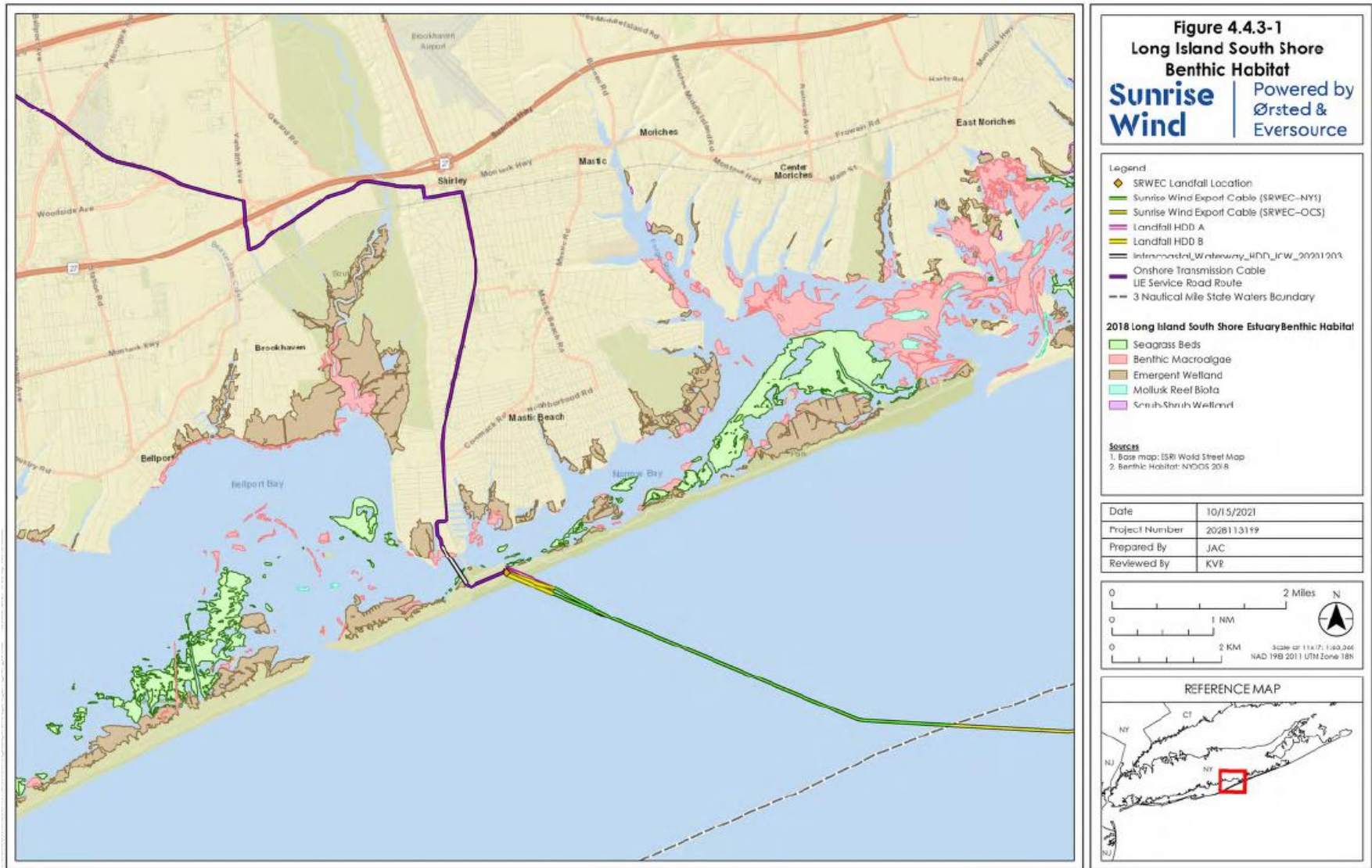


Figure 3-20. Seagrass, Macroalgae, Marsh (Emergent Wetland), Shellfish Reef, and Shrub/Scrub Habitats in the Vicinity of the SRWF Project Components (source: Appendix L of the COP, Sunrise Wind 2021)

3.3.7 Shellfish Reefs and Beds and Accumulations

No shellfish reefs or beds were observed in the Project area but were found in Belport Bay to the west of Smith Point Bridge (Figure 3-20). Soft bottom habitats, including those documented during the site-specific benthic surveys (e.g., sand and mud, sand with ripples, and sand with pebbles/granules) are suitable for the following ecologically and economically important shellfish species: Atlantic sea scallop (*Placopecten magellanicus*), Jonah crab (*Cancer borealis*), Atlantic rock crab (*Cancer irroratus*), channeled whelk (*Busycotypus canaliculatus*), ocean quahog clam (*Arctica islandica*), Atlantic surf clam (*Spisula solidissima*), and horseshoe crab (*Limulus polyphemus*).

Commercially harvested bivalves including sea scallops, ocean quahogs, and surf clams inhabit soft bottom habitats in the Northwest Atlantic OCS. Ocean quahogs are known to be distributed across the planned SRWEC–OCS and the SRWF, with their EFH overlapping with portions of the SRWF (NOAA Fisheries 2020a) and were reported within the SRWF during the Bay State Wind benthic assessments (Bay State Wind 2019). EFH for sea scallop overlaps with the planned SRWEC corridor as well as the western portion of the SRWF (NOAA Fisheries 2020b). Atlantic sea scallops occur along the continental shelf, typically at depths ranging from 59 to 360 ft (18 to 110 m) and are generally found in seabed areas with coarse substrates consisting of firm sand, gravel, shells, and rocks (Hart and Chute 2004).

EFH for Atlantic surf clam is present around the nearshore portions of the SRWEC corridor. Surf clams prefer sandy habitats along the continental shelf (Cargnelli et al. 1999), and are most abundant on Georges Bank, the south shore of Long Island, and along the coasts of New Jersey and the Delmarva Peninsula (NOAA Fisheries 2020c). Surf clams generally occur from the beach zone to a depth of about 200 ft (61 m), but abundance is low beyond about 125 ft (38 m). Surf clams can be found up to 3 ft (1 m) below the sediment water interface. The most recent data collected during the Atlantic Surfclam and Ocean Quahog Survey by the Northeast Fisheries Science Center (NEFSC) was in 2018 and found densities of ocean quahogs and Atlantic surf clams range from 0 to 0.375 per m² and 0 to 1.25 m², respectively (NEFSC 2021).

EFH for sea scallop overlaps with the planned SRWEC corridor as well as the western portion of the SRWF (NOAA Fisheries 2020b). Atlantic sea scallops occur along the continental shelf, typically at depths ranging from 59 to 360 ft (18 to 110 m) and are generally found in seabed areas with coarse substrates consisting of firm sand, gravel, shells, and rocks (Hart and Chute 2004). More detailed information on the distribution of these commercially fished bivalve species is provided in COP Appendix N, which describes the EFH associated with the Project.

Project-specific field survey and current public data sources related to benthic and shellfish resources, including state and federal agency-published papers and databases (e.g., LaFrance Bartley et al. 2018, NYSERDA 2017a, Poppe et al. 2014); online data portals and mapping databases (e.g., Northeast Ocean Data 2020, USGS 2020); environmental studies; published scientific literature relating to relevant benthic habitat distribution; and correspondence and consultation with federal and state agencies. A summary of the results from a site-specific benthic assessment survey in the SRWF and along the SRWEC is provided below. More detailed information concerning the results of site-specific benthic assessment surveys and additional details on benthic resources in OCS and NYS waters are presented in COP Appendices M1-M3. Habitat mapping integrates high resolution acoustic data from the site investigation surveys, the SPI/PV results, and results of a video survey that targeted possible complex bottom locations in the SRWF.

Benthic community structure within this region has been assessed by several studies including benthic characterization surveys associated with the development of nearby wind leases including Bay State

Wind (Bay State Wind 2019), Revolution Wind (DWW Rev I, LLC 2020), South Fork Wind Farm (Deepwater Wind South Fork, LLC 2019), in addition to other regional benthic assessments (Guida et al. 2017, Greene et al. 2010, Stokesbury 2012, 2014, NYSERDA 2017b). Most relevant to the RI-MA WEA are the CMECS Biotic Subclasses Attached Fauna and Soft Sediment Fauna, which are broad-scale categories for these seafloor habitats (COP Appendices M1 and M2).

Benthic invertebrates such as crustaceans, polychaetes, and bivalves serve as forage for EFH species South Bay. Although little information is available relating to the distribution and abundance of these species within Great South Bay, natural hard clam populations in Bellport Bay are evaluated biannually by the Town of Brookhaven; most recent data show densities range from 0 to 16 clams per m² within the Bay. More detailed information on shellfish distribution within Great South Bay is provided in COP Section 4.4.2.2 Benthic and Shellfish Resources.

Previous hard clam restoration efforts in Bellport Bay failed likely due to stressors including high nitrogen levels that fuel frequent brown tides (*Aureococcus anophagefferens*) in the area and are detrimental to hard clams (Bricelj et al. 2001). However, the recent breach (Hurricane Sandy in 2012) that created an inlet from the Atlantic Ocean into Bellport Bay may improve water quality and support bivalve production (Gobler et al. 2019). Natural hard clam populations in Bellport Bay are evaluated biannually by the Town of Brookhaven; most recent data show densities range from 0 to 16 clams per m² within the Bay (Figure 3-21).

In the 1970s, more than 50 percent of the hard clams eaten in the U.S. came from Great South Bay (Hinga 2005). However, oyster populations began declining in the 1930s and the hard clam population began declining in the 1980s. Declines in shellfish populations in Great South Bay have been attributed to overfishing and changes in water quality. Stony Brook University evaluated water quality in Great South Bay, including Bellport Bay, in 2021, and identified a brown tide (caused by *Aureococcus*) outbreak in Bellport Bay, in the vicinity of the ICW-HDD crossing at Smith Point but no impairment to the west of the crossing. Other impairments identified in this report include blooms of *Alexandrium*, an alga that causes paralytic shellfish poisoning, rust tides caused by the alga *Cochlodinium*, toxic blue-green algal blooms commonly caused by *Microcystis*, and unusually heavy growth of the green seaweed *Ulva*. The 2021 Long Island algal blooms and low oxygen zones are mapped in Figure 3-22 (Stony Brook University 2021).

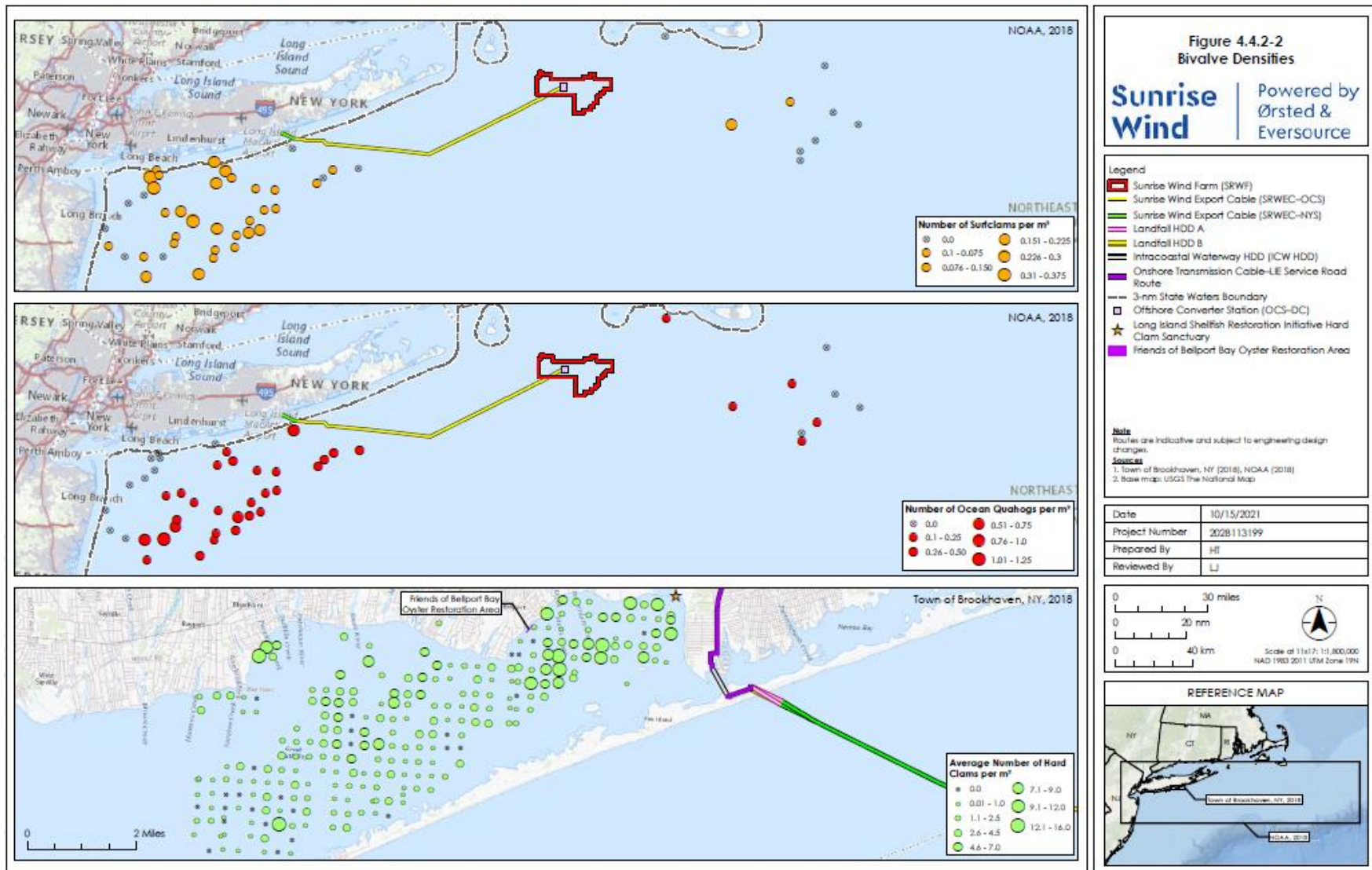


Figure 3-21. Densities of Bivalves in the Vicinity of the SRWF Project Components

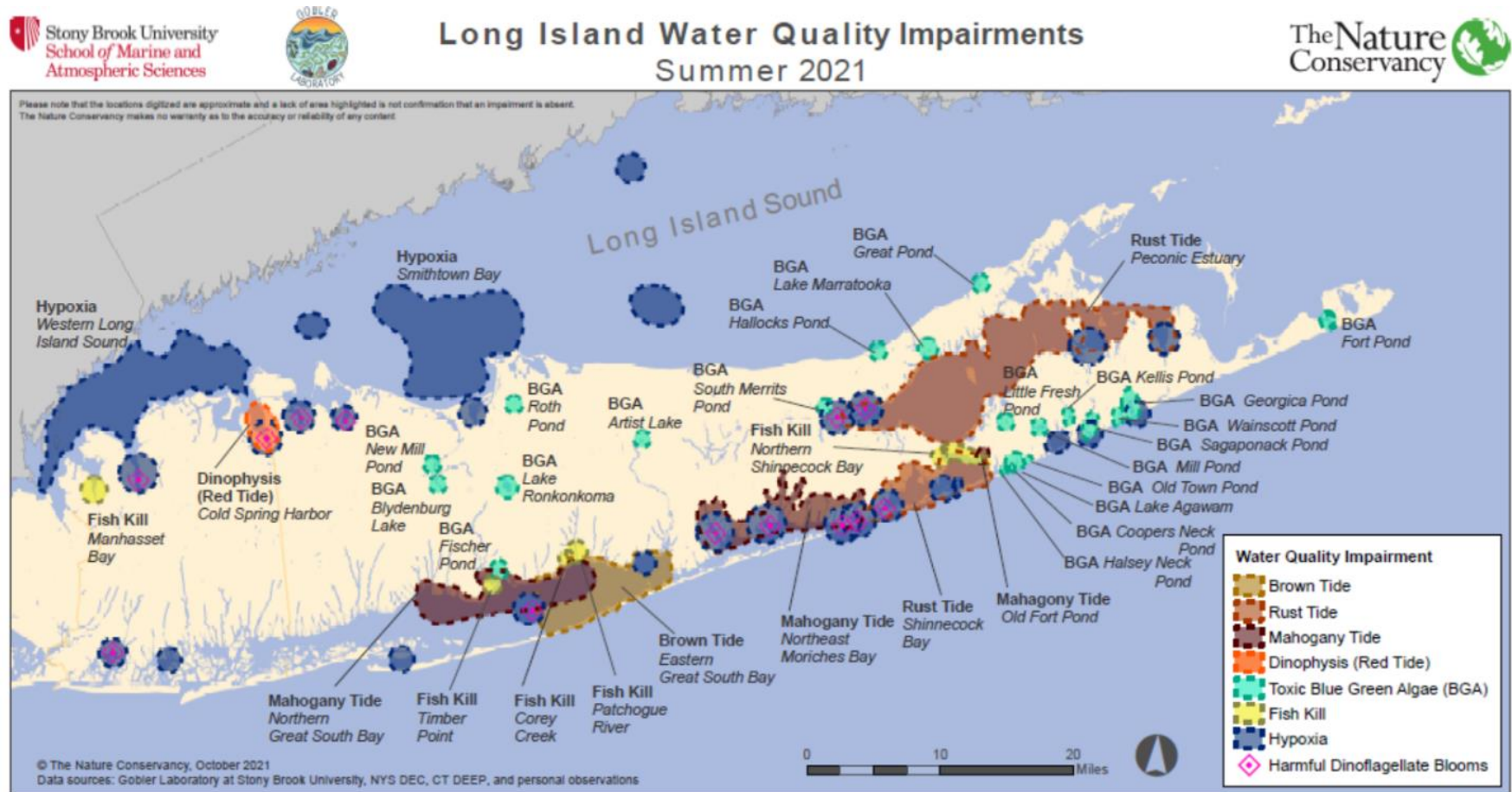


Figure 3-22. Water Quality Impairments Across Long Island During Summer 2021

EFH for ecologically and economically important shellfish (bivalves) species are also present in Project components SRWF, SREC-OCS and SREC-NYS. Soft bottom habitats (e.g., mud and sand with and without ripples, sand with and without ripples, and sand with mobile gravel) are suitable for the shellfish species Atlantic sea scallop (*Plactopecten magellanicus*), ocean quahog (*Artica islandica*), and surf clam (*Spisula solidissima*) (COP Appendix N). Shellfish beds also provide habitat various life stages of finfish species such as juvenile black sea bass, which are usually found in association with rough bottom, shellfish and eelgrass beds, and man-made structures in sandy-shelly areas; offshore clam beds and shell patches may also be used for over-wintering.

Ocean quahogs are present across the SRWEC-OCS and the SRWF. Ocean quahogs are considered a species of concern regarding possible habitat disturbance from offshore wind construction and operation activities in this region (Guida et al. 2017) and are managed shellfish species (NOAA Fisheries 2020a). Although difficult to detect using SPI/PV, the presence of ocean quahogs in the survey area was inferred based on the frequent presence of empty quahog shells on sandy and muddy sediment surfaces as well as large siphons detected in PV images, indicating live buried quahog.

Sea scallops were observed at 13 stations at the SRWF and 6 stations along the eastern portion of the SRWEC-OCS and EFH for this species is present in the SRWF Project component (NOAA Fisheries 2020b). Atlantic sea scallops typically occur along the continental shelf and are found from mean low water to depths of 656 ft (200 m) on sand, gravel, shells, and other rocky habitat. Scallop larvae settle on gravel and rocky substrate. This species has designated EFH in the SRWF and along the SRWEC-OCS and SRWEC-NYS. During the site-specific SPI/PV survey, sea scallops were observed at 13 stations at the SRWF and 6 stations along the eastern portion of the SRWEC-OCS.

Atlantic surf clams were not found during site-specific SPI/PV survey, although whole clam valves were observed on the sediment surfaces at some stations. EFH is designated for this species in in the nearshore portions of the SRWEC-NYS. Surf clams prefer sandy habitats along the continental shelf (Cargnelli et al. 1999a) and are abundant on Georges Bank and the south shore of Long Island (NOAA Fisheries 2020c). Surf clams generally occur from the beach zone to a depth of about 200 ft (656 m), but beyond about 125 ft (52 m) abundance is low. The surf clam prefers depths from 26 to 216 ft (8 to 66 m) in medium-grained sand but may also occur in finer-grained sediments. Burrows to 3 ft (0.9 m) below the sediment-water interface. This species also has designated EFH along the SRWEC-OCS route. Although no live surf clams were observed during the site-specific SPI/PV survey, whole clam valves were observed on the sediment surfaces at some stations.

3.3.8 Other Biogenic Habitats

Marine biogenic habitats are habitats created by living organisms such as corals, seagrass beds, burrowing anemones, and polychaetes, and provide fish habitat as well as other essential ecosystem functions and services, such as physical structuring, nutrient cycling, biodiversity support, and increases in primary, secondary, and tertiary production. For example, the biogenic structure created by seagrass beds is important to the physical, chemical and biological processes of shallow coastal and estuarine waters. The three-dimensional structure modifies water flow and reduces wave turbulence and storm surge. The root systems of established seagrass meadows also serve to stabilize bay sediments and reduce erosion. The grass beds serve as spawning and feeding habitat as well as refuge for fisheries and benthic habitat. Within the estuarine environment of the ICW-HDD, the presence of continuous or patchy SAV are considered sensitive and ecologically important benthic habitat. Soft Sediment Fauna in this environment includes mobile epifauna such as hermit crabs, sand dollars, shrimp, and sea stars as

well as sessile infauna including burrowing anemones and tube-building worms (*Diopters* sp.), and deep burrowing worms.

The spatial distribution of sand dollars and burrowing anemones, two commonly observed species, closely tracked the patterns observed in macrohabitat types and CMECS Substrate Subgroups. Stations predominately composed of CMECS Substrate Subgroup Medium Sand and macrohabitat type sand with ripples or sand and mud with ripples, were characterized by high densities of sand dollars, while high densities of burrowing anemones were found in the macrohabitat type sand and mud.

3.3.9 Pelagic (Offshore and Estuarine) Habitat

Localized changes in pelagic habitat, such as increased vertical mixing of the water column and subsequent declines in seasonal stratification and shelf-wide changes of tidal amplitudes, demonstrate that pelagic habitats are subject to change. Recent evidence indicates vertical mixing of the water column in offshore wind farms can also lead to a doming of the thermocline, resulting in nutrient transport to the surface mixed layer, rapid nutrient uptake, and primary production in the entire water column as well as changes in copepod dominated plankton communities (Floeter et al. 2017), without showing any effects on the distribution of pelagic fish.

Pelagic waters in the Project area are characterized by large temperature fluctuations and summer stratification, with depths up to 79 meters recorded in offshore waters during SPI/PV sampling. The general pattern in the annual temperature cycle indicates seasonal fluctuations of as much as 20°C at the surface and 12°C at the bottom, with thermal stratification beginning in April and increasing into August, when maximum surface to bottom gradients can reach up to 10°C. Vertical turnover occurs in September or October, at which time maximum bottom temperatures occur. This is followed by a drop in temperatures of up to 12°C throughout the water column by the next January. Actual surface and bottom temperatures vary substantially from year to year, particularly during the fall, as does the date of that turnover event. Surface to bottom temperature gradients were invariably negative (warmer at the surface, cooler at the bottom) and often large in spring and summer (stratified condition), but usually nonexistent to positive and small following the fall turnover and during the winter (isothermal or nearly so). Large changes in temperature have important physiological and behavior consequences, e.g., inducing migrations, in addition to influencing seawater density and water column structure, in fact, this temperature pattern is likely the major driver for seasonal migrations and re-distribution of highly mobile demersal nekton and mobile epibenthos and perhaps the settlement of new demersal and benthic organisms of all types from the plankton. No persistent hydrographic fronts appear to be present in the Project area (Guida et al. 2017).

Median salinity measured in the RIMA WEA during the survey period, including all depths, was 32.297 grams/kilogram (g/kg), with a full range spanning 30.939 to 33.509 g/kg (n=3,570), despite strong seasonal changes in other parameters. These salinities are entirely within anticipated range of salinities and the magnitude of the fluctuation is unlikely to be a driver of organismal distributions.

3.3.9.1 Habitat for Sensitive Life Stages

Potentially sensitive seafloor habitats, such as corals, SAV beds, and ecologically valuable cobble and boulder habitat can provide important habitat for various fish and other marine species. Cobble and boulder habitat can serve as nursery ground for juvenile lobster and as preferred habitat for squid to deposit their eggs. Both lobster and squid are specific in their habitat requirements and are also

economically important species in New England. SAV beds are designated as HAPC for summer flounder in this region. For these reasons, federal and state agencies consider evidence of these taxa to indicate potentially sensitive habitats. Some habitats are sensitive to environmental changes and loss of habitat can affect various life stages of benthic invertebrates and fish.

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

In the SRWEC–NYS area, species of ecological concern and/or concern regarding possible habitat disturbance from offshore wind construction and operation activities include black sea bass, Atlantic cod, sea scallop, and ocean quahog (Guida et al. 2017). Within the estuarine environment of the ICW-HDD, the presence of seagrass beds, characterized by continuous or patchy seagrass (SAV), are considered sensitive and ecologically important benthic habitat. Northeastern marine, estuarine, and riverine habitat types were reported to be moderately to highly vulnerable to stressors resulting from climate change (Farr et al. 2021), thereby also affecting life stages that require these habitats. In general, rocky and mud bottom, intertidal, kelp, coral, and sponge habitats were considered the most vulnerable habitats to climate change in marine ecosystems (Farr et al. 2021). Similarly, estuarine habitats considered most vulnerable to climate change include intertidal mud and rocky bottom, shellfish, kelp, SAV, and native wetland habitats (Farr et al. 2021). Riverine habitats found to be most vulnerable to climate change include native wetland, sandy bottom, water column, and SAV habitats (Farr et al. 2021). Examples of habitat for sensitive life stages in the Project area include:

- Atlantic cod in the SRWF Project area are present as eggs, larvae, juveniles, and adults. They spawn near the seafloor in early winter and high salinity zones of bays, estuaries, and in pelagic habitats, while juveniles use eelgrass habitats. Newly designated HAPC for spawning Atlantic cod is described in Section 3.3.10, below, and includes the entire lease area.
- Winter flounder offshore spawning habitat potentially in the wind energy area (Siemann and Smolowitz 2017) deposit their eggs on sandy bottoms and algal mats at night, usually about 40 times every spawning season. EFH for winter flounder eggs includes mud, muddy sand, sand, gravel, macroalgae, and submerged aquatic vegetation. Bottom habitats are unsuitable if exposed to excessive sedimentation which can reduce hatching success. EFH for winter flounder eggs has been identified in the SRWEC–NYS and Onshore Transmission Cable corridor.
- Ocean pout eggs are demersal and are laid in gelatinous masses, generally in sheltered nests, holes, or rocky crevices within hard bottom habitats in the SRWF and along the transmission corridors.
- Black sea bass juveniles and adults have well documented associations with structured habitats, including natural and artificial reefs, shellfish beds, shell hash, vegetated bottom, cobble, gravel, and boulder habitats (Drohan et al. 2007). Both juveniles and adults have strong site fidelity (Able and Hales 1997, Briggs 1979) and may be vulnerable to disruptions to structured habitats.
- Tidal marshes and SAV provide important habitat for many fish for breeding, spawning, and/or predator avoidance. Eelgrass beds are important to various life stages of species such as pollock (*Pollachius* spp.), red hake (*Urophycis chuss*), white hake (*Urophycis tenuis*), and other species in the Project area.

3.3.10 Habitat Areas of Particular Concern

HAPCs are discrete subsets of EFH that provide important ecological functions or are especially vulnerable to degradation (50 C.F.R. Part 600). Summer flounder HAPC occurs within the Project area near the ICW-HDD. It also occurs in the vicinity of the Project area (several miles from the ICW-HDD in Bellport Bay) (Figure 3-20).

Although not approved yet by NOAA, the NEFMC approved a new HAPC designation on July 20, 2022, that would include the SRWF. The proposed Southern New England HAPC comprises all large-grained complex and complex benthic habitats used by Atlantic herring, Atlantic sea scallop, little skate, monkfish, ocean pout, red hake, silver hake, windowpane flounder, winter flounder, winter skate, and yellowtail flounder, wherever present within the area bounded by a 10-km (6.2-mile) buffer around the RI/MA and MA WEAs (Plante 2022), as shown in Figure 3-23. HAPCs are discussed further in Section 4.3.

NOAA Habitat Areas of Particular Concern

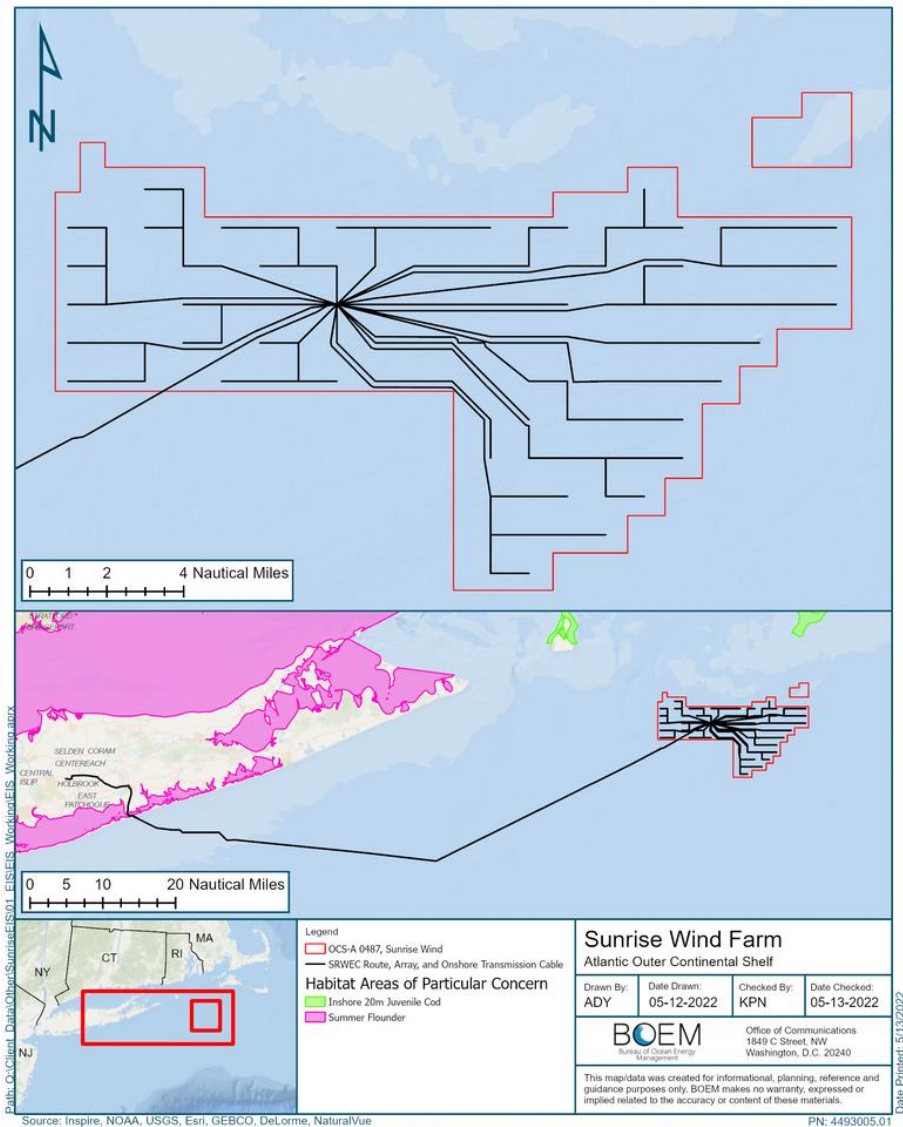


Figure 3-23. NOAA Habitat Areas of Particular Concern

A video survey was completed in October 2022 (Schott 2022) to document the presence and extent of SAV beds within 100 m of the ICW-HDD. There were six observations of SAV, and specifically eelgrass, all located on the north side of the channel. The density of the eelgrass was very low: a maximum of one to three shoots were observed within a single video frame. All eelgrass observations were within dense macroalgal beds and often the eelgrass shoots appeared to be uprooted and deposited within the macroalgal bed. SAV was not observed on the south side of the channel, despite an SAV bed being documented in this area previously (NYDOS 2020). Results from video transects completed in October 2012 confirmed the presence of some seagrass but did not indicate any significant populations of eelgrass in the proposed temporary landing site at Smith Point County Park. Most (four of six observations) of the observed eelgrass occurred as single, unrooted shoots that were likely the result of drifting/rafted eelgrass flower shoots. Further detail is provided in Section 3.3.5 Submerged Aquatic Vegetation.

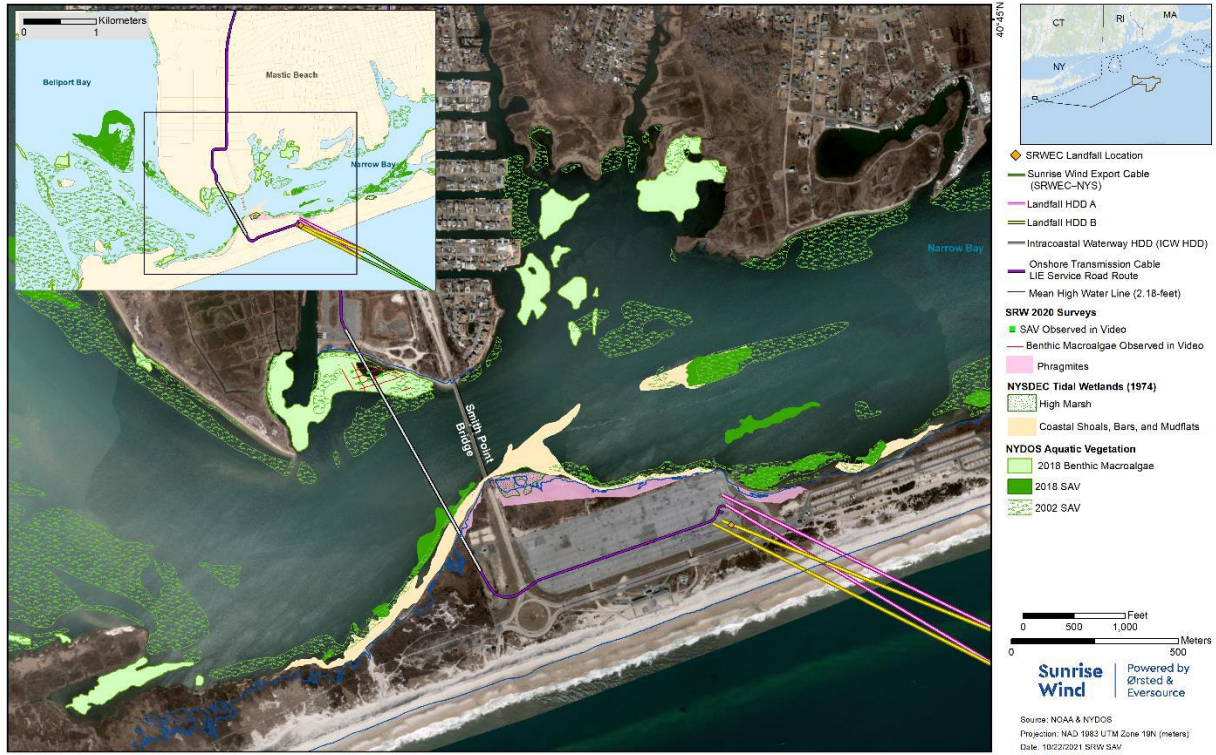


Figure 3-24. Tidal Wetlands and SAV Habitat in the SRWF Project Area

4.0 Designated Essential Fish Habitat

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

Within the SRWF area, 42 species of fish and invertebrates have designated EFH for various life stages (Table 4-1 **Error! Reference source not found.**). Within the 0.5-mi (800-m) corridor around the SRWEC centerline, 45 species of fish and invertebrates have designated EFH within the SRWEC–OCS, 32 species have designated EFH within the SRWEC–NYS, and 17 species have designated EFH within the Onshore Transmission Cable. EFH-designated species descriptions and their habitat designations presented in this assessment were drawn from the following sources:

- Species descriptions provided in COP, Appendix N (Sunrise 2022)
- 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)
- 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. 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 42 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, and Small-Mesh Multispecies FMP. MAFMC FMPs include Summer Flounder, Scup, Black Sea Bas FMP, Mackerel, Squid, and Butterfish FMP, Surfclams and Ocean Quahogs FMP, Bluefish FMP, and Monkfish FMP. NMFS FMPs include the Highly Migratory Species FMP. Designated EFH occurrence by taxonomic grouping, individual species, and life stage is summarized in Table 4-1 and Table 4-2.

Table 4-1. Designated EFH Based on Taxonomic Group, Species, and Life Stage Within the Sunrise Wind Project Area

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Gadids																	
Atlantic Cod <i>Gadus morhua</i>	X	X	X	-	X	X	X	-	X	X	-	-	X	X	X	-	<p>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)</p> <p>Eggs/Larvae: Pelagic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region, and in the high salinity zones of the bays and estuaries (NEFMC 2017).</p> <p>Juvenile: Intertidal and sub-tidal benthic habitats in the Gulf of Maine, southern New England, and on Georges Bank, to a maximum depth of 120 meters, including high salinity zones in the bays and estuaries listed in Table 19. Structurally-complex habitats, including eelgrass, mixed sand and gravel, and rocky habitats (gravel pavements, cobble, and boulder) with and without attached macroalgae and emergent epifauna, are essential habitats for juvenile cod. In inshore waters, young-of-the-year juveniles prefer gravel and cobble habitats and eelgrass beds after settlement, but in the absence of predators also utilize adjacent un-vegetated sandy habitats for feeding. Survival rates for young-of-the-year cod are higher in more structured rocky habitats than in flat sand or eelgrass; growth rates are higher in eelgrass. Older juveniles move into deeper water and are associated with gravel, cobble, and boulder habitats, particularly those with attached organisms. Gravel is a preferred substrate for young-of-the-year juveniles on Georges Bank and they have also been observed along the small boulders and cobble margins of rocky reefs in the Gulf of Maine (NEFMC 2017).</p> <p>Adults: Sub-tidal benthic habitats in the Gulf of Maine, south of Cape Cod, and on Georges Bank, between 30 and 160 meters, including high salinity zones in the bays and estuaries. Structurally complex hard bottom habitats composed of gravel, cobble, and boulder substrates with and without emergent epifauna and macroalgae are essential habitats for adult cod. Adult cod are also found on sandy substrates and frequent deeper slopes of ledges along shore. South of Cape Cod, spawning occurs in nearshore areas and on the continental shelf, usually in depths less than 70 meters (NEFMC 2017).</p>
Haddock <i>Melanogrammus aeglefinus</i>	-	-	-	-	X	X	X	-	X	X	-	-	-	X	-	-	<p>General habitat description: Haddock are a demersal gadoid species which are distributed from Greenland to Cape Hatteras, North Carolina along the western Atlantic (Cushing 1986). Haddock prefer gravel sand substrate which is abundant on Browns and Georges Banks (NOAA, 1999).</p> <p>Larvae: Pelagic habitats in coastal and offshore waters in the Gulf of Maine, the Mid-Atlantic, and on Georges Bank (NEFMC 2017).</p> <p>Juvenile / Adults: Sub-tidal benthic habitats between 40 and 140 meters in the Gulf of Maine, on Georges Bank and in the Mid-Atlantic region, and as shallow as 20 meters along the coast of Massachusetts, New Hampshire, and Maine. Essential fish habitat for adult haddock occurs on hard sand (particularly smooth patches between rocks), mixed sand and shell, gravelly sand, and gravel. Young-of-the-year juveniles settle on sand and gravel on Georges Bank but are found predominantly on gravel pavement areas within a few months after settlement. As they grow, they disperse over a greater variety of substrate types on the bank. Young-of-the-year haddock do not inhabit shallow, inshore habitats (NEFMC 2017).</p> <p>Sub-tidal benthic habitats between 50 and 160 meters in the Gulf of Maine, on Georges Bank, and in southern New England. Essential fish habitat for adult haddock occurs on hard sand (particularly smooth patches between rocks), mixed sand and shell, gravelly sand, and gravel substrates. They also are found adjacent to boulders and cobbles along the margins of rocky reefs in the Gulf of Maine (NEFMC 2017).</p>

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Pollock <i>Pollachius</i>	X	X	-	-	X	X	X	-	X	X	X	X	-	-	-	-	<p>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).</p> <p>Larvae: Pelagic inshore and offshore habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region, including the bays and estuaries (NEFMC 2017).</p> <p>Juvenile: Inshore and offshore pelagic and benthic habitats from the intertidal zone to 180 meters in the Gulf of Maine, in Long Island Sound, and Narragansett Bay, between 40 and 180 meters on western Georges Bank and the Great South Channel and in mixed and full salinity waters in a number of bays and estuaries north of Cape Cod. Essential fish habitat for juvenile pollock consists of rocky bottom habitats with attached macroalgae (rockweed and kelp) that provide refuge from predators. Shallow water eelgrass beds are also essential habitats for young-of-the-year pollock in the Gulf of Maine. Older juveniles move into deeper water into habitats also occupied by adults (NEFMC 2017).</p>
Offshore Hake <i>Merluccius albidus</i>	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	<p>General habitat description: Offshore hake are found on the continental shelf and slope of the Northwest Atlantic ocean. Additionally, they are found on the Florida slope community, and the edge of the Scotian Shelf (Markle et al. 1980).</p> <p>Larvae: Larvae are found in association with water temperatures ranging from 5-13 °C on the outer continental shelf. Most Offshore hake larvae were observed at depths of 70-130 m (NOAA, 1999).</p>
Red Hake <i>Urophycis chuss</i>	X	X	X	-	X	X	X	-	X	X	X	-	-	-	-	-	<p>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.</p> <p>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.</p> <p>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.</p>

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Silver Hake <i>Merluccius bilinearis</i>	X	X	X	-	X	X	X	-	X	X	-	-	-	X	-	-	<p>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).</p> <p>Eggs/Larvae: Pelagic habitats from the Gulf of Maine to Cape May, New Jersey, including Cape Cod and Massachusetts Bays (NEFMC 2017).</p> <p>Juveniles/ Adults: Pelagic and benthic habitats in the Gulf of Maine, including the coastal bays and estuaries and on the continental shelf as far south as Cape May, New Jersey, at depths greater than 10 meters in coastal waters in the Mid-Atlantic and between 40 and 400 meters in the Gulf of Maine, on Georges Bank, and in the middle continental shelf in the Mid Atlantic, on sandy substrates. Juvenile silver hake are found in association with sand-waves, flat sand with amphipod tubes, and shells, and in biogenic depressions. Juveniles in the New York Bight settle to the bottom at mid-shelf depths on muddy sand substrates and find refuge in amphipod tube mats (NEFMC 2017).</p> <p>Pelagic and benthic habitats at depths greater than 35 meters in the Gulf of Maine and the coastal bays and estuaries between 70 and 400 meters on Georges Bank and the outer continental shelf in the northern portion of the Mid-Atlantic Bight, and in some shallower locations nearer the coast, on sandy substrates. Adult silver hake are often found in bottom depressions or in association with sand waves and shell fragments. They have also been observed at high densities in mud habitats bordering deep boulder reefs, resting on boulder surfaces, and foraging over deep boulder reefs in the southwestern Gulf of Maine. This species makes greater use of the water column (for feeding, at night) than red or white hake (NEFMC 2017).</p>
White Hake <i>Urophycis tenuis</i>	-	-	-	-	-	-	-	-	X	X	X	-	-	X	-	-	<p>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).</p> <p>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).</p> <p>Juveniles/ Adults: Juveniles are found in association with sand waves, 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).</p>

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Flatfish																	
Summer Flounder <i>Paralichthys dentatus</i>	X	X	X	-	X	X	X	-	-	X	X	X	X	X	X	X	<p>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.</p> <p>Eggs: North of Cape Hatteras, EFH is the pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of the all the ranked ten-minute squares for the area where summer flounder eggs are collected in the MARMAP survey. South of Cape Hatteras, EFH is the waters over the continental shelf (from the coast out to the limits of the EEZ), from Cape Hatteras, North Carolina to Cape Canaveral, Florida, to depths of 360 ft. In general, summer flounder eggs are found between October and May, being most abundant between Cape Cod and Cape Hatteras, with the heaviest concentrations within 9 miles of shore off New Jersey and New York. Eggs are most commonly collected at depths of 30 to 360 ft (MAFMC 1998).</p> <p>Larvae: North of Cape Hatteras, EFH is the pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all the ranked ten-minute squares for the area where summer flounder larvae are collected in the MARMAP survey. South of Cape Hatteras, EFH is the nearshore waters of the continental shelf (from the coast out to the limits of the EEZ), from Cape Hatteras, North Carolina to Cape Canaveral Florida, in nearshore waters out to 50 miles from shore. Inshore, EFH is all the estuaries where summer flounder were identified as being present (rare, common, abundant, or highly abundant) in the ELMR database, in the "mixing" (defined in ELMR as 0.5 to 25.0 ppt) and "seawater" (defined in ELMR as greater than 25 ppt) salinity zones. In general, summer flounder larvae are most abundant nearshore (12-50 miles from shore) at depths between 30 to 230 ft. They are most frequently found in the northern part of the Mid-Atlantic Bight from September to February, and in the southern part from November to May (MAFMC 1998).</p> <p>Juveniles: North of Cape Hatteras, 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, in the highest 90 percent of all the ranked ten-minute squares for the area where juvenile summer flounder are collected in the NEFSC trawl survey. South of Cape Hatteras, EFH is the waters over the continental shelf (from the coast out to the limits of the EEZ) to depths of 500 ft, from Cape Hatteras, North Carolina to Cape Canaveral, Florida. Inshore, EFH is all of the estuaries where summer flounder were identified as being present (rare, common, abundant, or highly abundant) in the ELMR database for the "mixing" and "seawater" salinity zones. In general, juveniles use several estuarine habitats as nursery areas, including salt marsh creeks, seagrass beds, mudflats, and open bay areas in water temperatures greater than 37 °F and salinities from 10 to 30 ppt range (MAFMC 1998).</p> <p>Adults: North of Cape Hatteras, 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, in the highest 90 percent of all the ranked ten-minute squares for the area where adult summer flounder are collected in the NEFSC trawl survey. South of Cape Hatteras, EFH is the waters over the continental shelf (from the coast out to the limits of the EEZ) to depths of 500 ft, from Cape Hatteras, North Carolina to Cape Canaveral, Florida. Inshore, EFH is the estuaries where summer flounder were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Generally, summer flounder inhabit shallow coastal and estuarine waters during warmer months and move offshore on the outer continental shelf at depths of 500 ft in colder months (MAFMC 1998).</p>

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Windowpane Flounder <i>Scophthalmus aquosus</i>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	<p>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.</p> <p>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 (NEFMC 2017).</p> <p>Juveniles: Intertidal and sub-tidal benthic habitats in estuarine, coastal marine, and continental shelf waters from the Gulf of Maine to northern Florida, including mixed and high salinity zones in the bays and estuaries. Essential fish habitat for juvenile windowpane flounder is found on mud and sand substrates and extends from the intertidal zone to a maximum depth of 60 meters. Young-of-the-year juveniles prefer sand over mud (NEFMC 2017).</p> <p>Adults: Intertidal and sub-tidal benthic habitats in estuarine, coastal marine, and continental shelf waters from the Gulf of Maine to Cape Hatteras, including mixed and high salinity zones in the bays and estuaries. Essential fish habitat for adult windowpane flounder is found on mud and sand substrates and extends from the intertidal zone to a maximum depth of 70 meters (NEFMC 2017).</p>
Winter Flounder <i>Pseudopleuronectes americanus</i>	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	<p>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, gravelly, or boulder substrates (Pereira et al. 1999). Adult females spawn on sandy bottom in shallow habitats.</p> <p>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.</p> <p>Juveniles: Sub-tidal 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 90 meters, including the high salinity zones of the bays and estuaries. Essential fish habitat for juvenile winter skates occurs on sand and gravel substrates, but they are also found on mud. (NEFMC 2017).</p> <p>Adults: Sub-tidal 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 80 meters, including the high salinity zones of the bays and estuaries. Essential fish habitat for adult winter skates occurs on sand and gravel substrates, but they are also found on mud (NEFMC 2017).</p>

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Witch Flounder <i>Glyptocephalus cynoglossus</i>	X	X	X	-	X	X	X	-	-	X	-	-	X	X	X	-	<p>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.</p> <p>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.</p> <p>Juveniles: : Sub-tidal benthic habitats between 50 and 400 meters in the Gulf of Maine and as deep as 1500 meters on the outer continental shelf and slope, with mud and muddy sand substrates (NEFMC 2017).</p> <p>Adults: Sub-tidal benthic habitats between 35 and 400 meters in the Gulf of Maine and as deep as 1500 meters on the outer continental shelf and slope, with mud and muddy sand substrates (NEFMC 2017).</p>
Yellowtail Flounder <i>Limanda ferruginea</i>	X	X	X	-	X	X	X	-	X	X	-	-	X	X	X	-	<p>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.</p> <p>Eggs/Larvae: For these pelagic lifestages, EFH is sub-tidal 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) (NEFMC 2017).</p> <p>Juveniles: Sub-tidal 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 the bays and estuaries. Essential fish habitat for juvenile yellowtail flounder occurs on sand and muddy sand between 20 and 80 meters. In the Mid Atlantic, young-of-the-year juveniles settle to the bottom on the continental shelf, primarily at depths of 40-70 meters, on sandy substrates (NEFMC 2017).</p> <p>Adults: Sub-tidal 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 the bays and estuaries listed in Table 25. Essential fish habitat for adult yellowtail flounder occurs on sand and sand with mud, shell hash, gravel, and rocks at depths between 25 and 90 meters (NEFMC 2017).</p>
Other Finfish																	

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
American Plaice <i>Hippoglossoides platessoides</i>	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	<p>General habitat description: American Plaice is an arctic-boreal pleuronectid flatfish that is found in the Western Atlantic. They range from the outer coast of Labrador all the way south to Montauk Point, NY (Bigelow and Schroeder 1953; Smith et al. 1975).</p> <p>Larvae: American Plaice larvae are mostly found at temperatures ranging from 4-14 °C. Additionally, larvae were found at depths of 30-210 m, with most located between 50-90 m. (NOAA, 1999).</p>
Atlantic Herring <i>Clupea harengus</i>	X	-	-	-	X	X	X	-	X	X	X	X	X	X	X	X	<p>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.</p> <p>Eggs: Inshore and offshore benthic habitats in the Gulf of Maine and on Georges Bank and Nantucket Shoals in depths of 5 – 90 meters on coarse sand, pebbles, cobbles, and boulders and/or macroalgae at the locations shown in Map 98. Eggs adhere to the bottom, often in areas with strong bottom currents, forming egg “beds” that may be many layers deep (NEFMC 2017).</p> <p>Larvae: Inshore and offshore pelagic habitats in the Gulf of Maine, on Georges Bank, and in the upper Mid-Atlantic Bight, and in the bays and estuaries listed in Table 30. Atlantic herring have a very long larval stage, lasting 4-8 months, and are transported long distances to inshore and estuarine waters where they metamorphose into early stage juveniles (“brit”) in the spring (NEFMC 2017).</p> <p>Juveniles/Adults: Intertidal and sub-tidal pelagic habitats to 300 meters throughout the region, including the bays and estuaries. One and two-year old juveniles form large schools and make limited seasonal inshore-offshore migrations. Older juveniles are usually found in water temperatures of 3 to 15°C in the northern part of their range and as high as 22°C in the Mid-Atlantic. Young-of-the-year juveniles can tolerate low salinities, but older juveniles avoid brackish water (NEFMC 2017).</p>
Atlantic Wolffish <i>Anarhichas lupus</i>	X	-	-	-	X	-	-	-	X	-	-	-	X	-	-	-	<p>General habitat description: The Atlantic wolffish is found on both sides of the North Atlantic and infrequently in the Arctic. In the northwestern Atlantic, they range from Davis Strait, Canada, to Cape Hatteras, North Carolina (Fisheries and Oceans Canada 2018a). Adult Atlantic wolffish generally move inshore to spawn during the spring and summer, establishing nesting sites on boulders and in rocky crevices, which are guarded by the males until the eggs hatch in late summer and early fall (Fisheries and Oceans Canada 2018a).</p> <p>Eggs: Eggs are deposited in subtidal benthic habitats at depths less than 328 ft (100 m). Egg masses have been collected on the Scotian Shelf in depths of 328 to 426 ft (100 to 130 m), indicating that spawning is not restricted to coastal waters.</p> <p>Larvae: EFH includes pelagic and subtidal benthic habitats. Atlantic wolffish larvae remain near the bottom for up to six days after hatching, but gradually become more buoyant as the yolk sac is absorbed.</p> <p>Juveniles: EFH includes subtidal benthic habitats at depths of 230 to 604 ft (70 to 184 m) and Juvenile Atlantic wolffish do not have strong substrate preferences.</p> <p>Adults: Adult Atlantic wolffish have been observed spawning and guarding eggs in rocky habitats in less than 98 ft (30 m) of water in the Gulf of St. Lawrence and Newfoundland and in deeper (164 to 328 ft [50 to 100 m]) boulder reef habitats in the Gulf of Maine. Adults are distributed over a wider variety of sand and gravel substrates once they leave rocky spawning habitats, but are not caught over muddy bottom.</p>

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Monkfish <i>Lophius americanus</i>	X	X	-	-	X	X	X	-	X	X	X	-	X	X	X	-	<p>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).</p> <p>Eggs/Larvae: Pelagic habitats in inshore areas, and on the continental shelf and slope throughout the Northeast region. Monkfish eggs are shed in very large buoyant mucoidal egg "veils." Monkfish larvae are more abundant in the Mid-Atlantic region and occur over a wide depth range, from the surf zone to depths of 1000 to 1500 meters on the continental slope (NEFMC 2017).</p> <p>Juveniles: Sub-tidal benthic habitats in depths of 50 to 400 meters in the Mid-Atlantic, between 20 and 400 meters in the Gulf of Maine, and to a maximum depth of 1000 meters on the continental slope. A variety of habitats are essential for juvenile monkfish, including hard sand, pebbles, gravel, broken shells, and soft mud; they also seek shelter among rocks with attached algae. Juveniles collected on mud bottom next to rock-ledge and boulder fields in the western Gulf of Maine were in better condition than juveniles collected on isolated mud bottom, indicating that feeding conditions in these edge habitats are better. Young-of-the year juveniles have been collected primarily on the central portion of the shelf in the Mid Atlantic, but also in shallow nearshore waters off eastern Long Island, up the Hudson Canyon shelf valley, and around the perimeter of Georges Bank. They have also been collected as deep as 900 meters on the continental slope (NEFMC 2017).</p> <p>Adults: Sub-tidal benthic habitats in depths of 50 to 400 meters in southern New England and Georges Bank, between 20 and 400 meters in the Gulf of Maine, and to a maximum depth of 1000 meters on the continental slope, as shown on Map 84. Essential fish habitat for adult monkfish is composed of hard sand, pebbles, gravel, broken shells, and soft mud. They seem to prefer soft sediments (fine sand and mud) over sand and gravel, and, like juveniles, utilize the edges of rocky areas for feeding (NEFMC 2017).</p>
Atlantic Butterfish <i>Peprilus triacanthus</i>	X	X	X	-	X	X	X	-	X	X	-	-	X	X	X	-	<p>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.</p> <p>Eggs: EFH is pelagic habitats in inshore estuaries and embayments from Massachusetts Bay to the south shore of Long Island, New York, in Chesapeake Bay, and on the continental shelf and slope, primarily from Georges Bank to Cape Hatteras, North Carolina. EFH for Atlantic butterfish eggs is generally found over bottom depths of 1,500 meters or less where average temperatures in the upper 200 meters of the water column are 6.5-21.5°C (MAFMC 2011).</p> <p>Larvae: EFH is pelagic habitats in inshore estuaries and embayments in Boston harbor, from the south shore of Cape Cod to the Hudson River, and in Delaware and Chesapeake bays, and on the continental shelf from the Great South Channel (western Georges Bank) to Cape Hatteras, North Carolina. EFH for Atlantic butterfish larvae is generally found over bottom depths between 41 and 350 meters where average temperatures in the upper 200 meters of the water column are 8.5-21.5°C (MAFMC 2011).</p> <p>Juveniles: EFH is pelagic habitats in inshore estuaries and embayments from Massachusetts Bay to Pamlico Sound, North Carolina, in inshore waters of the Gulf of Maine and the South Atlantic Bight, and on the inner and outer continental shelf from southern New England to South Carolina. EFH for juvenile Atlantic butterfish is generally found over bottom depths between 10 and 280 meters where bottom water temperatures are between 6.5 and 27°C and salinities are above 5 ppt. Juvenile butterfish feed mainly on planktonic prey (MAFMC 2011).</p> <p>Adults: EFH is pelagic habitats in inshore estuaries and embayments from Massachusetts Bay to Pamlico</p>

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
																	Sound, North Carolina, inshore waters of the Gulf of Maine and the South Atlantic Bight, on Georges Bank, on the inner continental shelf south of Delaware Bay, and on the outer continental shelf from southern New England to South Carolina. EFH for adult Atlantic butterfish is generally found over bottom depths between 10 and 250 meters where bottom water temperatures are between 4.5 and 27.5°C and salinities are above 5 ppt. Spawning probably does not occur at temperatures below 15°C. Adult butterfish feed mainly on planktonic prey, including squids and fishes (MAFMC 2011).
Atlantic Mackerel <i>Scomber scombrus</i>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	<p>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 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).</p> <p>Eggs: EFH is pelagic habitats in inshore estuaries and embayments from Great Bay, New Hampshire to the south shore of Long Island, New York, inshore and offshore waters of the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina (mostly north of 38°N). EFH for Atlantic mackerel eggs is generally found over bottom depths of 100 meters or less with average water temperatures of 6.5-12.5°C in the upper 15 meters of the water column (MAFC 2011).</p> <p>Larvae: EFH is pelagic habitats in inshore estuaries and embayments from Great Bay, New Hampshire to the south shore of Long Island, New York, inshore waters of the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina (mostly north of 38°N). EFH for Atlantic mackerel larvae is generally found over bottom depths between 21 and 100 meters with average water temperatures of 5.5-11.5°C in the upper 200 meters of the water column (MAFC 2011).</p> <p>Juveniles: EFH is pelagic habitats in inshore estuaries and embayments from Passamaquoddy Bay and Penobscot Bay, Maine to the Hudson River, in the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina. EFH for juvenile Atlantic mackerel is generally found over bottom depths between 10 and 110 meters and in water temperatures of 5 to 20°C. Juvenile Atlantic mackerel feed primarily on small crustaceans, larval fish, and other pelagic organisms (MAFC 2011).</p> <p>Adults: EFH is pelagic habitats in inshore estuaries and embayments from Passamaquoddy Bay, Maine to the Hudson River, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina. EFH for adult Atlantic mackerel is generally found over bottom depths less than 170 meters and in water temperatures of 5 to 20°C. Spawning occurs at temperatures above 7°C, with a peak between 9 and 14°C. Adult Atlantic mackerel are opportunistic predators feeding primarily on a wider range and larger individuals of pelagic crustaceans than juveniles, but also on fish and squid (MAFC 2011).</p>

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Black Sea Bass <i>Centropristis striata</i>	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	<p>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).</p> <p>Juveniles: 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, in the highest 90 percent of all the ranked squares of the area where juvenile black sea bass are collected in the NEFSC trawl survey. Inshore, EFH is the estuaries where black sea bass are identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Juveniles are found in the estuaries in the summer and spring. Generally, juvenile black sea bass are found in waters warmer than 43°F with salinities greater than 18 ppt and coastal areas between Virginia and Massachusetts, but winter offshore from New Jersey and south. Juvenile black sea bass 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 (MAFMC 1998).</p> <p>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, in the highest 90 percent of all the ranked ten-minute squares of the area where adult black sea bass are collected in the NEFSC trawl survey. Inshore, EFH is the estuaries where adult black sea bass were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and seawater" salinity zones. Black sea bass are generally found in estuaries from May through October. Wintering adults (November through April) are generally offshore, south of New York to North Carolina. Temperatures above 43°F seem to be the minimum requirements. Structured habitats (natural and man-made), sand and shell are usually the substrate preference (MAFMC 1998).</p>
Bluefish <i>Pomatomus saltatrix</i>	X	X	-	-	X	X	-	-	-	X	X	X	X	X	X	X	<p>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).</p> <p>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).</p> <p>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.</p>

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Scup <i>Stenotomus chrysops</i>	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	<p>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).</p> <p>Juveniles: 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, in the highest 90 percent of all the ranked ten-minute squares of the area where juvenile scup are collected in the NEFSC trawl survey. Inshore, EFH is the estuaries where scup are identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. In general, juvenile scup are found during the summer and spring 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 45 °F and salinities greater than 15 ppt (MAFMC 1998).</p> <p>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, in the highest 90 percent of all the ranked ten-minute squares of the area where adult scup are collected in the NEFSC trawl survey. Inshore, EFH is the estuaries where scup were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing and "seawater" salinity zones. Generally, wintering adults (November through April) are usually offshore, south of New York to North Carolina, in waters above 45 °F (MAFMC 1998).</p>
Highly Migratory Species																	
Albacore Tuna <i>Thunnus alalunga</i>	-	-	-	-	-	-	-	-	X	X	X	-	X	X	-	-	<p>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.</p> <p>Juveniles: Offshore, pelagic habitats of the Atlantic Ocean from the outer edge of the U.S. EEZ through Georges Bank to pelagic habitats south of Cape Cod, and from Cape Cod to Cape Hatteras, North Carolina. EFH also includes offshore pelagic habitats near the outer U.S. EEZ between North Carolina and Florida, and offshore pelagic habitats associated with the Blake Plateau. EFH also includes offshore pelagic habitats in the western and central Gulf of Mexico (NOAA 2017).</p> <p>Adults: Offshore, pelagic habitats of the Atlantic Ocean from the outer edge of the U.S. EEZ through Georges Bank to pelagic habitats south of Cape Cod, and from Cape Cod to Cape Hatteras, North Carolina. EFH also includes offshore pelagic habitats near the outer U.S. EEZ between North Carolina and Florida, and offshore pelagic habitats associated with the Blake Plateau. EFH also includes offshore pelagic habitats in the western and central Gulf of Mexico (NOAA 2017).</p>

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Bluefin Tuna <i>Thunnus thynnus</i>	-	-	-	-	-	-	-	-	X	X	X	-	X	X	-	-	<p>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).</p> <p>Juveniles: Coastal and pelagic habitats of the Mid-Atlantic Bight and the Gulf of Maine, between southern Maine and Cape Lookout, 110 from shore (excluding Long Island Sound, Delaware Bay, Chesapeake Bay, and Pamlico Sound) to the continental shelf break. EFH in coastal areas of Cape Cod are located between the Great South Passage and shore. 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 (16 to 19 °C; 0 to 40 m deep). EFH in other locations associated with temperatures ranging from 4 to 26 °C, often in depths of less than 20 m (but can be found in waters that are 40-100 m in depth in winter) (NOAA 2017).</p> <p>Adults: EFH is located in offshore and coastal regions of the Gulf of Maine the mid-coast of Maine to Massachusetts; on Georges Bank; offshore pelagic habitats of southern New England; from southern New England to coastal areas between the mouth of Chesapeake Bay and Onslow Bay, North Carolina; from coastal North Carolina south to the outer extent of the U.S. EEZ, inclusive of pelagic habitats of the Blake Plateau, Charleston Bump, and Blake Ridge. EFH also consists of pelagic waters of the central Gulf of Mexico from the continental shelf break to the seaward extent of the U.S. EEZ between Apalachicola, Florida and Texas (NOAA 2017).</p>
Skipjack Tuna <i>Katsuwonus pelamis</i>	-	-	-	-	-	-	-	-	X	X	X	-	X	X	X	-	<p>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.</p> <p>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) (NOAA 2017).</p> <p>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 (NOAA 2017).</p>

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Yellowfin Tuna <i>Thunnus albacares</i>	-	-	-	-	-	-	-	-	X	X	-	-	X	X	-	-	<p>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.</p> <p>Juveniles: Offshore pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank and Cape Cod, Massachusetts. Offshore and coastal habitats from Cape Cod to the mid-east coast of Florida and the Blake Plateau. Locally distributed in the Florida Straits and off the southwestern edge of the West Florida Shelf. In the central Gulf of Mexico from Florida Panhandle to southern Texas. Localized EFH southeast of Puerto Rico (NOAA 2017).</p> <p>Adults: Offshore pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank and Cape Cod, Massachusetts. Offshore and coastal habitats from Cape Cod to North Carolina, and 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 (NOAA 2017).</p>
Invertebrates																	
Atlantic Sea Scallop <i>Placopecten magellanicus</i>	X	X	X	-	X	X	X	-	X	X	X	-	X	X	X	-	<p>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.</p> <p>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.</p> <p>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 have greatest survival rates when they attach to sedentary branching organisms or any hard surface substrate (NOAA EFH Mapper 2022). 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.</p> <p>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. Age 1 juveniles on Georges Bank are less dispersed than older juveniles and typically associate with gravel-pebble deposits (NEFMC 2017).</p> <p>Essential habitats for older juvenile and adult sea scallops are found on sand and gravel substrates in depths of 18 to 110 meters, but they are also found in shallower water and as deep as 180 meters in the Gulf of Maine. In the Mid-Atlantic they are found primarily between 45 and 75 meters and on Georges Bank they are more abundant between 60 and 90 meters. 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 in the vicinity of the spawning population. Bottom currents stronger than 25 cm/sec</p>

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
																	(half a knot) inhibit feeding. Growth of adult scallops is optimal between 10 and 15°C and they prefer full strength seawater (NEFMC 2017).
Atlantic Surfclam <i>Spisula solidissima</i>	-	-	-	-	-	-	-	-	-	X	-	-	-	X	-	-	<p>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. 1999 c). Preference for sandy habitats and spawns in the summer and early fall.</p> <p>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.</p>
Ocean Quahog <i>Arctica islandica</i>	-	-	-	-	-	-	-	-	X	X	-	-	X	X	-	-	<p>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).</p> <p>Juveniles and Adults: Throughout the substrate, to a depth of three feet below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90 percent of all the ranked ten-minute squares for the area where ocean quahogs were caught in the NEFSC surfclam and ocean quahog dredge surveys. Distribution in the western Atlantic ranges in depths from 30 feet to about 800 feet. Ocean quahogs are rarely found where bottom water temperatures exceed 60 °F, and occur progressively further offshore between Cape Cod and Cape Hatteras (MAFMC 1998).</p>

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Longfin Inshore Squid <i>Doryteuthis pealeii</i>	-	X	X	X	-	-	-	-	X	X	X	X	X	X	-	-	<p>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).</p> <p>Eggs: EFH for <i>Doryteuthis pealeii</i> eggs occurs in inshore and offshore bottom habitats from Georges Bank southward to Cape Hatteras, generally where bottom water temperatures are between 10°C and 23°C, salinities are between 30 and 32 ppt, and depth is less than 50 meters. <i>Doryteuthis pealeii</i> eggs have also been collected in bottom trawls in deeper water at various places on the continental shelf. Like most loliginid squids, <i>D. pealeii</i> egg masses or “mops” are demersal and anchored to the substrates on which they are laid, which include a variety of hard bottom types (e.g., shells, lobster pots, piers, fish traps, boulders, and rocks), submerged aquatic vegetation (e.g., <i>Fucus</i> sp.), sand, and mud (MAFC 2011).</p> <p>Juveniles (Recruits): EFH is pelagic habitats in inshore and offshore continental shelf waters from Georges Bank to South Carolina, in the southwestern Gulf of Maine, and in embayments such as Narragansett Bay, Long Island Sound, and Raritan Bay. EFH for recruit longfin inshore squid is generally found over bottom depths between 6 and 160 meters where bottom water temperatures are 8.5-24.5°C and salinities are 28.5-36.5 ppt. Pre-recruits migrate offshore in the fall where they overwinter in deeper waters along the edge of the shelf. They make daily vertical migrations, moving up in the water column at night and down in the daytime. Small immature individuals feed on planktonic organisms while larger individuals feed on crustaceans and small fish (MAFC 2011).</p> <p>Juveniles (Recruits): EFH is pelagic habitats in inshore and offshore continental shelf waters from Georges Bank to South Carolina, in inshore waters of the Gulf of Maine, and in embayments such as Narragansett Bay, Long Island Sound, Raritan Bay, and Delaware Bay. EFH for recruit longfin inshore squid is generally found over bottom depths between 6 and 200 meters where bottom water temperatures are 8.5-14°C and salinities are 24-36.5 ppt. Recruits inhabit the continental shelf and upper continental slope to depths of 400 meters. They migrate offshore in the fall and overwinter in warmer waters along the edge of the shelf. Like the prerecruits, they make daily vertical migrations. Individuals larger than 12 cm feed on fish and those larger than 16 cm feed on fish and squid. Females deposit eggs in gelatinous capsules which are attached in clusters to rocks, boulders, and aquatic vegetation and on sand or mud bottom, generally in depths less than 50 meters (MAFC 2011).</p>
Northern Shortfin Squid <i>Illex illecebrosus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	<p>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).</p> <p>Adult: Adult Northern Shortfin Squid have been observed at temperatures ranging from -0.5 to 27.3 °C, salinities of 30 to 36.5 ppt and depths from the surface to as great as 1000 m. During the winter, adults migrate to offshore habitats (NOAA, 1999).</p>
Skates																	
Barndoor Skate <i>Dipturus laevis</i>	-	-	-	-	-	-	-	-	X	X	-	-	X	X	-	-	<p>General habitat description: Demersal species that ranges from Newfoundland, the Gulf of St. Lawrence, off Nova Scotia, the Gulf of Maine and the northern sections of the Mid-Atlantic Bight down to North Carolina. Some populations move inshore to shallow waters during spring and autumn seasons (NOAA, 1999).</p> <p>Juvenile: Juvenile barndoor skate have mostly been observed at Georges bank, Gulf of Maine, southern New England, and Mid-Atlantic Bight down to the Hudson canyon. Juveniles were observed in depths of 41-400 m and in temperatures from 3-18 °C (NOAA, 1999).</p>

Common Name/ Scientific Name	EFH Habitat within Project Area																EFH Description
	EGG				LARVAE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
																	<p>Adults: Adult barndoor skate have been observed in the Gulf of Maine, Georges Bank, in southern New England and in the Mid-Atlantic Bight down to the Hudson Canyon. Lower abundance of adults were observed in the summer, as adults move into inshore waters (NOAA, 1999).</p>
Little Skate <i>Leucoraja erinacea</i>	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	<p>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).</p> <p>Juveniles/Adults: Intertidal and sub-tidal 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 80 meters, as shown on Map 90, and including high salinity zones in the bays and estuaries. Essential fish habitat for juvenile little skates occurs on sand and gravel substrates, but they are also found on mud (NEFMC 2017).</p> <p>Intertidal and sub-tidal 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 100 meters, and including high salinity zones in the bays and estuaries listed in Table 28. Essential fish habitat for adult little skates occurs on sand and gravel substrates, but they are also found on mud (NEFMC 2017).</p>
Winter Skate <i>Leucoraja ocellata</i>	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	<p>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.</p> <p>Juveniles: Sub-tidal 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.</p> <p>Adults: Sub-tidal 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.</p>

Table 4-2. Designated EFH Based on Shark Species and Life Stage Within the Sunrise Wind Project Area

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	NEONATE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Sharks													
Basking Shark <i>Cetorhinus maximus</i>	X	X	-	-	X	X	-	-	X	X	-	-	<p>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).</p> <p>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 (NOAA 2017).</p>
Blue Shark <i>Prionace glauca</i>	X	X	-	-	X	X	-	-	X	X	-	-	<p>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).</p> <p>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 (NOAA 2017).</p> <p>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 (NOAA 2017).</p>
Common Thresher Shark <i>Alopias vulpinus</i>	X	X	X	-	X	X	X	-	X	X	X	-	<p>General habitat description: The common thresher shark is found in both coastal and oceanic and cool and warm waters (Gervellis and Natanson 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.</p> <p>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).</p>

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	NEONATE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Dusky Shark <i>Carcharhinus obscurus</i>	X	X	X	-	X	X	X	-	X	X	X	-	<p>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).</p> <p>Neonates: EFH in the Atlantic Ocean includes offshore areas of southern New England to Cape Lookout, North Carolina. Specifically, EFH is associated with habitat conditions including temperatures from 18.1 to 22.2 °C, salinities of 25 to 35 ppt and depths at 4.3 to 15.5 m. Seaward extent of EFH for this life stage in the Atlantic is 60 m in depth (NOAA 2017).</p> <p>Juveniles / Adults: Coastal and pelagic waters inshore of the continental shelf break (< 200 meters in depth) along the Atlantic east coast from habitats offshore of southern Cape Cod to Georgia, including the Charleston Bump and adjacent pelagic habitats. Inshore extent for these life stages is the 20 meter bathymetric line, except in habitats of southern New England, where EFH is extended seaward of Martha’s Vineyard, Block Island, and Long Island. Pelagic habitats of southern Georges Bank and the adjacent continental shelf break from Nantucket Shoals and the Great South Channel to the eastern boundary of the United States EEZ. Adults are generally found deeper (to 2000 meters) than juveniles, however there is overlap in the habitats utilized by both life stages. Offshore waters of the western and north Gulf of Mexico, at and seaward of the continental shelf break (a buffer is included ~10 nautical miles north of the 200 meter bathymetric line), and in proximity to numerous banks along the continental shelf edge (e.g., Ewing and Sackett Bank). The continental shelf edge habitat from Desoto Canyon west to the Mexican border is important habitat for adult dusky sharks (NOAA 2017).</p>
Porbeagle Shark <i>Lamna nasus</i>	X	X	-	-	X	X	-	-	X	X	-	-	<p>General habitat description: The porbeagle shark is a lamnid shark common in deep, cold temperate waters of the North Atlantic, South Atlantic, and South Pacific Oceans (NOAA Fisheries 2017).</p> <p>Neonate / Juvenile / Adult: At this time, available information is insufficient for the identification of EFH by life stage, therefore all life stages are combined in the EFH designation. EFH in the Atlantic Ocean includes offshore and coastal waters of the Gulf of Maine (not including Cape Cod Bay and Massachusetts Bay) and offshore waters of the Mid-Atlantic Bight from Georges Bank to New Jersey. EFH for all life stages of porbeagle shark has been identified in the SRWF and SRWEC–OCS</p>

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	NEONATE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Sandbar Shark <i>Carcharhinus plumbeus</i>	-	X	X	-	X	X	X	X	X	X	X	X	<p>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.</p> <p>Neonates: Atlantic coastal areas from Long Island, New York to Cape Lookout, North Carolina, and from Charleston, South Carolina to Amelia Island, Florida. Important neonate/YOY EFH includes: Delaware Bay (Delaware and New Jersey) and Chesapeake Bay (Virginia and Maryland), where the nursery habitat is limited to the southeastern portion of the estuaries (salinity is greater than 20.5 ppt and depth is greater than 5.5 m); Great Bay, New Jersey; and the waters off Cape Hatteras, North Carolina. In all nursery areas between New York and North Carolina, unless otherwise noted, EFH is associated with water temperatures that range from 15 to 30 °C; salinities that vary from 15 to 35 ppt; water depths that range from 0.8 to 23 m; and sand, mud, shell, and rocky sediments/benthic habitat. 170 EFH in the Gulf of Mexico includes localized coastal areas on the Florida panhandle (Indian Pass and St. Andrew Sound, Florida) in water temperatures from 20 to 31 °C at salinities from 19 to 39 ppt and depths of 2.1 to 5.2 m in silt/clay habitats (NOAA 2017).</p> <p>Juveniles: EFH includes coastal portions of the Atlantic Ocean between southern New England (Nantucket Sound, Massachusetts) and Georgia in water temperatures ranging from 20 to 24 °C and depths from 2.4 to 6.4 m. Important nurseries include Delaware Bay, Delaware and New Jersey; Chesapeake Bay, Virginia; Great Bay, New Jersey; and the waters off Cape Hatteras, North Carolina. For all EFH, water temperatures range from 15 to 30 °C, salinities range from 15 to 35 ppt, water depth ranges from 0.8 to 23 m, and substrate includes sand, mud, shell, and rocky habitats. EFH in the Gulf of Mexico includes localized areas off Apalachicola Bay, Florida (NOAA 2017).</p> <p>Adults: EFH in the Atlantic Ocean includes coastal areas from southern New England to the Florida Keys, ranging from inland waters of Delaware Bay and the mouth of Chesapeake Bay to the continental shelf break. EFH in the Gulf of Mexico includes coastal areas between the Florida Keys and Anclote Key, Florida; areas offshore of the Big Bend region; coastal areas of the Florida panhandle and Gulf coast between Apalachicola and the Mississippi River; and habitats surrounding the continental shelf between Louisiana and south Texas. Adults commonly use habitats in the West Florida Shelf, off Cape San Blas, and cool, deep, clear water offshore of Texas and Louisiana (NOAA 2017).</p>

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	NEONATE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Sand Tiger Shark <i>Carcharias taurus</i>	X	X	X	X	X	X	X	X	-	-	-	-	<p>General habitat description: Sand tiger shark are a large, coastal species found in tropical and warm temperate waters around the world, often in very shallow water (13 ft [4 m]) (NOAA Fisheries 2017). In the northwestern Atlantic, mature sand tiger shark males and juveniles are found between Cape Cod and Cape Hatteras, and mature and pregnant females are found between Cape Hatteras and Florida (NOAA Fisheries 2017).</p> <p>Neonate / Juveniles: Neonate EFH ranges from Massachusetts to Florida, specifically the PKD bay system, Sandy Hook, and Narragansett Bays as well as coastal sounds, lower Chesapeake Bay, Delaware Bay (and adjacent coastal areas), Raleigh Bay and habitats surrounding Cape Hatteras. Juveniles EFH includes habitats between Massachusetts and New York (notably the PKD bay system), and between mid-New Jersey 253 and the mid-east coast of Florida. EFH can be described via known habitat associations in the lower Chesapeake Bay and Delaware Bay (and adjacent coastal areas) where temperatures range from 19 to 25 °C, salinities range from 23 to 30 ppt at depths of 2.8-7.0 m in sand and mud areas, and in coastal North Carolina habitats with temperatures from 19 to 27 °C, salinities from 30 to 31 ppt, depths of 8.2-13.7 m, in rocky and mud substrate or in areas surrounding Cape Lookout that contain benthic structure (NOAA 2017).</p> <p>Adults: In the Atlantic along the mid-east coast of Florida (Cape Canaveral) through Delaware Bay. Important habitats include lower Chesapeake Bay and Delaware Bay (and adjacent coastal areas) where sand tiger sharks spend 95 percent of their time in waters between 17 and 23 °C. EFH is restricted off the coast of Florida to habitats that are less than 200 meters in depth (NOAA 2017).</p>
Shortfin Mako Shark <i>Isurus oxyrinchus</i>	X	X	-	-	X	X	-	-	X	X	-	-	<p>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.</p> <p>Neonates, Juveniles, and Adults: EFH in the Atlantic Ocean includes pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank (off Massachusetts) to Cape Cod (seaward of the 200m bathymetric line); coastal and offshore habitats between Cape Cod and Cape Lookout, North Carolina; and localized habitats off South Carolina and Georgia. EFH in the Gulf of Mexico is seaward of the 200 m isobaths in the Gulf of Mexico, although in some areas (e.g., northern Gulf of Mexico by the Mississippi delta) EFH extends closer to shore. EFH in the Gulf of Mexico is located along the edge of the continental shelf off Fort Meyers to Key West (southern West Florida Shelf), and also extends from the northern central Gulf of Mexico around Desoto Canyon and the Mississippi Delta to pelagic habitats of the western Gulf of Mexico that are roughly in line with the Texas/Louisiana border (NOAA 2017).</p>
Smoothhound Shark Complex (Atlantic Stock) <i>Mustelus canis</i>	X	X	X	X	X	X	X	X	X	X	X	X	<p>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.</p> <p>Neonates, Juveniles, and Adults: At this time, available information is insufficient for the identification of EFH for this life stage, therefore all life stages are combined in the EFH designation. Smoothhound shark EFH identified in the Atlantic is exclusively for smoothdogfish. EFH in Atlantic coastal areas ranges from Cape Cod Bay, Massachusetts to South Carolina, inclusive of inshore bays and estuaries (e.g., Pamlico Sound, Core Sound, Delaware Bay, Long Island Sound, Narragansett Bay, etc.). EFH also includes continental shelf habitats between southern New Jersey and Cape Hatteras, North Carolina (NOAA 2017).</p>

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	NEONATE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
Spiny Dogfish <i>Squalus acanthias</i>	-	-	-	-	-	X	-	-	X	X	X	X	<p>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).</p> <p>Juveniles: Pelagic and epibenthic habitats, primarily in deep water on the outer continental shelf and slope between Cape Hatteras and Georges Bank and in the Gulf of Maine. Young are born mostly on the offshore wintering grounds from November to January, but newborns (neonates or “pups”) are sometimes taken in the Gulf of Maine or southern New England in early summer (MAFMC 2014).</p> <p>Female Adults: Pelagic and epibenthic habitats throughout the region. Adult females are found over a wide depth range in full salinity seawater (32-35 ppt) where bottom temperatures range from 7 to 15°C. They are widely distributed throughout the region in the winter and spring when water temperatures are lower, but very few remain in the Mid-Atlantic area in the summer and fall after water temperatures rise above 15°C (MAFMC 2014).</p> <p>Male Adults: Pelagic and epibenthic habitats throughout the region. Adult males are found over a wide depth range in full salinity seawater (32-35 ppt) where bottom temperatures range from 7 to 15°C. They are widely distributed throughout the region in the winter and spring when water temperatures are lower, but very few remain in the Mid-Atlantic area in the summer and fall after water temperatures rise above 15°C (MAFMC 2014).</p>
Tiger Shark <i>Galeocerdo cuvier</i>	-	-	-	-	X	X	-	-	X	X	-	-	<p>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).</p> <p>Juveniles and Adults: EFH in the Atlantic Ocean extends from offshore pelagic habitats associated with the continental shelf break at the seaward extent of the U.S. EEZ boundary (south of Georges Bank, off Massachusetts) to the Florida Keys, inclusive of offshore portions of the Blake Plateau. EFH in the Gulf of Mexico includes pelagic and coastal habitats between Tampa Bay, Florida Bay and Florida Keys, and the edge of the West Florida Shelf; and an area extending from off eastern Louisiana, Mississippi, and Alabama to offshore pelagic habitats in the central Gulf of Mexico. Grass flats in the Gulf of Mexico are considered feeding areas, and are included as EFH. EFH also includes coastal and pelagic habitats surrounding Puerto Rico (except on the northwest side of the island) and the U.S. Virgin Islands (NOAA 2017).</p>

Common Name/ Scientific Name	EFH Habitat within Project Area												EFH Description
	NEONATE				JUVENILE				ADULT				
	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	SRWF	SRWEC-OCS	SRWEC-NYS	Onshore Cable	
White Shark <i>Carcharodon carcharias</i>	X	X	X	X	X	X	X	-	X	X	X	-	<p>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.</p> <p>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 (NOAA 2017).</p> <p>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. (NOAA 2017).</p>

4.2 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 are more susceptible because they are immobile or have limited mobility. Certain habitats are also considered sensitive. Sensitive species and habitats are listed below.

- Winter flounder eggs and larvae, which are demersal and are found in 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*

In addition to the above, the spawning Atlantic cod life stage is considered sensitive and vulnerable for the purpose of this EFH assessment. While juvenile and adult Atlantic cod are highly mobile, this species demonstrates high fidelity to specific spawning sites, meaning they return to the same location year after year, and can be sensitive to anthropogenic disturbances during spawning (Dean et al. 2022). For example, underwater noise produced from offshore wind development activities (e.g., HRG surveys) may overlap and mask biologically important, low frequency (5-100 Hz) grunting sounds created by male cod during spawning seasons.

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

BOEM and other researchers have been conducting a monitoring survey in Southern New England, including within and around the SRWF to document cod spawning activity using acoustic telemetry, grunts detected using PAM at fixed stations and on gliders, and hook and line sampling to assess reproductive condition of adults. The study will be conducted for three years, and the first two years of data have been collected, although no formally reviewed reports have been issued. During the studies, Atlantic cod have been detected in the northwest corner of the SRWF where fixed station telemetry

receivers have been installed. However, to date, no cod grunts have been detected in the SRWF area Figure 4-1.

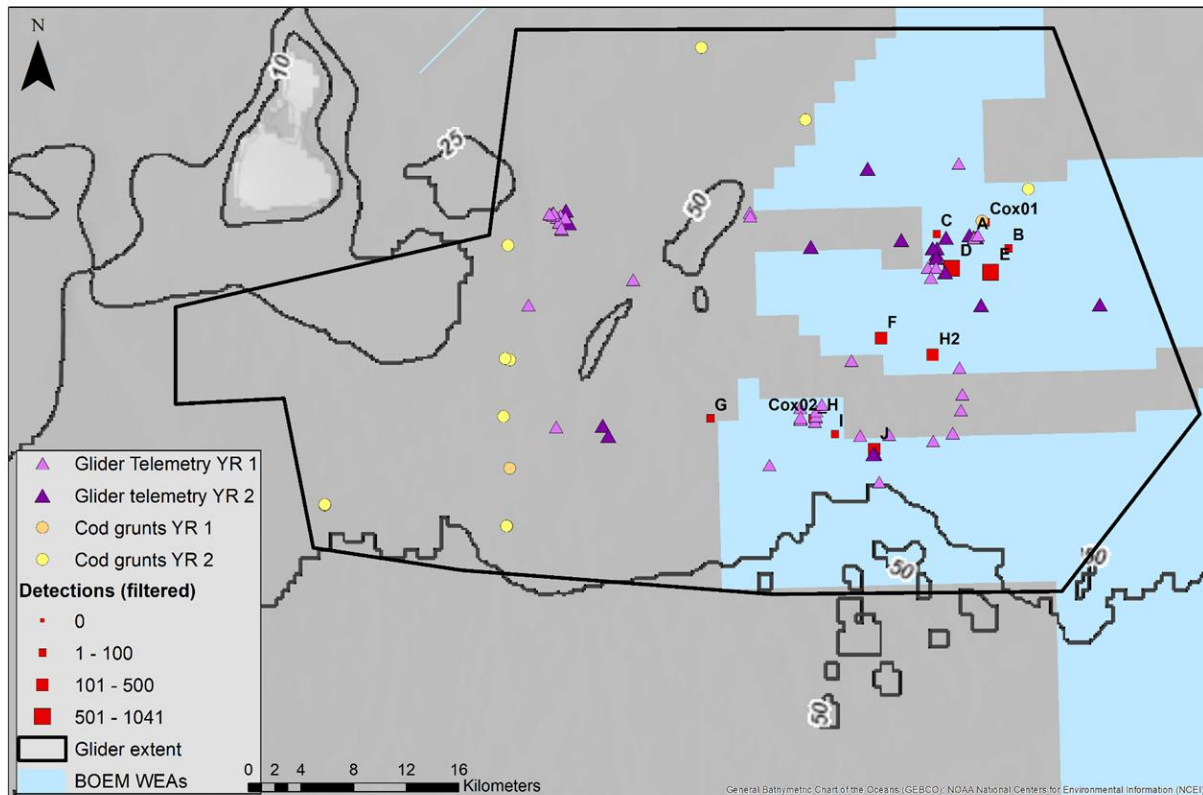


Figure 4-1. Preliminary results from Atlantic cod monitoring surveys conducted in 2021 and 2022 in the Cox Ledge area.

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

development of new stock/population assessments, that would allow managers to better work towards rebuilding Atlantic cod populations.

4.3 Habitat Areas of Particular Concern (HAPC)

NMFS and the regional fisheries management councils have identified subsets of EFH as HAPCs. These are habitat types and/or geographic areas identified as priorities for habitat conservation, management, and research that provide extremely important ecological functions or are especially vulnerable to degradation, but this designation does not confer any specific protections (MAFMC 2016). The councils identify HAPCs based on one or more of the following considerations: (1) the importance of the ecological function provided by the habitat, (2) the extent to which the habitat is sensitive to human-induced environmental degradation, (3) whether, and to what extent, development activities are, or would be, stressing the habitat type, and (4) the rarity of the habitat type (MAFMC 2016).

4.3.1 Summer Flounder HAPC

The MAFMC has identified HAPC for summer flounder as “All native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH” (MAFMC 2016). These areas have been identified as important for shelter, predation, nursery habitat, and, potentially, reproduction (MAFMC 1998a). Lascara (1981) demonstrated an increased ability of summer flounder to effectively capture prey by utilizing the seagrass as a “blind” to ambush prey. SAV and macroalgae have been shown to attract common summer flounder prey for both adults and juveniles (Packer et al. 1999). Additionally, it has been concluded that any loss of areas containing SAV and macroalgae along the Atlantic Seaboard may negatively affect summer flounder stocks (Laney 1997).

Within the Project area, the Onshore Transmission Cable corridor may cross some portion of mapped HAPC for summer flounder in NYS waters specifically near the ICW-HDD, off of the south shore of the channel. SAV was also mapped in the vicinity of the SRW Project Area (several miles away in Bellport Bay). but those areas would be completely avoided by the existing cable route. October 2022 surveys (Schott 2022) found no significant SAV forming patches or meadows in the proposed SRW temporary landing site for the temporary equipment to be used for the ICW-HDD, but identified eelgrass at six locations (see section 3.3.5 for more detail). Four of the six locations included eelgrass shoots in macroalgae but shoots appeared unrooted. Two locations of eelgrass emerged from an algal mat on the sediment surface, but, compared to the single eelgrass plants observed, these clusters of plants appeared more likely to be rooted.

4.3.2 Juvenile Atlantic Cod HAPC

HAPC for juvenile Atlantic cod is defined as occurring between the mean high-water line and a depth of 66 ft (20 m) in rocky habitats, in SAV, or in sandy habitats adjacent to rocky and SAV habitats for foraging, from Maine through Rhode Island. Juvenile Atlantic cod HAPC can be found in the region, but it does not occur within the footprint of the SRWF, SRWEC, ICW-HDD, nor its immediate vicinity (see Table 3-1 and Table 3-2).

4.3.3 Southern New England HAPC

On July 30, 2022, the New England Fishery Management Council (NEFMC) approved a new HAPC designation to address concerns over potential adverse impacts from offshore wind development on sensitive hard-bottom habitats and cod spawning activity. However, this new HAPC designation is pending final approval by NMFS and has not yet been.

The Southern New England HAPC comprises all large-grained complex and complex benthic habitats wherever present within the area bounded by a 10-km (6.2-mile) buffer around the RI/MA and MA WEAs (Plante 2022), including the SRWF, as shown in Figure 4-2. The designation is intended to protect high-value complex habitats within this area, emphasizing currently known and potentially suitable areas used by Atlantic cod for spawning (Bachman and Couture 2022; NEFMC 2022). This EFH designation was informed by the findings of a three-year, BOEM-funded study investigating the use of Cox Ledge and surroundings by spawning Atlantic cod (#AT-19-08) (BOEM pers. comm. 2021).

The designation would also apply to large-grained complex and complex benthic habitats used by Atlantic herring, Atlantic sea scallop, little skate, monkfish, ocean pout, red hake, silver hake, windowpane flounder, winter flounder, winter skate, and yellowtail flounder.

The new HAPC is intended to provide conservation focus for specific New England Council-managed species with EFH in the area due to concerns about impacts from offshore development, specifically offshore wind in the near term, and possible offshore aquaculture in the future (NEFMC 2022).

If approved by NOAA, the HAPC would include all areas in Southern New England with complex habitats, defined by NEFMC (2022) as:

- Hard bottom substrates, defined by the Coastal and Marine Ecological Classification Standard (CMECS) as Substrate Class Rock Substrate and by the four Substrate Groups: Gravels, Gravel Mixes, Gravelly, and Shell. This CMECS modifier was developed by NOAA Fisheries for their habitat mapping recommendations, including both large-grained and small-grained hard habitats.
- Hard bottom substrates with epifauna or macroalgae cover.
- Vegetated habitats (e.g., submerged aquatic vegetation and tidal wetlands).

The HAPC designation would apply within EFH designated for the following species and lifestages with stock boundaries within the Southern New England area: Atlantic cod juveniles and adults, Atlantic herring eggs, Atlantic sea scallop eggs, juveniles, and adults, little skate juveniles and adults, monkfish juveniles and adults, ocean pout eggs, juveniles, and adults, red hake juveniles and adults, winter flounder eggs, juveniles, and adults, and winter skate juveniles and adults (Table 4-1).

The SRWF overlaps Cox Ledge, within the Southern New England HAPCE and an area of concern for fishery managers because it provides important habitat for several commercially and recreationally important species in addition to spawning habitat for Atlantic cod. A portion of Cox Ledge was designated by the New England Fishery Management Council (NEFMC) as a habitat management area to protect EFH for a number of managed fish species. NOAA acknowledged the importance of Cox Ledge

but disapproved the designation because it concluded the proposed gear restrictions approved by the NEFMC would likely be ineffective at minimizing impacts on habitat function (NEFMC 2018; NOAA2017a). The HAPC designation was informed by the findings of a three-year, BOEM-funded study investigating the use of Cox Ledge and surroundings by spawning Atlantic cod, black sea bass, and other species in the southern New England region, including the Lease Area. The study is being conducted by NMFS and a team comprising a state resource agency, a university, and a nonprofit organization (BOEM 2019). Portions of this work have been completed and preliminary reporting is presented in this Draft EIS. Peer-reviewed literature and reporting on this research may also be complete and will be considered in the Sunrise Wind Final EIS, if available.

Two Project configurations have been developed by BOEM that would avoid and minimize impacts to this HAPC from the construction and operation of the SRWF and are described in Section 6.3.

Two Habitat Alternative configurations have been developed by BOEM that would avoid and minimize impacts to this HAPC from the construction and operation of the RWF (see Section 6.2).

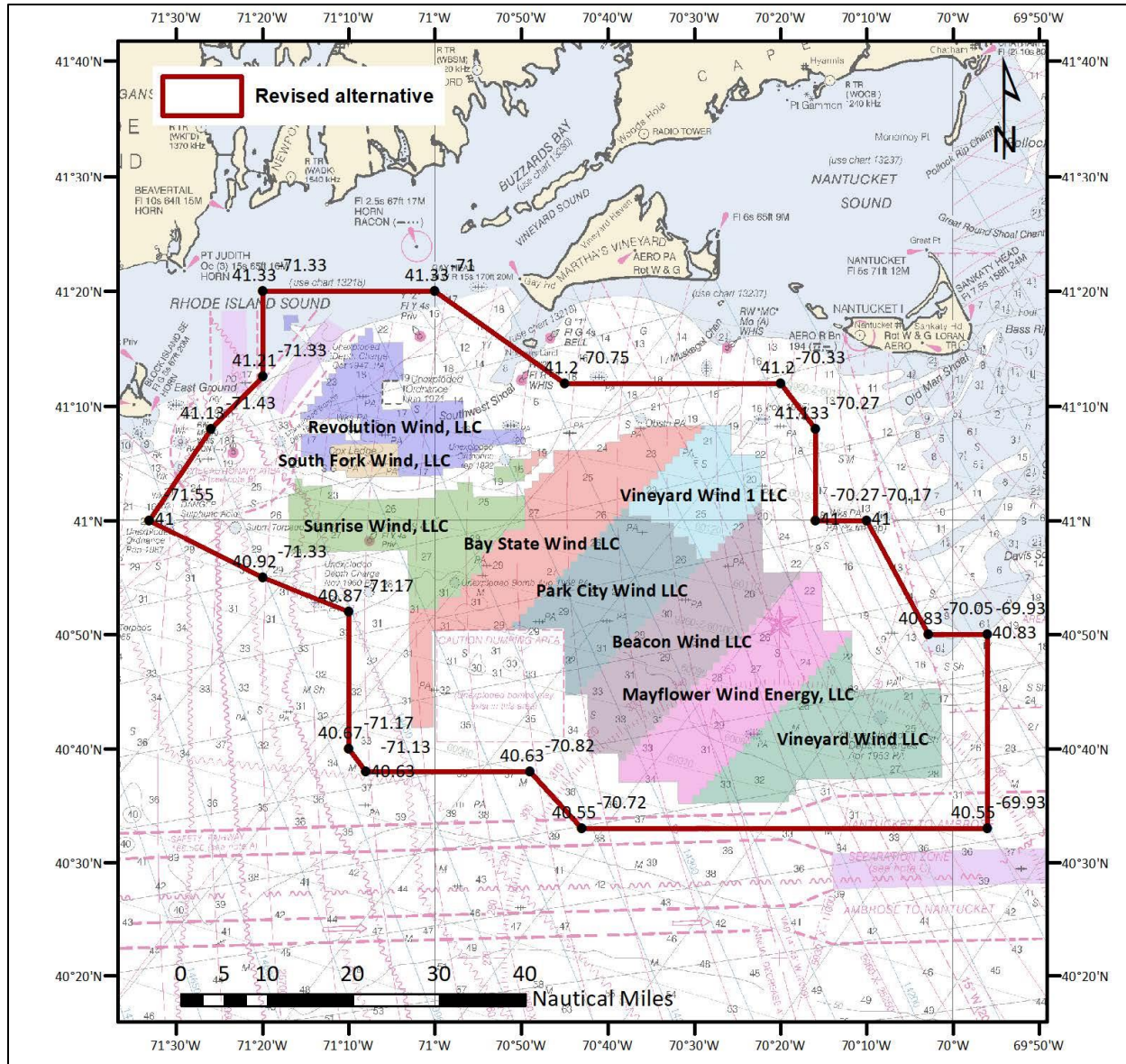


Figure 4-2. Southern New England HAPC Designation

4.3.4 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, river herring, as well as invertebrates such as clams, crabs and worms. Impacts to prey species may lead to indirect impacts to EFH and EFH species and life stages due to lost foraging opportunities.

4.3.5 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.

Sessile Benthic/Epibenthic – Soft Bottom

(Includes slow-moving benthic/epibenthic species and/or life stages; could include heterogenous complex habitat)

- Atlantic scallop (eggs, larvae, juveniles, adults)
- Atlantic surfclam (juveniles, adults)
- Flatfish (eggs, larvae, juveniles, adults)
- Longfin Inshore Squid (eggs, juvenile, adults)
- Northern shortfin squid (adults)
- Ocean quahog (juveniles, adults)
- Skates (juveniles, adults)

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

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

Sessile Benthic/Epibenthic – Complex Habitat

(Includes slow-moving species and/or life stages; could include heterogenous complex habitat)

- Longfin Inshore Squid (eggs, juvenile, adults)
- Northern shortfin squid (adults)
- Skates (juveniles, adults)

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

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

Pelagic

- American Plaice (Larvae)
- Atlantic butterfish (eggs, larvae, juveniles, adults)
- Atlantic herring (eggs, larvae, juveniles, adults)
- Atlantic mackerel (eggs, larvae, juveniles, adults)
- Bluefish (eggs, larvae, juveniles, adults)
- Haddock (larvae)
- Highly Migratory Species (HMS) (eggs, larvae, juveniles, adults)
- Longfin Inshore Squid (eggs, juvenile, adults)
- Northern shortfin squid (adults)
- Pollock (larvae, juveniles)
- Sharks (neonates, juveniles, adults)
- All other finfish, flatfish, and except winter flounder (eggs, larvae for both)

4.3.6 NOAA Trust Resources

NOAA Trust Resources have also been identified in the vicinity of the SRWF, SRWEC-NYS and Onshore Cable. 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
Striped bass			x	x

Blackfish/tautog			x	x
Weakfish			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 robin	x	x	x	x

5.0 Adverse Effects

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 maximum impacts resulting from the SRWF, SRWEC-OCS, SRWEC-NYS and Onshore Cable footprints. Potential adverse effects on EFH habitat may include noise, water quality changes, alterations to substrates used by EFH-designated species during specific life stages, and impairments to pelagic or benthic organisms. If a Project component is likely to result in a short-term, long-term, or permanent impairment of designated EFH or HAPC for a managed species and life stage, this would constitute an adverse effect on EFH. Impacts to EFH species are summarized in Table A- 1 and Table A- 2 in Appendix A.

The following sections summarize potential impacts of the Proposed Project 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 such as habitat alterations, sediment deposition, and noise.

5.1 Construction & 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, including Converter Stations, as Applicable

Project installation will generate short-term to long-term and potentially permanent, direct and indirect effects on EFH through vessel activity; pile driving and seabed preparation/boulder relocation/dredging; and installation of scour protection. These effects would occur intermittently at varying locations in the project area over the duration of project construction and installation. Depending on the nature, extent, and severity of each effect, this may reduce the suitability of EFH for managed species. This would constitute short-term to long-term and potentially permanent adverse effects on EFH. The construction and installation of the SRWF involves activities that would generate underwater noise exceeding established thresholds for mortality and permanent or short-term injury, temporary threshold shift (TTS), and behavioral effects. Underwater noise would render the affected habitats unsuitable for EFH species over the short-term and could have short-term impacts on prey availability for EFH species. The extent, duration, and severity of noise effects on EFH would vary depending on the noise source and the sensitivity of the affected EFH species and their prey to noise impacts during their life cycle. These effects are detailed by project component in the following sections (i.e., vessel activity, pile driving). The

assessment of noise impacts provided in the following sections emphasizes direct noise effects on EFH species based on the sensitivity of different hearing groups and life stages. However, these results are also applicable to prey resources important to EFH species. Fish eggs and larvae are prey and forage resources for some EFH species during certain life stages. Fish and invertebrates from any hearing group may provide prey for EFH species. Accordingly, short-term noise impacts that temporarily reduce habitat suitability for EFH species may also have localized effects on the availability of their prey resources. Individual prey organisms available to EFH species may increase or decrease depending on the nature of the noise effect and species-specific sensitivity. In contrast, short-term injury, auditory masking, or behavioral effects may limit the ability of EFH species to detect and locate prey organisms.

Spatial trends in sediment composition were found in the SRWF area. For example, the northwest region had a higher frequency of gravels; the southeast and west-central regions were characterized by finer substrata and limited small-scale sediment mobility; the northeast region was generally composed of Fine to Coarse Sand with sand ripples common. Boulders were infrequently observed at the SRWF but did occur in the northwest region, with the exception of an area located along the southern border at approximate longitude of 71.1°W. The biological attributes of the SRWF followed similar spatial trends to the physical features. The northwest portion of the SRWF was the only area where gravel was observed consistently across stations. Gravel in this area ranged in size from “washed” pebbles and granules to patchy cobbles and boulders on sand, which were encrusted by epifauna (e.g., bryozoa and hydroids). CMECS biotic classes, e.g., soft sediment fauna, attached fauna, inferred fauna) are mapped in Figure 3-9.

The southeast region of the SRWF were predominantly Very Fine Sand (CMECS Substrate Subgroup) and sand and mud (macrohabitat type) and had high occurrences of burrowing anemones and sabellid worms. The northeast region of the SRWF, which were predominantly Medium Sand or Fine Sand (CMECS Substrate Subgroup) and sand with ripples (macrohabitat type), had high occurrences of sand dollars. The northwest region of the SRWF was more heterogenous in seabed composition than other portions but included a higher frequency of Gravelly Sand and Sandy Gravel (CMECS Substrate Subgroups) compared to the rest of the SRWF and was generally more complex in macrohabitat types (e.g., sand with mobile gravel, patchy cobbles and boulders on sand), was inhabited by attached epifauna (e.g., hydroids [*Tubularia* spp.], sea stars, and bryozoa).

Cobble and boulder habitat can serve as structure for hard and soft corals, nursery ground for juvenile lobster, and as preferable benthic habitat for squid to deposit their eggs. Taxa considered sensitive with respect to this habitat include corals, squid eggs, and American lobster. Biogenic habitats included the non-reef building hard coral and burrowing anemones. The northern star coral was found at five stations, all in the northwest corner of the SRWF. Generally, the western portion of the SRWEC–OCS was characterized by high densities of sand dollars while the eastern portion of the SRWEC–OCS was inhabited by burrowing anemones and sea stars, and 52 percent of SPI/PV stations included burrowing anemones.

5.1.1.1 Vessel Activity

Habitat Loss/Conversion

During installation of the 94 WTG and the OCS-DC and associated foundations, 13 wind turbine vessels would be deployed simultaneously during foundation installation and 6 wind turbine vessels would be deployed simultaneously during structure installation. Vessels may require anchoring to facilitate construction activities. Certain construction vessels such as jack-up vessels would require stabilization

spuds. These activities would occur intermittently during installation of WTG and OCS-DC foundation installation.

Anticipated benthic habitat disturbing activities during WTG and OCS-DC installation include anchor placement, anchor chain sweep, and spud placement. These activities would take place within the SRWF, including all three of the NOAA Habitat Complexity Categories. 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. Benthic habitat types within the SRWF that are subject to disturbance from vessel activities mentioned above include rocky habitat (24,913 acres), soft bottom mud (149 acres), and soft bottom sand (35,283 acres). The proposed project currently includes 102 WTG positions. Of those, 43 are proposed to be installed in complex habitat, one (1) in large grained complex habitat and the majority of 58 WTGs in soft bottom sand and muddy sand habitats.

The precise extent and location of anchoring impacts anticipated at each foundation is not currently known as vessel positioning and anchoring requirements are affected by wind and current conditions in real time. The applicant proposes to use appropriate installation technology designed to minimize disturbance to the seabed and sensitive habitat (such as beaches and dunes, wetlands and associated buffers, streams, hard-bottom habitats, seagrass beds, and the near-shore zone); avoid anchoring on sensitive habitat; and implement turbidity reduction measures to minimize impacts to sensitive habitat from construction activities (see APM in Table 6-1). For the purpose of this consultation, BOEM assumes that the entirety of the 656-foot (200-meter) impact radius around each foundation could potentially experience some degree of anchoring disturbance. This equates to approximately 31 acres of anchoring disturbance at each of the monopile foundation sites. In addition to general construction vessel anchoring, benthic habitat would be disturbed by jack-up vessel anchoring during foundation construction and installation.

Impacts to soft-bottom benthic habitat are expected to recover within 18 to 24 months following initial disturbance via bedform recovery through natural sediment transport processes and recolonization by habitat-forming organisms from adjacent habitats. This estimate is based on observed recovery rates from seabed disturbance at the nearby BIWF (HDR 2020). In contrast, anchoring activities in large-grained complex, complex, and heterogenous complex benthic habitats could change the composition of benthic habitat by creating furrows of soft-bottomed habitat through boulder and cobble substrates. This would permanently modify the distribution of substrates in the affected area, resulting in a long-term to permanent effects on benthic habitat composition. This would constitute a long-term effect on benthic habitat structure. General construction vessel anchoring would occur within a 656-foot radius around each foundation. Actual anchoring impacts would occur within a subset of this area and would avoid large-grained complex and complex habitat to the extent practicable. The acreage shown is the total area of the impact radii around each foundation, minus overlapping jack up vessel anchoring impacts.

Medium- and low-density boulder fields present in large-grained complex and complex habitats within each lease area zone are important EFH for several managed species, including Atlantic cod (adults and spawning adults), longfin squid (i.e., benthic squid mops), ocean pout (all life stages), winter flounder (adults), and monkfish (adults and juveniles). Damage caused to medium- and low-density boulder fields, as well as associated biogenic features and attached, habitat forming organisms that provide shelter, attachment surfaces, and prey resources for the aforementioned EFH species would incur direct, long-term impacts from anchors, anchor chains, and spuds as these habitats generally take several years to decades to fully recover (Auster and Langton 1999; Collie et al. 2005; Tamsett et al. 2010). EFH species could also incur short-term to long-term, indirect impacts from a loss of benthic epifauna/prey,

such as crabs, shrimps, and sea stars. Anchoring could also result in the direct mortality of immobile, longfin squid egg mops and damage and/or disturb nests guarded by ocean pout, a currently overfished species of federally managed finfish.

Anchors, anchor chains, and spuds could directly impact gravelly sand, sandy gravel, and slightly gravelly sand substrates, which are the dominant CMECS substrates found in large-grained complex and complex habitats within every lease area zone. Gravelly substrates are a preferred spawning substrate of Atlantic herring that deposit benthic eggs. The crushing of herring eggs would constitute an indirect impact to EFH species such as Atlantic cod, which feed on Atlantic herring, a species of commercially valuable schooling fish that is significantly below target population levels. Atlantic sea scallops (adults, juveniles, and larvae), a commercially valuable and relatively immobile, benthic species of invertebrates also inhabits gravelly sand, sandy gravel, and slightly gravelly sand substrates. This species would be vulnerable to both direct, permanent (crushing) and indirect, short-term (sedimentation and turbidity causing reductions in habitat quality) anchoring impacts. Hydroids, a prey item of Winter skates (adults and juveniles) could also be crushed; however, hydroids are ubiquitous organisms in ocean ecosystems. Lastly, shell hash substrates, a biogenic substrate present in both large-grained and complex are important EFH for juvenile and larval red hake, young-of-the-year (YOY) and juvenile winter flounder, and larval and juvenile Atlantic sea scallops, which could be crushed or caused to flee these sheltering habitats.

Dominant bedform features and CMECS substrates within the soft-bottom habitats in the lease area include ripples, linear depressions, trawl scars, and mega-ripples, and medium to fine sands, respectively. Winter flounder (larvae, YOY, juvenile, and adults) and winter skates (adults and juveniles) are soft-bottom EFH species known to utilize medium to fine sandy substrates. Anchoring in these substrates could result in short-term (i.e., fleeing the area) or permanent (crushing of YOY winter flounder and/or attached hydroids) impacts to soft-bottom associated EFH species and prey. Ripples and mega-ripples, which are important bedform features for soft-bottom associated EFH species, including adult Atlantic cod (Gerstner et al., 1998), that can be found sheltering in these areas from currents, could also be damaged.

Effects on EFH and EFH Species:

- Direct
 - Short-term loss/conversion of EFH (Plan 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 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 SRWF are generally medium- to coarse-grained with areas of sand and muddy sand deposits. Hydrodynamic and sediment transport modeling were conducted to assess the sediment suspension and resulting deposition from proposed construction activities associated with the SRWF and SRWEC (COP Appendix H). Model scenarios were developed for each proposed construction activity. The sediment disturbance was evaluated for: 1) excavation of HDD exit pits using a mechanical dredge in NY state (NYS) waters, 2) installation of the SRWEC using jet-plowing in NYS (SRWEC-NYS) and Federal (SRWEC-OCS) waters, and 3) installation of the IAC using jet-plowing in Federal waters.

The hydrodynamic and sediment transport analysis characterized the hydrodynamics within the Project area, the hind-cast results of the Northeast Coastal Ocean Forecast System (NECOFS) model (NERACOOS, UMass Dartmouth Massachusetts Fishery Institution, and MIT Sea Grant College), used the numerical scheme of the FV-COM (Finite-Volume Coastal Ocean Model). The NECOFS hydrodynamic model output was used as input for sediment transport modeling within the Project construction area. The sediment transport model used was the Particle Tracking Model (PTM) in the Surface-Water Modeling System (SMS), was developed by the Coastal Inlets Research Program (CIRP) and the Dredging Operations and Environmental Research Program at the USACE Research and Development Center for the transport and fate of suspended sediments surrounding dredging and sub-surface construction activity. Once the model was validated, a year was selected from the 39-year hindcast that was representative of average annual conditions. A ranking process resulted in the selection of 1997 as being the most representative of average annual conditions.

Surficial sediment characteristics along the SRWEC and in the SRWF were provided from grab samples collected in January 2020 in support of the Project in Federal waters. A single grab sample and the USGS East Coast Sediment Texture Database was used to define the surficial seafloor sediments along the SRWEC in NYS waters and at the HDD exit pit representative location.

General findings from the sediment transport analysis indicated the suspended sediment plume from the proposed construction activities is transient and its location in relation to the sediment disturbance varies with the tidal cycles. The sediment plume is shown to be larger in areas where there are higher percentages of fine-grained surficial seafloor sediments.

The excavation of HDD pits resulted in peak TSS concentrations of 60 milligrams per Liter (mg/L) with concentrations exceeding 50 mg/L within 35 meters (m) of the sediment source. This activity resulted in a 0.07 hectares (ha) area on the seafloor where the deposition thickness was greater than 10 millimeters (mm), extending a maximum of 36 m from the source. The predicted time to return to ambient turbidity levels was 1.2 hours after completion.

For SRWEC-NYS, peak TSS concentrations reached 141 mg/L with concentrations exceeding 100 mg/L within 120 m of the SRWEC route centerline. The maximum deposition thickness was 10.1 mm resulting in a small area (0.0015 ha) having a thickness greater than 10 mm with a maximum extent of 7.5 m from the route. While the time to return to ambient turbidity levels will vary along the SRWEC-NYS route, the time to return to ambient levels was 0.3 hours after completion.

The SRWEC-OCS showed similar results to SRWEC-NYS with peak TSS concentrations reaching 261 mg/L and concentrations exceeding 100 mg/L within 89 m of the SRWEC-OCS route centerline. The maximum

deposition thickness was 12.7 mm resulting in a small area (0.0015 ha) having a thickness greater than 10 mm with a maximum extent of 7.5 m from the route. While the time to return to ambient turbidity levels will vary along the SRWEC route, the time to return to ambient levels was 0.4 hours after completion.

Modeling of the IAC installation had similar results to the SRWEC with peak TSS concentrations up to 305 mg/L and concentrations exceeding 100 mg/L within 120 m of the route centerline. The predicted sediment deposition was less with a maximum thickness of 5.7 mm.

The cumulative impacts of installing two HDD pits sequentially were assessed. The results show the planned spacing between HDD pits (approximately 100 m) is adequate to avoid overlap of sediment deposition from the two sequential activities. Cumulative impacts were also evaluated for the short (approximately 1 km) SRWEC-NYS segment where the two poles of the bundle split to meet the HDD pits in NYS waters. Again, the results indicate there will not be overlap of sediment deposition from the installation of the split SRWEC-NYS.

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 by decreasing habitat quality for benthic species and life stage: small sessile or slow-moving benthic EFH species and life stages (e.g., benthic eggs and larvae) would experience greater impacts from deposition when compared with larger, mobile species and 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 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. Temporary 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 on EFH and EFH Species:

- 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.

Vessel Noise

Vessel noise may interfere with feeding and breeding, alter schooling behaviors and migration patterns (Buerkle 1973; Schwarz and Greer 1984; Soria et al. 1996; Vabø et al. 2002; Mitson and Knudsen 2003; Ona et al. 2007; Sarà et al. 2007) and induce endocrine stress response (Wysocki et al. 2006). Fish communication is mainly in the low-frequency (<1000 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 ~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 (Handegard et al. 2003). Spawning cod present in the area would be particularly vulnerable to this impact as they are sensitive to anthropogenic disturbances (Dean et al. 2022), which likely includes underwater sound. Fish may respond to approaching vessels by diving towards 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 (~10 to 1,000 Hz) emitted by vessels.

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).

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, certain 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 impacted 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 impacted. Demersal and benthic invertebrates would not be anticipated to be impacted as a result of increased noise from vessels associated with construction of the proposed Project. Therefore, EFH-designated fish within the SRWF may initially exhibit a negative behavioral response to vessel activity; however, as vessel traffic increases throughout the 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 on EFH and EFH Species:

- 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.

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 (NPDES) 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
 - Low likelihood, but potentially long-term and wide-spread 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
 - 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

Underwater Sound

Acoustic impacts from construction of the proposed Project would result primarily from pile driving activities related to installing the WTGs and OCS monopile or jacket foundations and the temporary pile-supported trestle. 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 (μPa).

All fish perceive the particle motion component of sound and have sensory structures in the inner ear that function to detect particle motion (Popper and Hawkins 2018; Nedelec et al. 2016). 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). 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. However, 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 or behavioral reactions such as temporary displacement or temporary disruption of normal activities such as feeding or movement. 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 injury thresholds for fish were developed by the Fisheries Hydroacoustic Working Group (2008) and Popper et al. (2014) and are provided in Table 5-1.

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 susceptible to 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 the 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).

Very little is known about the sensitivity of aquatic animals to the energy that is generated within and close to the substrate (Hawkins et al. 2021). Roberts et al. (2015) observed behavioral changes to blue mussels (*Mytilus edulis*) in response to experimental seabed vibration stimulus. The responses show that a vibration is likely to impact the overall fitness of both individuals and beds of blue mussels. It is not

known how energetically costly the behaviors exhibited in their experimental work were, or to what extent they would affect the long-term fitness of the animals (Roberts et al. 2015). Sound-detection organs vary widely among fishes and invertebrate species, and it is likely that detection capabilities and sensitivities may differ substantially between species (Hawkins et al. 2021).

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 guidelines or thresholds for particle motion exposure currently not possible (Popper et al. 2014; Popper and Hawkins 2018).

Table 5-1. Acoustic Metrics and Thresholds for Fish for Impulsive Pile Driving

Fish Type	Physiological Effects		Behavioral Disturbance ^c
	L_{pk} (dB re 1 μ Pa)	$L_{e, 24\text{ hr}}$ (dB re 1 μ Pa ² s)	L_p (dB re 1 μ Pa)
	Impulsive	Impulsive	Impulsive/Non-Impulsive
Fish (\geq 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 μ Pa = decibels relative to 1 micropascal; dB re 1 μ Pa²s = 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

Impact Pile Driving

Underwater noise generated by impact pile driving is one of the predominant IPFs that could result in potential physiological and behavioral impacts on EFH species due to the relatively high source levels produced by impact pile driving and the large distances over which the noise is predicted to propagate. Up to 94 WTG foundations and 1 OCS–DC foundation with four legs would be installed. The typical SRWF WTG foundation pile installation would require approximately 1 to 4 hours of impact pile driving to a final embedment depth of 164 ft (50 m) below the seafloor, with some difficult installations potentially taking up to 12 hours to install due to more difficult substrate conditions. After installation, the WTG would be placed on top of the foundation pile and the vessels would be repositioned to the next site. Between one and three WTG monopile foundations may be installed per day.

Monopile foundations for WTGs will be up to 7/12 m in diameter and installed using an impact pile driver with a maximum hammer energy of up to 4,000 kilojoules (kJ). The pin piles used to secure the OCS–DC piled jacket foundation will be up to 13 ft (4 m) in diameter and installed using an impact pile driver with a maximum hammer energy of up to 4,000 kJ. The exact location and number of piles to be installed each day is uncertain, thus five scenarios are summarized in the following list. The first two scenarios assumed consecutive (non-simultaneous) pile installation while the third through fifth scenarios assumed concurrent (simultaneous) pile installations:

1. Consecutive installation of two WTG monopiles or four OCS–DC pin piles consecutively in 1 day for 51 days.
2. Consecutive installation of three WTG monopiles or four OCS–DC pin piles consecutively in 1 day for 34 days.
3. Concurrent installation of four WTG monopiles in 1 day, two each by two different installation vessels operating concurrently in close proximity to each other (“Proximal”, i.e., 3 NM apart) for 25.5 days, plus four OCS–DC pin piles per day for 2 days.
4. Concurrent installation of four WTG monopiles in one day, two each by two different installation vessels operating concurrently at long distances from each other (“Distal”, i.e., opposite ends of the SRWF) for 25.5 days plus four OCS–DC pin piles per day for 2 days.
5. Concurrent installation of two WTG monopiles and four OCS–DC pin piles in one day by one vessel and two WTG monopiles per day by a second vessel operating concurrently for 2 days and then two WTG monopiles per day by a single vessel for 47 days.

For the OCS–DC foundation, the jacket foundation would be placed first, with the pin pile placed through the jacket and driven to its penetration depth (295 ft [90 m]). Pile driving of each pin pile may take up to 48 hours. Because separate vessels are anticipated to be used for WTG and OCS–DC foundation installations, these activities may occur concurrently. Pile driving activities will occur on up to 51 days between May 1 and December 31; no pile driving activities will occur between January 1 and April 30.

The applicant proposes a number of APMs to reduce noise propagation during pile driving. The Project will use bubble curtains, hydro-damper, AdBm, and/or Helmholtz resonator to reduce noise propagation during monopile foundation pile driving. The Project is committed to achieving ranges associated with 10 dB of noise attenuation. The final selection of the single or suite of technologies that comprise NAS will be dependent upon the pile and environmental characteristics of the piling location. In addition, passive acoustic monitoring (PAM) for protection of cetaceans which will also be protective of EFH and EFH species, and will monitor for cod vocalizations as well. There will be a PAM operator on duty conducting acoustic monitoring in coordination with the visual PSOs during all pre-start clearance periods, piling, and post-piling monitoring periods. During pile-driving activities, ramp up procedures will be used, allowing mobile resources to leave the area before full-intensity pile-driving begins. No pile installation will occur from 01 January to 30 April.

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, and sharks), 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 5-2.

Table 5-2. 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, and some tunas,	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

Noise from impact pile driving for the installation of WTGs and OCS foundations would occur intermittently during the installation of offshore structures. A total of 94 foundations for WTGs and one for the OCS are anticipated for the proposed Project. Each WTG requires one monopile and each pile requires 1 to 4 hours of continuous driving to install, with a maximum continuous driving time of 12 hours. The OCS foundation requires 8 monopiles. 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.). Dimensions of the piles considered during modeling were: 8 to 12-meter tapered monopiles (23 feet [7 meters] at the waterline and 39 feet [12 meters] at the mudline. Impact hammer installation of the monopile foundations would produce the most intense underwater noise impacts with the greatest potential to cause injury-level effects on fish; therefore, these effects are the focus of the assessment below. Sound fields from 7/12-meter monopiles were modeled at one representative location in the Offshore Project area using IHC S-4000 impact hammers. The modeling also used a 10-decibel (dB)-per-hammer-strike noise attenuation to incorporate the use of a single noise-abatement system¹ (e.g., one or multiple bubble curtain[s]). This attenuation is considered achievable with currently available technologies (Bellmann et al. 2020). The resulting values represent a radius extending around each pile where potential injurious-level or behavioral effects could occur and are presented in Table 5-3.

¹ Note that the noise-abatement system implemented must be chosen, tailored, and optimized for site-specific conditions.

Soft start during impact pile driving is a mitigation technique that involves the gradual increase in hammer blow energy to allow marine life to leave the area.

Although some fish may move during pile driving, they were considered static receivers and acoustic distances where sound levels could exceed fish regulatory thresholds were determined using a maximum-over-depth approach and finding the distance that encompasses at least 95 percent of the horizontal area that would be exposed to sound at or above the specified level (Küsel et al. 2022).

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 - R95% (km) ^a	Pin Piles - R95% (km) ^b
Fish ≥ 2 grams	LE,24h	187	8.66	4.05
	Lpk	206	0.07	0.06
	Lrms	150	7.54	5.32
Fish < 2 grams	LE,24h	183	11.59	5.69
	Lpk	206	0.07	0.06
	Lrms	150	7.54	5.32
Fish without swim bladder	LE,24h	216	0.43	0.06
	Lpk	213	0.02	0.01
Fish with swim bladder not involved in hearing	LE,24h	203	2.38	0.64
	Lpk	207	0.07	0.05
Fish with swim bladder involved in hearing	LE,24h	203	2.38	0.64
	Lpk	207	0.07	0.05

Source: Küsel et al. 2022

a Maximum R95% (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 R95% (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; *R95%* = maximum acoustic range at which the sound level was encountered after the 5% farthest points were excluded; *LE,24h* = cumulative sound exposure level over 24 hours; *Lpk* = peak sound pressure level; *Lrms* = sound pressure level root mean squared

The single-strike (or peak sound pressure level [L_{pk}]) injury distances represent how close a fish would have to be to the source to be instantly injured by a single pile strike. The cumulative injury distances consider 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 distances for behavioral effects are instantaneous values, 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 show that injury from a single strike is limited to 70 meters from the pile for both winter and summer seasons and injury from prolonged cumulative exposure (over 24 hours) extends as far as 9.35 kilometers from the pile during the winter water profile. Modeling indicates that behavioral effects on fish could occur up to 7.54 kilometers from the pile source during the winter and 5.18 kilometers from the pile source during the summer. Within this area, it is likely that some level of behavioral reaction is expected and could include startle responses or migration out of areas exposed to underwater noise (Hastings and Popper 2005). Behavioral disturbance to fish from pile driving noise is therefore considered temporary for the duration of the activity. To mitigate impacts to the extent practicable, the Project would employ a bubble curtain. 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.

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. 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 SRWF 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 such as Atlantic cod). With no attenuation (0 dB), these species are potentially subject to mortality or mortal injury at over a thousand meters from the noise source, depending on the type of monopile or jacket being installed. Mortality appears to occur most often when fish are within 30 ft (9.1 m) of driving of relatively large diameter piles (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 ft (2.4 m) in diameter, whereas Ruggione et al. (2008) found no mortality to caged yearling coho salmon (*Oncorhynchus kisutch*) placed as close as 2.0 ft (0.6 m) from a 1.5-ft (0.45-m) diameter pile and exposed to more than 1,600 strikes.

Hearing specialization is often associated with intra-specific communication that can be disrupted by changes in the ambient noise environment. For example, spawning Atlantic cod communicate using low-

frequency grunts to locate potential mates and signal fertility (Rowe and Hutchings 2006; Stanley et al. 2017). However, Brawn (1961) reported that cod grunt during both aggression and spawning. Noise from pile driving could potentially have an impact on cod reproduction by reducing the efficiency of these vocalizations (Stanley et al. 2017).

Environmental stressors such as noise can cause masking, which could interfere with communication and potentially disrupt spawning activity (Rowe and Hutchings 2006). Underwater noise sufficient to alter behavior could have disruptive effects on Atlantic cod spawning (Dean et al. 2012), especially at night, as Atlantic cod courtship and spawning behaviors occur primarily at night (Dean et al. 2014; Zemeckis et al. 2019). However, once the environmental stressor (noise) is discontinued, the masking stops. Monopile installation for the Project is the most likely to produce impacts that would temporarily disturb aggregated Atlantic cod during spawning season. A few species with an air bladder not involved in hearing have designated EFH in the SRWF (Category 2, i.e., yellowfin tuna, bluefin tuna). Mortality and potential mortal injuries from cumulative pile-driving noise to species with an air bladder not involved in hearing could occur within a maximum range of 3,786 to 4,829 feet (1,154 to 1,472 meters) from the source with no attenuation (Popper et al. 2014). 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-impacted species with EFH designated in the SRWF include those species in Category 1, such as invertebrates, sharks, 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). Mortality and potential mortal injury from pile driving sound for these species has the smallest radius, ranging from 755 to 1,152 ft (230 to 351 m) with no attenuation. 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.

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 impacted 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 on EFH and EFH Species:

- 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.

Habitat Loss/Conversion

Development of the SRWF would include installation of 94 WTGs and their foundations, and one OCS-DC and foundation. The installation of the WTGs and OCS-DC 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 SRWF.

Impact footprints for WTG foundations intersect complex, large grain complex and soft bottom habitat types. Impact footprints for OCS-DC foundations intersect complex and soft bottom habitat types. WTG foundation footprints would permanently impact all three habitat types, with each 39-ft (12-m) turbine foundation footprint permanently altering approximately 0.03 acres (121.41 m²) of benthic substrate, for a total of 2.82 acres (1.14 hectares) of benthic impacts. OCS-DC foundation footprints would permanently alter approximately 0.24 acres (0.097 hectares).

The WTG and OCS foundations would displace approximately 2.39 acres (0.97 hectares) of complex habitat, 0 acres of large grained complex habitat, and 2.25 acres (0.91 hectares) of soft bottom habitat. These habitats would no longer be available to EFH species such as gadids, flatfish, and skates for the life of the Project.

An estimated 47.89 acres (19.38 hectares) of complex habitat, 0.11 acres (0.04 hectares) of large grained complex habitat, and 62.76 acres (25.4 hectares) of soft bottom habitat would be modified by placement of scour protection around the WTG and OCS 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 could 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 intermediate-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.

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.

The artificial reef effect created by offshore structures like WTGs is well documented and can have a beneficial effect on many marine species (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 (Floeter et al. 2017; McCandless et al. 2014). On balance, and due to the relatively localized spatial extent of the project, the reef effect of offshore windfarms is likely to produce a neutral effect on EFH. Any potential beneficial effects could be offset if the colonizable habitats provided by offshore wind energy structures aggregate predators and prey, increasing predation risk, or provide steppingstones for non-native species invasions (Gill 2005; Raoux et al. 2017). The net effect of WTGs on pelagic EFH is likely to be neutral to adverse depending on species-specific responses, with the recognition that beneficial effects could be negated should these structures inadvertently promote the establishment of invasive species. In addition to reef effects, the WTGs are likely to create localized hydrodynamic effects that could have localized effects on food web productivity and pelagic eggs and larvae. Hydrodynamic effects on EFH are described further 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, largescale food web shifts are not expected due to the installation of WTGs and conversion of pelagic habitat to hard surface. EFH and life stages likely to experience adverse to neutral impacts from the long-term alteration of pelagic habitats by the WTG and OCS foundations include gadid eggs and larvae, flatfish eggs and larvae, pelagic juvenile and adult fishes, all life stages of various shark species, and squid juveniles and adults.

Effects on EFH and EFH Species:

- Direct
 - Long-term 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 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
 - Long-term 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.
 - Long-term beneficial effects to EFH and EFH species.

Drilling

In typical situations, piles are driven until the target embedment depth is met, then the pile hammer is removed and the monopile is released from the pile gripper. If unfavorable sediment conditions do not allow pile driving, a drive-drill-drive solution could be required. In some cases, instead of hammer piling or drilling, vibropiling could be used to embed the foundation with vibration.

If pile driving for the entire piling installation is not possible due to the presence of rock or hard sediment in some lower part of the substrate, the drive and drill method would be used. When the pile meets a point where it cannot be advanced (referred to as refusal), the monopile would be drilled out below the pile tip (typically several feet). Then, the piling would be resumed and piled to its final position. If refusal occurs again, the drilling/driving would continue until the monopile has reached its final position.

If drilling occurs during WTG and OCS foundation installation, direct impacts to benthic EFH and sessile or slow-moving EFH would occur. It is unclear whether or not the sound emitted by marine drilling activities impacts fish. The available literature suggests that noise effects on fish produced by continuous drilling operations may mask acoustic signals conveying important environmental information (McCauley 1998, Popper et al. 2014). Masking may arise when sounds exceed the hearing thresholds of fish and it is probable that, within close proximity to drilling operations, sounds would reach above the recommend thresholds. McCauley (1998) determined that any noise effects to fish from marine drilling activity would likely be temporary behavioral changes within a few hundred meters of the source. For instance, measured source levels during drilling operations reached 120 dB at 3–5 km, which may have caused fish avoidance (McCauley 1998). Recordings of planktivorous fish choruses were still active during drilling operations off the coast of the Timor Sea; however, it is likely that partial masking of their calls would have occurred (McCauley 1998). The sounds emitted by marine drilling operations for wind farm construction are expected to be short-term and intermittent. It is therefore unlikely that the acoustic characteristics of this source will cause prolonged acoustic masking to fish and the risk of impact from this activity is expected to be low.

There are no data on the effect of sound from drilling on marine invertebrates. However, evidence from research on the levels of particle motion associated with behavioral responses in blue mussels indicates that the threshold of sensitivity in this species falls within vibration levels measured near blasting, pile driving, and impact drilling (Roberts et al. 2015). Only a small number of studies have indicated reception of vibration in bivalves and an associated behavioral response, which included closing syphons and, in more active mollusks, moving away from the substrate (Mosher 1972, Ellers 1995, Kastelein 2008). Anticipated drilling for the Project is typically short duration and intermittent, so it is unlikely that drilling has more than short-term consequences. Risk of impact to invertebrates from sounds emitted by marine drilling are expected to be low.

Drill spoils could cause short-term and localized increases in turbidity through sediment suspension and localized direct impacts to sessile or slow-moving organisms through sediment deposition and burial. Moreover, drill spoil would cause direct, short-term impacts on benthic habitat through habitat conversion around the perimeter of each foundation.

Effects on EFH and EFH Species:

- Direct
 - Short-term, local increases in turbidity: 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.
 - Short-term, local deposition and burial: Sessile Benthic/Epibenthic – Soft Bottom; Sessile Benthic/Epibenthic – Complex Habitat; Prey Species – Benthic/Epibenthic.
- Indirect
 - Short-term decrease in prey availability and foraging opportunities: Mobile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Complex Habitat; Pelagic; Prey Species – Pelagic.

5.1.1.3 Seabed Preparation (including UXO Removal)/Boulder Re-location/Dredging

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 39-foot (12-meter) turbine foundation footprint would permanently alter approximately 0.07 acres (0.03 hectares) of benthic substrate, for a total of 2.82 acres (1.14 hectares) of benthic impacts. OCS-DC foundation footprints would permanently alter approximately 0.24 acres (0.097 hectares). Prior to installation of WTG and OCS foundations, seabed surface preparation may be required. An estimated 47.89 acres (19.38 hectares) of complex habitat, 0.11 acres (0.04 hectares) of large grained complex habitat, and 62.76 acres (25.4 hectares) of soft bottom habitat would be modified by placement of scour protection around the WTG and OCS 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. To prepare the seabed prior to installation, excavation may be required where debris is buried or partially buried.

Sand and Muddy Sand was the primary habitat type mapped within the SRWF (33,710 acres; approximately 56 percent of the area); Coarse Sediment was also mapped within the SRWF (22,723 acres; approximately 38 percent of the area) (see Table 3-2).

The occurrence of boulders is often an indicator of the presence of glacial moraine. Any boulders within close proximity to each monopile and the IAC 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 OCS foundations may be required depending on the seabed and the foundation type. Other foundation preparation activities would include leveling of sand waves and removal of surface or subsurface debris. Excavation may be required where debris is buried or partially buried. Depending on micro-siting of each foundation, short-term seafloor disturbance would take place within an

approximately 3,798.8-acre (1,552 hectares) area, comprised of 1,586.5 acres of complex habitat, 22.9 acres of large grain complex habitat, and 2,189.4 acres of soft bottom habitat. 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 as 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 OCS 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, large grain complex, and soft bottom benthic habitats during one or more life stages. IAC, 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.

Benthic or epibenthic eggs that occur within the SRWF project area could be exposed to lethal crushing, burial, or entrainment effects. This includes eggs and larvae of selected EFH species, and eggs and larvae that provide prey for EFH species. Pelagic eggs and larvae of Atlantic cod and the pelagic eggs of red hake, two species of federally managed fish that are currently below target population levels and that have rebuilding plans in place, would be particularly vulnerable to mortality from entrainment effects. Crushing and burial impacts result from the placement of material on the substrate and would be lethal for benthic and epibenthic eggs and larvae that do not have the ability to avoid the area. The following EFH species with benthic, epibenthic, or pelagic eggs or larvae that may be exposed to crushing, burial, or entrainment effects during SRWF construction and installation:

EFH species with benthic or epibenthic adults that occur within the SRWF project area could be exposed to lethal crushing, burial, or entrainment effects. Adults of EFH species in the area are likely to exhibit behavioral avoidance responses and would not be subject to lethal crushing, burial, or jet plow entrainment effects. However, during placement of material on the substrate, there is potential for adult fish utilizing benthic or epibenthic habitats to be crushed or buried. For example, Ocean pout, monkfish, winter flounder, winter skates, little skates, Atlantic cod, and red hake are benthic or epibenthic EFH species known to be associated with the various bedform features (i.e., low- to medium-boulder fields, ripples, and linear depressions) and CMECS substrate subgroup types (e.g., gravelly sand, sandy gravel, coarse sand, medium sand, and fine sand) present in each lease area zone and subject to impacts from seabed preparation for WTG and OSS foundations. Ocean pout, a species of fish that guards benthic nests, could be seasonally vulnerable to being crushed or buried. Benthic invertebrates and other prey organisms targeted by these species would be killed or otherwise rendered inaccessible by burial and entrainment effects. While unlikely, use of the jet plow during the inter-array cable installation could result in lethal entrainment of adult fish within the disturbance area. EFH species having benthic or epibenthic adult life stages that are known or likely to occur within the spatial extent of crushing, burial, and jet plow entrainment effects from SRWF construction and installation include:

Effects on EFH and EFH Species:

- Direct
 - 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.
- Indirect
 - Short-term loss of benthic prey items: Mobile Benthic/Epibenthic – Soft Bottom; Mobile Benthic/Epibenthic – Complex.

Sediment Suspension

Seabed preparation activities (e.g., removal of debris or seabed leveling) would result in short-term and localized resuspension and sedimentation of finer grain sediments. Hydrodynamic and sediment transport modeling were conducted to assess the sediment suspension and resulting deposition from proposed construction activities and are detailed in Section 5.1.1.1. Modeling demonstrated that sediments within the SRWF would return to ambient levels within 0.4 hours after the disturbance was completed. 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.

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 would be 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. These changes could include additional micro siting 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 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 remains unknown but would 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 is 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).

Underwater Sound (UXO/MEC Detonation)

Sunrise Wind may encounter UXOs on the seabed in the Lease Area and along export cable routes. While low impact deflagration is proposed to remove these items, 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. Sunrise 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	Lpk, 0-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 μ Pa = decibels relative to 1 micropascal; kg = kilograms; Lpk = 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) suggests 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 impacted 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.

The applicant has proposed APMs to mitigate noise exposure from UXO detonation events. These include no UXO detonations from December through April and UXO detonations during nighttime hours. Sunrise Wind will use an NAS for all UXO detonation events and is committed to achieving the modeled ranges associated with 10 dB of noise attenuation. If a NAS system is not feasible, Sunrise Wind will implement mitigation measures for the larger unmitigated zone sizes, with deployment of vessels or use of an aerial platform adequate to cover the entire clearance zones.

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.

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

Habitat Conversion

The WTGs would extend up to 459 feet (140 meters) above mean sea level (AMSL) with the upper blade tip height of 787 ft (240 m) AMSL, with a spacing of 1.15 by 1.15 miles between WTGs in an east-west/north-south orientation that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA and MA WEA within the 5,743.8-acre SRWF. The WTGs would be mounted on monopile foundations, and OCS 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 13.1 feet (4 meters) in height, would extend away from the foundation as far as 66 feet (20 meters). Each WTG would contain about 1,850 gallons (7,000 liters) of transformer oil and 238 gallons (900 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 SRWF would include installation of 94 WTGs and their foundations, and the OCS-DC and foundations. The installation of the WTG and OCS-DC would permanently alter 108.12 acres (43.7 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 SRWF.

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 OCS-DC foundations and associated scour protection, where required. It is anticipated that mobile life stages would move out of the area to avoid potential impacts. However, as more wind farms are installed the construction impacts become additive and species may not be able to entirely avoid effects. Demersal non-mobile life stages would be impacted 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 SRWF footprint. EFH-designated species that would likely be impacted by crushing and burial effects of installation of scour protection are similar to those listed in Section 5.1.1.1.

Effects on EFH and EFH Species:

- Direct
 - Long-term 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 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
 - Long-term 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.
 - Long-term beneficial effects to EFH and EFH species.

Sediment Suspension

Installation of the WTGs and the OCS-DC, as well as scour protection, would disrupt 108.12 acres (43.7 hectares) of benthic habitat. Hydrodynamic and sediment transport modeling were conducted to assess the sediment suspension and resulting deposition from proposed construction activities and are detailed in Section 5.1.1.1. Modeling demonstrated that sediments within the SRWF would return to ambient levels within 0.4 hours after the disturbance was completed. 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 OCS-DC locations. EFH-designated species that would likely be impacted sediment suspension due to the of scour protection are similar to those listed in Section 5.1.1.1.

Effects on EFH and EFH Species:

- 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.
 - 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.

5.1.1.5 Inter-Array and Offshore Export Cable Installation

IAC and offshore export cable impact footprints would be dominated by the sand and muddy sand benthic habitat type. Cable impact footprints would include areas that could be impacted 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 cables may potentially impact approximately 1,945 acres (787.1 hectares), primarily categorized as soft bottom (61 percent) with some area categorized as complex (39 percent) and no large grain complex (0 percent). Cable protection may be required for up to 15 percent of the route (up to 139 acres [56.3 hectares]), with the project design envelope allowing for up to 180 acres (72.8 hectares) with a

maximum disturbance corridor width of 98ft (30 m) per circuit for the IAC. The majority of the area that could be impacted by cable protection is classified as soft bottom.

The impact footprints associated with the SRWEC-OCS and SRWEC-NYS intersect 368 acres complex substrate, and 33,869 acres (13,706.3 hectares) of soft bottom habitat. Impact footprints include those for seabed preparation activities, cable installation, installation of cable protection, and anchoring and sediment excavation associated with HDD at landfall. Short-term disturbance activities to prepare the seafloor and lay the cable may potentially impact approximately 2,150 acres (870.1 hectares) of the seafloor, primarily soft bottom habitat (61 percent) with the remainder classified as complex (39 percent). Cable protection may be required for up to 15 percent of the route (up to 139 acres 56.3 hectares]), Most of the area that could be impacted by cable protection was classified as soft bottom. Cofferdam and HDD activities would result in less than 6.5 acres (2.6 hectares) of short-term disturbance.

Primary habitats along the SRWC-OCS were characterized primarily by sandy and muddy sand (Table 3-2, Figure 3-5). The SRWEC-OCS included large grained, complex, and soft bottom primary habitats (Figure 3-9). Coarse sediment habitats were observed along the export corridor near the SRWF and near the state waters boundary but the majority of the mapped area was sand and muddy sand habitats with discrete areas of mud and sandy mud habitats and one area of mixed sediment – small gravel and sand habitat near where the corridor shifts to the west. Considering habitats with modifiers, sand and muddy sand was the most prevalent habitat type mapped at the SRWEC–OCS (50 percent), followed by sand and muddy sand – mobile (36 percent), and mud and sandy mud (9.4 percent). Coarse sediment – mobile made up 3.4 percent of the SRWEC–OCS. No boulder fields were mapped although individual boulders were identified in the portions of the corridor located further offshore.

Biotic subclasses in the SRWEC-OCS were soft sediment fauna and attached fauna (Figure 3-10). The hard coral *Astrangia poculata*, a sensitive taxa, was not observed. Cerianthids (burrowing anemones) were observed at two stations in sand and muddy sand habitat where the corridor shifts to the west.

The sand and muddy sand habitats in the SRWEC-OCS were characterized by CMECS subgroups medium, fine, and very fine sand and accounted for 40 of the 81 SPI/PV ground-truth sites (Figure 3-11). Sand and muddy sand (mobile) included a coarse sand in the subgroup and accounted for 29 of the survey sites. The subgroup of very fine sand was present intermittently (9 sites) along the OCS corridor, coincident with mud and sandy mud. Gravelly sand, very coarse and coarse sand subgroups occurred at a total of 3 survey sites.

The spatial distribution of seabed composition was also reflected in the biological component of the benthic environment along the SRWEC–OCS. Generally, the western portion of the SRWEC–OCS was characterized by high densities of sand dollars while the eastern portion of the SRWEC–OCS was inhabited by burrowing anemones and sea stars. Gravel was not a substantial proportion of the sediments along the SRWEC–OCS and was not greater than 5 percent cover at any station, with the exception of two stations both of which were composed of Gravelly Sand (CMECS Substrate Subgroup; i.e., 5-30 percent cover of gravel), with pebble/granule being the largest gravel at these two stations. A total of 19 percent of the SPI/PV sample stations included burrowing anemones.

SRWEC-NYS waters were characterized by soft sediments ranging from very fine sand to medium sand (Table 3-2, Figure 3-5) with evidence of generally low organic matter content and evidence of benthic microalgae at many survey stations. Macrohabitat characteristics indicated greater bedload transport nearer to shore with more distinct ripples in the sand as well as greater suspended material which

contributed to higher turbidity. This trend indicates decreasing wave action effects proceeding from shallower waters out into deeper areas.

The SRWEC–NYS area included all primary benthic habitats except glacial drift. Coarse sediment habitats were found near the point where the SRWEC–NYS portion of the Project area widens nearshore (Figure 3-9). The majority of the SRWEC–NYS was composed of sand and muddy sand habitats. Of the habitats with modifiers, sand and muddy sand was the most prevalent (67 percent), followed by coarse sediment – mobile (15 percent), and sand and muddy sand – mobile (14 percent). Coarse sediment – mobile with medium/high density boulder fields made up < 1 percent of the SRWEC–NYS. Biotic subclasses (Figure 3-10) were dominated by soft sediment fauna. The hard coral *Astrangia poculata*, a sensitive taxon, was not observed, and cerianthids (burrowing anemones) were observed and were prevalent in sand and muddy sand habitats just inshore of the state waters boundary.

The sand and muddy sand habitat in the SRWEC-NYS waters were characterized by CMECS subgroups fine and very fine sand. Fine sand subgroups occurred at the single sand and muddy sand with boulder field site nearer shore and the sand and muddy sand. Coarse sediment habitat was characterized by medium, fine, and very fine sand subgroup.

The landing (landfall) area for the SREC includes up to 6.5 ac (2.6 ha) for up to three HDD cables, temporary anchoring walls, and drilling rig, in addition to 2.5 ac (1 ha) for the beach stringing area and trenching to the ICW-HDD crossing. Coastal habitats in the landing area relevant to the EFH assessment include those located within state waters and inland to the mainland, inclusive of bays and back-barrier lagoons (USFWS 1997) that separate the barrier islands from the coastal mainland on the Long Island south shore. At landfall, the cables intercept coastal habitats associated with the landfall/ICW-HDD work areas on Fire Island including maritime beaches, dunes, and grasslands, although the landfall/ICW work area on the mainland is primarily developed. The onshore facilities correspond with existing developed areas including parking lots and paved roadways.

The SRWEC-NYC intercepts the soft bottom sand before it reaches shore and emerges in the paved parking area at Smith Point County Park. From there, the cable corridor follows roadways and existing infrastructure until it meets the location of the ICW-HDD.

The ICW-HDD crossing included two primary habitats sand and muddy sand and coarse sediment. Sand and muddy sand was the dominant habitat type mapped and coarse sediment habitats were found along the ICW west of the bridge, coincident with the dredged navigational channel, and was represented by coarse sediment (Table 3-2).

Benthic habitat complexity categories were complex and soft bottom (Figure 3-12). Complex categories included present/potential presence of benthic macroalgae and/or SAV. Of the habitats with modifiers, sand and muddy sand was the most prevalent habitat type mapped within the ICW-HDD crossing (74 percent), followed by sand and muddy sand with recent and/or potential SAV and/or benthic macroalgae (18 percent), and coarse sediment (7 percent). Sands were observed except in coarse sediment habitats where gravelly sand and sandy gravel was recorded. Sand and muddy sand habitats were dominated by areas of potential and occurring benthic macroalgae and SAV, primarily on the west side of the ICW bridge (Figure 3-10).

Biotic subclasses included attached and soft sediment fauna (Figure 3-13). Coarse sand habitats in the ICW-HDD channel included 3 of the 8 SPI/PV ground-truth sites and were characterized by the sandy

gravel, gravelly sand CMECS subgroup (Figure 3-14). Vegetated habitats (2 sites) and sand and muddy sand (3 sites) occurred along the shore were both characterized by sand or finer CMECS subgroups.

The ICW-HDD were more than 5 percent cover of gravel and were classified with the CMECS substrate group of either gravel mixes or gravelly. The remaining ICW-HDD area were classified as sand or finer. The Biotic Subclass of attached fauna occurred at stations composed of gravel, and the mobile sand present at the other stations in the ICW-HDD were classified with the Biotic Subclass of soft sediment fauna and included habitat for sensitive life stages present Bryozoa and serpulid tubes. HAPC for summer flounder includes entire aquatic area of ICW.

Underwater Sound (UXO/MEC Detonation)

Sunrise Wind may encounter UXOs on the seabed 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. Sunrise Wind conducted modeling of acoustic fields for UXO detonations and ranges to physiological injury were calculated (Hannay and Zykov 2022). Threshold levels and impacts are the same as described in Section 5.1.1.3.

5.1.1.6 Vessel Activity

Habitat Disturbance

During installation of the IAC and SRWEC, up to 33 vessels would simultaneously lay and bury the cable using a mechanical plow, aided by a pull anchor and tugboat, while one vessel would be needed when using a jet plow. 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.

Maximum total IAC length is approximately 180 miles (290 km). Maximum total offshore export cable length is approximately 106 miles (170 km). Short-term disturbance activities to prepare the seafloor and lay the SRWEC and landfall HDD cables may potentially impact approximately 1,270.2 acres, primarily categorized as soft bottom (93 percent), with some area categorized as complex (7 percent) and no large grain complex (0 percent). Impacts to EFH would be expected to be similar to those listed in Section 5.1.1.1.

Localized impacts on sessile and or slow-moving benthic resources would occur in these areas. Sessile demersal and benthic life stages such as eggs and larvae would be subject to mortality from these activities. In addition, sessile and slow-moving benthic invertebrates such as bivalves would also likely be subject to mortality because of these activities. Mobile benthic organisms would be temporarily displaced by the anchors. Certain construction vessels would require stabilization spuds. The spuds would cause some localized direct impacts where they meet the sediment. Vessels may also have a direct impact via organism entrainment while taking on ballast water and engine cooling. Impacts from increased vessel traffic and construction activities would be short-term and localized in nature.

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. Within these areas 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.

IAC installation would occur during Q3 of 2024 to Q1 of 2025, and offshore export cable installation would occur during Q1 of 2024 to Q4 of 2024. 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 OCS foundation installation discussed in Section 5.1.1.1.

Sediment Suspension

In general, vessel activities associated with cable installation would cause short-term impacts to water quality intermittently throughout Project construction. Hydrodynamic and sediment transport modeling were conducted to assess the sediment suspension and resulting deposition from proposed construction activities and are detailed in Section 5.1.1.1. Modeling demonstrated that sediments within the SRWF would return to ambient levels within 0.4 hours after the disturbance was completed. 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.

Vessel Noise

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

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.

5.1.1.7 Seabed Preparation (including UXO removal/Boulder re-location/Dredging)

Habitat Alteration

Seabed preparation may be required prior to installation of IAC and SRWEC and could 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. Short-term disturbance activities to prepare the seafloor may potentially impact approximately 3,798.8 acres (1,537.3 hectares), primarily categorized as soft bottom 2189.4 acres (886.0 hectares), with some area categorized as complex 1586.5 acres (642.0 hectares) and heterogeneous complex 22.9 acres (9.3 hectares).

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, large-grained complex, and soft bottom benthic habitats during one or more life stages. IAC and SRWEC 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 on EFH and EFH Species:

- 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.
 - 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 Suspension

Seabed preparation and subsequent sediment suspension prior to installation of IAC would take place within areas that were previously disturbed during the seabed preparation activities associated with WTG and the OCS-DC foundation installations. Hydrodynamic and sediment transport modeling were conducted to assess the sediment suspension and resulting deposition from proposed construction activities and are detailed in Section 5.1.1.1. Modeling demonstrated that sediments within the SRWF would return to ambient levels within 0.4 hours after the disturbance was completed. Similar impacts to EFH species are expected to occur. Sand re-deposition would be minimal and close in vicinity to the trench centerline, minimizing impacts to demersal fish eggs. 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.

- 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.
 - 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.

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-percent mortality of entrained individuals. 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 and the limited volume of water withdrawn, BOEM does not expect population-level impacts on any given species.

Effects on EFH and EFH Species:

- 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.

Underwater Sound

As previously discussed, 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 IAC includes boulder clearance of 59.3 acres (24 hectares) and sandwave clearance of 118.5 acres (48 hectares).

Effects on EFH and EFH Species:

- 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.

5.1.1.8 Trenching/Cable Installation

Habitat Loss/Conversion

The installation of IAC 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 IAC length is 180.2 miles (290 km). IAC 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. An estimated 2,150 acres (870.07 hectares) of short-term benthic disturbance is anticipated during the IAC installation process. 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 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. Hydrodynamic and sediment transport modeling were conducted to assess the sediment suspension and resulting deposition from proposed construction activities and are detailed in Section 5.1.1.1. Modeling demonstrated that sediments within the SRWF would return to ambient levels within 0.4 hours after the disturbance was completed. 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.

Offshore export cables would be placed by the same methods listed above for IAC, depending on site conditions. The installation disturbance area is 104.6 miles (168.3 km). Direct impacts to EFH due to habitat disturbance are expected within the designated 98-foot-(29.9-m)-wide cable corridor along the entire length of each corridor. An estimated 1,259 acres (59.5 hectares) of short-term benthic disturbance is anticipated during the offshore export cable installation process, and approximately 25.2 acres (10.2 hectares) of long-term benthic habitat disturbance is anticipated during the cable installation. Impacts are expected to be similar to those of the IAC and substation interconnection cables.

The estuarine portion of the SRWEC-NYS would be affected by cable installation. These areas have a more diverse fish assemblage compared to the SRWF. 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. During cable installation, 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 impacted by the loss of SAV habitat during construction.

HAPC for juvenile and adult summer flounder is likely to be temporarily impacted from Project activities. 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. All impacts to HAPC would be short-term and limited to the duration of construction.

Anchoring of vessels within New York State waters will only occur during the scope of work associated with the following activities: 1) installation and use of Temporary Equipment to receive the transit barge during construction activities in Smith Point County Park; 2) horizontal directional drill (HDD) and cable pull-in for the Landfall HDD; and 3) installation of temporary measurement buoys. Anchoring is not planned for 1) installation of the ICW HDD; 2) installation of the SRWEC-NYS; or 3) trials of installation equipment. Areas of sensitive benthic habitat are located within the Project Corridor, including hard-bottom habitat and submerged aquatic vegetation. Commercial shellfish beds, salt marsh, or corals are not present within the Project corridor.

Installation of the IAC, 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. Cofferdam installation, 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.

A number of AMPs have been developed to minimize impact to EFH and EFH species during cable installation. To minimize impacts to areas sensitive and slow to recover that are utilized by EFH-designated species, onshore export cable corridors and landfall will be sited within existing rights-of-way or previously disturbed/developed lands to the extent practicable. Onshore, cable landfall and offshore facilities will be sited 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 identified through a stakeholder and scientific review process and sensitive benthic habitat to the extent practicable. Efforts will be made to avoid hard-bottom habitats and seagrass communities, where practicable, and restore any damage to these communities. Areas that would require extensive seabed or onshore alterations would be avoided to the extent practicable. Onshore and offshore cables will be buried below the surface or seabed to the extent practicable. Offshore cable burial depth will be periodically inspected during project operation to ensure that adequate coverage is maintained to avoid interference with fishing gear/activity. Anchoring on sensitive habitat will be avoided and turbidity reduction measures will be implemented to minimize impacts to sensitive habitat from construction activities. BMPs will be used to minimize seabed disturbance and sediment dispersion during cable installation and construction of project facilities.

Effects on EFH and EFH Species:

- 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.

Sediment Suspension and Redeposition

Cable installation activities would generate localized plumes of suspended sediments within the immediate proximity of the trench excavation and reburial. Models predicted that sediment plumes would resettle and TSS concentrations would return to background levels within 0.3 hours of disturbance. IAC installation would occur during Q1 of 2024 to Q3 of 2025. Sediment-producing activities would occur intermittently during the cable installation process.

Hydrodynamic and sediment transport modeling were conducted to assess the sediment suspension and resulting deposition from proposed construction activities associated with the SRWF and SRWEC. (Sunrise COP; Appendix H) Model scenarios were developed for each proposed construction activity. Where multiple installation methods are being considered, the model scenario assumed the method that would create the most sediment disturbance.

Sediments in inshore Project areas are comprised of fine to medium grains. Therefore, suspension and settlement of sediments would be expected. 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 would be associated with early life stages of demersal species. Immediately following installation, indirect impacts from suspended sediments could potentially cause mortality to demersal fish eggs due to burial and reduced hatching success (Berry et al. 2011). 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 of 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 would be expected. Direct impacts would be associated with early life stages of demersal species. Immediately following installation, impacts from suspended sediments could potentially cause mortality to demersal fish eggs due to burial and reduced hatching success (Berry et al. 2011). Impacts to demersal life stages and sessile organisms due to burial via sediment deposition may occur but would be expected to be localized and short-term.

Effects on EFH and EFH Species:

- 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.

Horizontal Directional Drilling (HDD)

Installation of the SRWEC landfall will be accomplished using an HDD methodology. HDD will be used to connect the SRWEC offshore cable to the Onshore Transmission Cable at the Landfall and to cross the Intercoastal Waterway (ICW) from Fire Island to mainland Long Island. The drilling equipment will be located onshore and used to create a borehole, one for each cable, from shore to an exit point on the seafloor approximately 0.5 mi (800 m) offshore.

The HDD crossing included 133 mapped acres, comprising the two primary habitats sand and muddy sand and coarse sediment. Sand and muddy sand was the dominant habitat type mapped and coarse sediment habitats were found along the west of the bridge, coincident with the dredged navigational channel, and was represented by coarse sediment.

Benthic habitat complexity categories were complex and soft bottom. Complex categories included present/potential presence of benthic macroalgae and/or SAV. Of the habitats with modifiers, sand and muddy sand was the most prevalent habitat type mapped within the HDD crossing (74 percent), followed by sand and muddy sand with recent and/or potential SAV and/or benthic macroalgae (18 percent), and coarse sediment (7 percent). Sands were observed except in coarse sediment habitats where gravelly sand and sandy gravel was recorded. Sand and muddy sand habitats were dominated by areas of potential and occurring benthic macroalgae and SAV, primarily on the west side of the ICW bridge. Biotic subclasses included attached and soft sediment fauna. The non-reef-building hard coral *Astrangia poculata* and the burrowing anemone ceranthids, were not observed within the HDD area. Coarse sand habitats in the HDD channel were characterized by the sandy gravel, gravelly sand CMECS subgroup. Vegetated habitats and sand and muddy occurred along the shore were both characterized by sand or finer CMECS subgroups.

Rocky habitat (9.34 acres) , soft bottom sand and mud (122 acres) , tidal marsh (< 2 acres) SAV and macroalgae (24 acres), and biogenic habitats (Bryozoa and serpulid tubes) were found in the area. The benthic community analysis of the sediment grabs collected five taxa accounted for just over 60 percent of the total benthic infaunal abundance (1) an oligochaete, Naididae (Family, LPIL), (2) the amphipod *Eobrolgus spinosus*, (3) the polychaete *Exogone dispar*, (4) the amphipod *Elasmopus levis*, and (5) the amphipod *Gammaropsis* (Genus, LPIL). Acoustic impacts from the installation of the casing pipes and sheet piles on EFH species are similar but less than those discussed in detail in Section 5.1.1.2.

During installation of the estuarine portion of the onshore cable, impacts to SAV would be minimized, where practicable, by the use of HDD to install the cable beneath overlying sediments and SAV without direct physical disturbance. During HDD, a sediment mix including drilling mud (i.e., bentonite) would be 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 and 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. 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). Impacted 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 natural succession would proceed, reestablishing the HAPC areas. 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.

HDD: Temporary Pile-Supported Trestle

Temporary equipment proposed for use for the HDD will be transported via a temporary trestle. Heavy construction materials are needed to energize the Project across the ICW to Smith Point County Park. Since using the Smith Point Bridge is not an option due to its current deteriorating condition, several options including a single Horizontal Directional Drill (HDD) bypassing Fire Island, open cut sea-to-shore transition, dismantling of equipment, and helicopter transport were considered and deemed infeasible due to logistics, safety considerations, and the weight of the equipment needing to be transported. The only practical solution identified to move materials was a temporary pile-supported trestle. The trestle support piles would be placed in the mudline by barge-based installation equipment. It is estimated that approximately 24 driven piles would be required. The barge used for installation of the piles and trestle would require two to four temporary spuds to hold its station during installation. The spuds associated with the installation-barge would have a diameter of approximately 30 inches. Once the Temporary Equipment is installed, a transit barge will require up to four spuds to hold its station during equipment transfer. The spuds associated with the transit barge would have a diameter of approximately 30 inches. For Landfall HDD activities, the contractor would primarily utilize vessels that do not require the use of anchors to maintain position (e.g., dynamic positioning vessels), which would avoid impacts to existing buried resources. Sunrise Wind conducted a SAV survey in fall 2022 to confirm the presence/absence of submerged aquatic vegetation in the vicinity of the Temporary Equipment. Based on the results of that survey, no indications of significant populations of eelgrass were found within the proposed site for the Temporary Equipment.

HDD: Casing Pipe Installation

Installation of the SRWEC landfall will be accomplished using an HDD methodology. HDD will be used to connect the SRWEC offshore cable to the Onshore Transmission Cable at the Landfall and to cross the Intercoastal Waterway (ICW) from Fire Island to mainland Long Island. The drilling equipment will be located onshore and used to create a borehole, one for each cable, from shore to an exit point on the seafloor approximately 0.5 mi (800 m) offshore. Where each borehole exits to the seabed surface, a casing pipe supported by sheet pile “goal posts” may be temporarily installed to collect drilling mud from the borehole exit point.

Impact and vibratory pile driving are anticipated to occur during the construction and installation phase for the export cable landfall. This portion of the construction will include the installation of a temporary casing pile by impact pile driving and ‘goal posts’ steel sheet piles with vibratory pile driving. Acoustic modeling for vibratory pile driving at the HDD exit pit location was also performed to determine threshold distances from installation of sheet piles to create the casing pipe support “goal posts” and support the construction barge. The modeling assumed the use of an APE model 300 vibratory hammer to drive the sheet piles vertically to 10 m below the seabed. For modeling purposes, it was assumed that

each pile would require 2 hours to install and up to four piles would be installed per day. Results of the sheet pile installation acoustic modeling indicate the estimated distance to the 9.74 km threshold, is much greater than the approximate 805-m (0.5-mi) distance to shore from the construction site. The shoreline adjacent to this location is quite linear and effectively splits a circle of 9.74 km in half. Thus, the area of a circle with 9.74-km radius ($\pi \times r^2$ where r is 9.74 km) was calculated and divided in half resulting in an ensounded area of 149 square kilometers (km^2) from sheet pile installation.

There would be up to two casing pipes which would be installed from a construction barge using a pneumatic pipe ramming tool (e.g., Grundoram Taurus or similar). Installation of a single casing pipe may take up to 3 hours of pneumatic hammering on each of 2 days for installation. Installation time will be dependent on the number of pauses required to weld additional sections onto the casing pipe. For both casing pipes, this would mean a total of 4 days of installation. Removal of the casing pipes is anticipated to require approximately the same amount of pneumatic hammering and overall time, or less, meaning the pneumatic pipe ramming tool may be used for up to 3 hours per day on up to 8 days.

Up to six goal posts may be installed to support the casing pipe between the barge and the penetration point on the seabed.

Each goal post would be composed of two vertical sheet piles installed using a vibratory hammer such as an APE model 300 (or similar). A horizontal cross beam connecting the two sheet piles would then be installed to provide support to the casing pipe. Up to 10 additional sheet piles may be installed per borehole to help anchor the barge and support the construction activities. This results in a total of up to 22 sheet piles per borehole and two boreholes bringing the overall total to 44 sheet piles. Sheet piles used for the goal posts and supports would be up to 100 ft (30 m) long, 2 ft (0.6 m) wide, and 1 inch (2.5 centimeter [cm]) thick. Installation of the goal posts would require up to 6 days per borehole, or up to 12 days total for both boreholes. Removal of the goal posts may also involve the use of a vibratory hammer and likely require approximately the same amount of time or less (12 days total for both boreholes) as installation. Thus, use of a vibratory pile driver to install and remove sheet piles may occur on up to 24 days at the landfall location.

An increase in underwater sound levels will occur as a result of vibratory and impact pile driving at the temporary pier location. Overall, impacts are likely to be limited to sub-lethal effects that in some cases may increase the possibility for delayed mortality (Hawkins et al. 2014). Because pile driving sources produce low frequency noise that is within the hearing range of most fish and the majority of pile installations will involve a non-impulsive (vibratory hammer) source, the potential for fish to experience TTS, masking, and behavioral impacts is higher than permanent injury or mortality.

The maximum radial distance to recoverable injury thresholds is approximately 0.091 mi (146.6 m), and the maximum distance to the fish behavioral threshold is 0.55 mi (891.3 m), both of which result from installation using an impact hammer. Some fish may move away from the area before noise levels exceed the threshold for injury but given the size of the potential zones of ensoundment exceeding the behavioral disturbance threshold, some behavioral disturbance of individual fish is likely (Popper et al. 2014). However, potential impacts from this activity are similar to or less than potential impacts already assessed as par to the Sunrise Wind project.

Modeling of vibratory and impact pile driving at the SRWEC landfall site on the ocean side of Fire Island across from the temporary pier location was conducted to estimate acoustic sound fields and potential

impacts (Küsel et al. 2022). A pneumatic hammer with a high strike rate (64,800 per pile) was modeled for casing pipe installation at the site and resulted in larger distances to SEL injury thresholds than estimated here for temporary pier installation. The radial distances to SEL injury thresholds for unmitigated impact pile driving of the casing pipe were up to 2,280 m for large fish and 2,510 m for small fish (Küsel et al. 2022). Therefore, the potential impacts from impact pile driving associated with the temporary pier installation are expected to be less than those assessed for the SRWEC landfall construction. Additionally, the land surrounding the temporary pier construction site will effectively stop the transmission of sound at relatively short distances in directions where the shoreline is nearby. Monitoring and mitigation measures will be implemented to mitigate impacts to fish during pile driving activity including soft-start techniques and seasonal restrictions (Sea Turtle and ESA-Listed Fish Species PSMMP). However, no specific monitoring or shutdowns will be implemented since effective monitoring tools for fish are not currently available. Time-of-year-in-water restrictions will be employed to the extent feasible to avoid or minimize direct impacts to species of concern, such as Atlantic sturgeon or winter flounder, during installation of the temporary pier.

Table 5-5. Acoustic Ranges to Fish Thresholds for Temporary Pier Piles, Casing Pipe, and HDD Goal Posts

Faunal Group	Metric	Impact Threshold	Temporary Pier (up to 16 in cylinder pile)	Casing Pipe	Vibratory Threshold	Goal Posts (Vibratory Pile Driving)
Fish ≥ 2 grams	LE,24h	187	92.5	3.15	7.14	0.10
	Lpk	206				
	Lrms	150		2.84		
Fish < 2 grams	LE,24h	183	146.6	4.72	9.01	0.10
	Lpk	206				
	Lrms	150		2.84		
Fish without swim bladder	LE,24h	216	3.3	0.16	0.16	0.10
	Lpk	213				
Fish with swim bladder not involved in hearing	LE,24h	203	14.7	0.85	0.69	0.10
	Lpk	207				
Fish with swim bladder involved in hearing	LE,24h	203	14.7	0.85	1.10	0.02
	Lpk	207				

Source: Küsel et al. 2022,

^a Maximum R95% (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 R95% (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; R95% = maximum acoustic range at which the sound level was encountered after the 5% farthest points were excluded; LE_{24h} = cumulative sound exposure level over 24 hours; Lpk= peak sound pressure level; Lrms = sound pressure level root mean squared

Effects on EFH and EFH Species:

- 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.
- Indirect – no indirect impacts anticipated.

5.1.1.9 Cable Protection (Concrete Mattresses, etc.)

Cable protection could 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 15 percent of the cable route may require cable protection. 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.

Habitat Loss/Conversion

IAC and substation interconnection cable construction area potentially requiring cable protection is comprised of 473.8 acres (191.74 hectares) of soft bottom habitat, 0 acres of large grained complex habitat, and 307.9 acres (124.6 hectares) of complex habitat. Cable protection may be required for up to 15 percent of the route (up to 129 acres [52.2 hectares]), with the project design envelope allowing for up to 139.36 acres (56.4 hectares). The majority of the area that may be impacted by cable protection is classified as soft bottom habitat (80 percent). Most of the remaining area (20 percent) intersects habitats categorized as complex.

The offshore export cable construction area that could potentially require cable protection is comprised of 473.8 acres (191.74 hectares) of soft bottom habitat and 307.9 acre (124.6 hectares) of complex habitat. Impact calculation above is based on an assumed 39 ft (12 m) 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 OCS-DC 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 impacted 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 SRWF footprint. EFH-designated species that would likely be impacted by crushing and burial effects of installation of scour protection are like those listed in Section 5.1.1.1.

Benthic Effects from Cable Protection

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 would result in the intermediate to long-term modification of complex benthic habitat. A maximum potential impact of approximately 2,150 acres (870 hectares) of complex benthic habitat would be permanently altered by placement of protective structures.

The nearshore terminus (estuarine portion) of the cable route overlaps areas of complex habitat but will avoid the designated HAPC for summer flounder. While the project would avoid macroalgae and seagrass areas during construction, any impacts on macroalgae or aquatic vegetation would constitute an intermediate-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 intermediate-term to long-term by alteration of natural habitat and the placement of protective structures.

Non-Complex (Soft Bottom) Benthic Habitat

The placement of concrete mattresses and other protective structures to exposed segments of the cable would result in long-term conversion 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 cable installation would therefore result in long-term adverse effects on EFH. 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 intermediate-term to long-term by alteration of natural habitat and the placement of protective structures.

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 impacted by suspended sediment are similar to those listed in Section 5.1.1.1.

5.1.2 Operation/Presence of Structures

5.1.2.1 Artificial Substrate (WTG/OSS/Converter Station/Scour Protection)

Community Structure Changes/Invasive Species

Development of the SRWF would include installation of 94 WTGs, the OCS-DC and their foundations. The installation of the WTGs and OCS-DC 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 SRWF.

Underwater Sound

The operation of the SRWF 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.

SRWF

Offshore WTGs produce continuous, non-impulsive underwater noise during operation, mostly in lower-frequency bands below 8 kilohertz (kHz). There are several recent studies that present sound properties of similar turbines in environments comparable to that of the proposed Project. These are presented in detail in the Underwater Acoustic and Exposure Modeling Survey (Küsel et al. 2021). Studies indicate that operating turbines (e.g., both older-generation, geared turbine designs and quieter, modern, direct-drive systems like those proposed for the SRWF) produce underwater noise on the order of 110 to 125 dB relative to 1 μ Pa SPL_{RMS} at a reference distance of 50 meters, occasionally reaching as high as 128 dB relative to 1 μ Pa SPL_{RMS} in the 10-Hz to 8-kHz range (Tougaard et al. 2020). When compared to injury thresholds for fish, no physiological effects on fish as a result of WTG operational noise is anticipated. In addition, WTG operational noise is not expected to exceed fish behavioral thresholds. 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.

Collectively, these findings suggest that the SRWF operations could have limited adverse effects on habitat suitability for EFH-designated species within a certain distance of each monopile foundation. The extent of these effects is difficult to quantify as they are likely to vary depending on wind speed, water temperature, ambient noise conditions, and other factors. 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 722 ft (220 m) from each foundation. This equates to adverse effects on habitat suitability over 3,835 acres (1,552 hectares) for the 39-ft (12-m) monopile.

Offshore Export Cables and Array Cables

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

Vessel Noise

Impacts on EFH from ship and aircraft noise during operation and maintenance of the SRWF are expected to be similar to those discussed for the construction phase, though much lesser in intensity and spatial extent. The underwater noise generated by vessel and aircrafts would be similar to the range of noise from existing vessel and aircraft traffic in the region and are not expected to substantially affect the existing underwater noise environment.

Short-term, localized impacts from geophysical surveys during operation and maintenance may occur from the use of multi-beam echosounders, side-scan sonars, shallow penetration sub-bottom profilers, medium penetration sub-bottom profilers and marine magnetometers. The survey equipment to be employed would be equivalent to the equipment utilized during survey campaigns associated with Lease Area OCS-A 0500 conducted in 2016, 2017, 2018, 2019, and 2020 and with Lease Area OCS-A 0487 conducted in 2019 and 2020 (CSA Ocean Sciences Inc.2020).

5.1.2.2 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 SRWF 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). 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 water current speed and direction. Monopile wakes have been observed and modeled at the kilometer scale (Cazenave et al. 2016; Vanhellefont 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 ft (100 to 200 m) 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 ft (200 to 400 m) downstream of each monopile. Because the WTGs would be spaced 1 nm by 1 nm (1.85 by 1.85 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.

Affected Species

The 94 WTGs would 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 SRWF footprint.

Pelagic juveniles and adults with EFH-designated species utilizing water column habitat could experience localized hydrodynamic effects down current of each SRWF monopile. These effects may be limited to decreased current speeds but could also include minor changes to seasonal stratification regimes. Adults and juveniles would be expected to elicit an avoidance behavioral response away from potential unsuitable habitat due to hydrodynamic effects from monopiles. These localized effects would persist throughout the life of the project. EFH-designated species with pelagic juvenile and adult life stages that would likely to occur within the SRWF area.

5.1.3 Operation/Presence of Inter-Array and Offshore/Onshore Cables

5.1.3.1 Power Transmission (EMF, Heat)

Operation of the WTGs would not generate electro-magnetic field (EMF); however, once the IAC become energized, the cables would produce a magnetic field, both perpendicularly and in a lateral direction around the cables. The IAC would be alternating current (AC). There would be no EMF emissions from the OCS–DC itself; however, several cables come into this structure and the cables would emit EMF when energized. Therefore, the following discussion focuses on potential impacts from AC EMF emissions of the IAC.

The IAC would be shielded and, where feasible, buried beneath the seafloor and would otherwise be protected. Shielded electrical transmission cables do not directly emit electrical fields into surrounding areas but are surrounded by magnetic fields that can cause induced electrical fields in moving water (Gill et al. 2012). Exposure to EMF could be short- or long-term, depending on the mobility and behavior of the species/life stage.

A modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the IAC, and OCS–DC was performed by Exponent Engineering, PC (Exponent Engineering 2020a (COP Appendix J1)), along with a summary of data from field studies conducted to assess impacts of EMF on marine organisms. Though multiple cables come into the OCS–DC, the cables would be sufficiently distributed that the level of EMF emissions at this structure would be similar to the individual cables themselves. These studies constitute the best source of evidence to assess the potential impacts on finfish and invertebrate behavior or distribution in the presence of energized cables.

The available laboratory-generated research regarding the effects of 50- or 60-Hz AC power sources on fish behavior do not indicate that produced fields would have adverse effects on magnetosensitive and electrosensitive species. Controlled laboratory studies conducted with eel and salmon (Richardson et al. 1976; Armstrong et al. 2015; Orpwood et al. 2015) support the conclusion that EMF produced by 50-75 Hz AC cables do not alter the behavior of magnetosensitive fish species, indicating that high frequency EMF are not easily detected by magnetosensitive migratory fish species. Laboratory studies assessing the EMF detection abilities of elasmobranchs indicate that the EMF detection ability decreases as the source frequency increases over 20 Hz and suggest that elasmobranchs would be unlikely to easily detect electric fields produced by 50/60 Hz power sources (Andrianov et al. 1984; Kempster et al. 2013). In a laboratory study, demersal catshark were exposed to magnetic fields produced by a 50-Hz source and did not exhibit any significant behavioral changes (Orr 2016). Field studies have also concluded that energized power cables neither attract nor repel elasmobranchs (Love et al. 2016). Based on the available information, EMF produced by 50/60 Hz power sources such as the IAC is unlikely to be detected by elasmobranchs and is unlikely to cause changes in elasmobranch behavior or distribution.

Love et al. (2016) conducted a series of surveys between 2012 and 2014 to track fish populations at both energized and unenergized submarine cables off the California coast. These studies were designed to assess whether EMF produced by the energized cable had any in situ effects on the distribution of marine species. Over three years of observations, no differences in fish communities at energized and unenergized cable sites were noted, indicating that EMF had no effect on fish distributions, although the physical structure of the unburied cables did create a “reef effect” (Love et al. 2016). Additionally, multiple fish surveys have been conducted at existing offshore windfarm sites. Results from these studies strongly indicate that operating windfarms and cables do not adversely affect the distributions of resident fish populations.

Nearly 10 years of pre- and post-operational data from the Horns Rev Offshore Wind Farm site near Denmark indicate “no general significant changes in the abundance or distribution patterns of pelagic and demersal fish” (Leonhard et al. 2011), including species similar to those expected to inhabit the SRWF. Researchers did note an increase in fish species associated with hard ground and vertical features, especially around WTG footings (Leonhard et al. 2011).

Compared to fish and elasmobranchs, relatively little is known about the response of marine invertebrates to EMF. Field surveys on the behavior of large crab species and lobster at submarine cable sites (Love et al. 2017; Hutchison et al. 2018) indicate that the Project’s calculated magnetic-field levels are not likely to impact the distribution and movement of large epibenthic crustaceans. Ancillary data and observations from these field studies also suggest that cephalopod behavior is similarly unaffected by the presence of 60-Hz AC cables. Based on the modeling results and existing evidence, the EMF associated with the cables would be below the detection capability of most invertebrate species and would be unlikely to result in measurable impacts on EFH invertebrate species. Based on the modeling results and existing evidence, EMF associated with the IAC, and OCS–DC would not be expected to adversely affect EFH habitat in the SRWF. These conclusions are consistent with the findings of a previous comprehensive review of the ecological impacts of marine renewable energy projects, where it was determined that there has been no evidence demonstrating that EMF at the levels expected from marine renewable energy projects would cause an effect (negative or positive) on any species (Copping et al. 2016). Moreover, a 2019 BOEM report that assessed the potential for AC EMF from offshore wind facilities to affect marine populations concluded that, for the southern New England area, no negative effects would be expected for populations of key commercial and recreational fish species (Snyder et al. 2019).

5.1.3.2 Cable Protection

Community structure changes due to installation of cable protection is discussed in detail in Section 1.

5.1.3.3 Power Conversion

The SRWF includes up to 94 individual WTGs which would generate AC power that would be transmitted to the OCS-DC through up to 180 mi (290 km) of IAC. The OCS-DC would convert the power to DC for transmission to the existing onshore electrical grid through up to 106 mi (170 km) of offshore SRWEC and up to 17 mi (27 km) of onshore SRWEC. The onshore SRWEC would terminate at the OnCS-DC where power would be converted from DC to AC and ultimately transmitted through an Onshore Interconnection Cable to an existing Long Island Power Authority (LIPA) substation located in the Town of Brookhaven, NY.

The OCS-DC would be centrally located within the Lease Area and would house AC and DC equipment rated up to ± 320 kilovolts (kV). The main equipment for the OCS-DC to convert the HVAC generated by WTGs prior to onshore transmission includes medium voltage AC (66 kV) gas-insulated switchgear, one or more converter transformers, converter reactors, and supervisory control and data acquisition (SCADA) and protection systems. The approximate dimensions of the main OCS-DC topside platform are 328 ft x 262 ft (100 m x 80 m). The topside platform is located approximately 78 ft (24 m) above the mean higher high water (MHHW) elevation. The total height of the OCS-DC platform and equipment, including lightning protection and ancillary structures, would extend approximately 361 ft (110 m) from the lowest astronomical tide (LAT). The OCS-DC platform would be founded on a steel jacket pile structure. The placement of gravel material would be required to the level the seafloor (pre-installation seafloor grade) where the jacket pile structure would be installed. Scour protection would be installed around the base of the jacket pile structure following installation to stabilize where the IAC and SRWEC are pulled into the foundation. The OCS-DC location was characterized as Sand and Mud.

The OCS-DC requires the withdrawal of raw seawater through a cooling water intake system (CWIS) to dissipate heat produced through the AC to DC conversion and then discharge this water as thermal effluent to the marine receiving waters. The Design Intake Flow (DIF) for the OCS-DC is 8.1 MGD; however, the Average Intake Flow (AIF) would generally range from 4.0 million gallons per day (MGD) to 5.3 MGD. The OCS-DC is proposing to discharge non-contact cooling water (NCCW) and non-contact stormwater to the marine receiving water.

Entrainment/Impingement

A total of 42 individual species of fish and invertebrates identified above in Section 4 have designated EFH in the vicinity of the OCS-DC. In addition, a benthic study conducted in 2020 detected the presence of multiple epifaunal and infaunal species. The sample collected closest to the OCS-DC location included habitats likely containing soft sediment fauna such as burrowing anemones, Jonah crab, horseshoe crab (*Limulus polyphemus*), ocean quahog, sand dollar (*Echinorachnius parma*), sea scallop, surf clam, channeled whelk (*Busycotypus canaliculatus*), amphipod species, and sea star species.

The OCS-DC cooling water intake was designed to maintain a through screen velocity less than 0.5 feet per second (ft/s) (0.1525 meter per second [m/s]) which is below the EPA threshold for new facilities and is protective against impingement of juvenile and adult fish. Thus, only species with egg or larval life stages present in the vicinity of the OCS-DC would be susceptible to entrainment. A total of 17 finfish species and whose early life stages could be near the OCS-DC during water withdrawal activity meet this criterion.

To evaluate the potential ichthyoplankton entrainment during operational OCS-DC withdrawals, species abundance data was obtained from the NOAA National Centers for Environmental Information (NCEI) electronic database. This database include data collected by NOAA's Marine Resource Monitoring, Assessment, and Prediction (MARMAP) program from 1977-1987 and by the Ecosystem Monitoring (EcoMon) program from 1995 through 2017 throughout the North Atlantic region.

Ichthyoplankton tows were collected using 24-inch (in) (60 centimeter [cm]) bongo plankton nets with either 0.333-millimeter (mm) or 0.505-mm mesh. A total of 31,351 ichthyoplankton tows were conducted between North Carolina and Nova Scotia throughout the 40-year survey duration and are included in the NCEI database. For this analysis, the robust data set was trimmed to include only those ichthyoplankton tows that were conducted within the general geographic region of the OCS-DC and SRWF. The boundaries of this geographic region were selected to avoid shallow shoreline areas which would be expected to contain species not present at the OCS-DC location, to extend to the edge of the continental shelf, and to encompass a large number of samples to help offset the natural variability inherent in marine systems. This truncated data set was utilized to assess entrainment susceptibility associated with operation of the OCS-DC and consists of 1,859 total ichthyoplankton tows and contains a total of 90,799 individual ichthyoplankton. The NCEI dataset does not identify eggs to species level; therefore, the species-specific ichthyoplankton entrainment results shown below are based only on larval life stages.

The OCS-DC would include three openings for intake pipes located approximately 30 ft (10 m) above the pre-installation seafloor grade. The water depth of the intake pipe openings was selected to minimize the potential of biofouling and entrainment of ichthyoplankton and to take advantage of the cooler water temperatures found at depth to maximize cooling potential of water withdrawn. An NPDES permit application for the OCS-DC was submitted to the Environmental Protection Agency in December 2021 (TRC 2021).

Identification of fish species and life stages that would be most susceptible to entrainment from the OCS-DC were evaluated based on their abundance or their significance to commercial and recreational fisheries. The NPDES permit included annual entrainment estimates of ichthyoplankton by grouping egg and larval stages (Sunrise Wind 2022, Appendix N2). Since the NCEI dataset does not identify eggs to species level, entrainment numbers were considered larval estimates only when calculating adult equivalent losses. This approach is conservative as more larvae survive than eggs.

To evaluate impacts of this entrainment, supplementary analyses were conducted as part of the preparation of the EFH assessment, and not included in the NPDES permit. Entrainment estimates for adult equivalent losses (AELs) were completed for eight abundant or commercially important fish species and are listed below. AELs are estimates of the number of entrained organisms removed from the population that otherwise would have survived to some future age, or age of equivalence. To estimate AELs for the OCS-DC, the annual estimates of entrained larvae and eggs (x') from Appendix N2 of Sunrise Wind (2022) were multiplied by the survival fraction at the age of equivalence i and the proportion p of returning adults that belong to life stage i (Equation (1)):

$$n \tag{1}$$

$$AEL_j = \sum_{j=1} S_{ij} x^{wi} p_j$$

Where AEL_j is the expected number of adult equivalents of life stage j lost due to operations; S_{ij} is the survival fraction of organisms of starting life stage i surviving to life stage j ; x' is the extrapolated number of organisms of life stage i during time t ; and p_j is the expected proportion of returning equivalent adults of life stage j .

Survival rates of early life stages are often expressed on a life stage-specific basis so that the fraction surviving from any life stage i to adulthood or age of equivalence j is expressed as the product of survival fractions for all life stages (k) through which a fish must pass before reaching age of equivalence j .

The parameters used to evaluate the adult equivalent entrainment, such as instantaneous natural mortality and instantaneous fishing mortality rates at varying life stages were acquired from the EPA Regional Benefits Analysis for the Final Section 316(b) Phase III existing facilities rule (EPA 2006). Age of adulthood for the eight species of interest were found in Fishes of the Gulf of Maine (Bigelow and Schroeder 2003).

Based on this analysis, forage species are expected to be those most susceptible to entrainment impacts associated with operation of the OCS-DC including Atlantic herring, red hake, Atlantic mackerel (*Scomber scombrus*), and silver hake (*Merluccius bilinearis*). The commercially important species with eggs and larvae that could be most susceptible to operation of the OCS-DC include yellowtail flounder (*Limanda ferruginea*), summer flounder, and Atlantic butterfish (*Peprilus triacanthus*).

Atlantic cod (*Gadus morhua*) is a species of concern in this region. However, eggs and larvae of this species are not expected to be as susceptible to OCS-DC operation relative to the other species. This analysis estimates that a total of up to 34,239 Atlantic cod eggs and larvae could be entrained on an annual basis which would result in 16.5 equivalent adults. The peak spawning period for Atlantic cod occurs in December and January in this region. To put these potential entrainment rates in context, one (1) large female Atlantic cod can produce 3 to 9 million eggs annually (NOAA Fisheries 2021). The adult equivalent losses for Atlantic cod are estimated to be 16.5 fish lost.

Table 5-6. Annual Entrainment Estimates of Eight Fish Species Including Egg and Larval Stages and Adult Stages

Species	Annual Entrainment Estimates		
	Larvae	Adult Equivalent Losses	Fecundity
Atlantic Cod	34,239	16.5	3,000,000 to 9,000,000

Atlantic Herring	1,015,627	573.1	12,000 to 260,000
Red Hake	279,085	1.84	No estimate
Silver Hake	47,076	5.75	343,000 to 391,000
Yellowtail Flounder	78,988	0.25	350,000 to 4,570,000
Atlantic Butterfish	318,433	38.9	No estimate
Atlantic Mackerel	2,649	0.04	285,000 to 1,980,000
Summer Flounder	69	0.01	Up to 6,000,000

Thermal Plume

The location, design, and operation of the cooling water discharge (Dump Caisson) was selected to minimize degradation by minimizing the thermal plume size to the greatest extent practicable and preventing thermal plume migration to the surface waters or benthos. For optimal performance of the CWIS, the Dump Caisson needed to be sited deep enough that it would be submerged in the 100-year wave event and at a sufficient distance away from the intake pipes to avoid heated effluent being subsequently withdrawn by the SWLP.

To identify the optimal location for the Dump Caisson, the Cornell Mixing Zone Expert System (CORMIX) was used to evaluate the mixing zone associated with multiple discharge locations in the water column. The assessment considered four different seasons using a 2 degrees Fahrenheit (°F) (1 degree Celsius [°C]) temperature differential (ΔT) threshold to delineate the extent of the mixing zone. The optimal location for the Dump Caisson discharge was determined to be approximately 40 ft (12 m) below local mean sea level (LMSL). At this optimized location rapid and complete mixing occurs. The thermal plume would be contained to a distance of 87 ft (27 m) from the outfall and occupy a maximum area of 731 ft² (66.9 m²) in a worst-case, slack tide scenario.

Operation of the OCS-DC would not be expected to affect marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, or coral reefs. None of these aquatic sites would be in the near proximity of the OCS-DC nor within the boundary of the Lease Area.

5.2 Project Monitoring Activities

5.2.1 Fisheries

5.2.1.1 Trawl Survey

The trawl survey would periodically disturb soft bottom benthic habitat within a set of pre-selected tow tracks identified as suitable for this gear type. The trawl survey net would be the same design as the NorthEast Area Monitoring and Assessment Program (NEAMAP) survey net which is a 400 x 12-cm three-bridle four-seam bottom trawl, and the net is paired with Thyboron, Type IV 168 cm (66 in) trawl doors. A 2.5-cm (1-in) knotless cod end liner would be used to sample marine taxa across a broad range of size and age classes. Trawl surveys are scheduled to occur throughout the year, which would include a winter, spring, summer, and fall survey. The trawl surveys at SRWF and Revolution Wind Farm (RWF) would be executed simultaneously using the same vessel, sampling gear, and scientific crew, and catch rates at both the SRW and RWF impact areas would be compared to the same two reference areas. The RWF Project area for the trawl survey was limited to the northern portion of the RWF lease area which encompasses an area of approximately 125 km². The two reference areas proposed for the trawl survey are also 125 km². The entire SRW lease area is approximately 445 km². In order to sample an equivalent amount of area (125 km²) within the SRW impact site, it is proposed that the SRW trawl survey impact area be limited to the western portion of the lease site. This greatest concentration of effort by the large mesh otter trawl fleet occurred in this portion of the lease site from 2011 through 2016. Within the SRWF and the reference areas, the sampling density associated with each seasonal survey would be one station per 8.3 km². The order in which the reference areas and the SRWF trawl survey are conducted would be randomized prior to the start of each survey. A sample size of 15 trawl tows per area would be targeted per season in each year at the start of the survey. The proposed seasonal sampling intensity equates to an annual sampling target of 180 tows per year across the SRWF and reference areas.

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. This activity would directly affect EFH species and their prey through death of most 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). The selected location for the trawl survey is subjected to regular disturbance by commercial fishing activity, and that this type of disturbance has already and would continue to occur whether the Trawl Survey 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.

5.2.1.2 Acoustic Telemetry – Highly Migratory Species

Highly migratory species are currently being monitored by acoustic telemetry in the SRWF area. The Project is focusing on monitoring bluefin tuna, shortfin mako sharks, and blue sharks, shortfin mako sharks and tuna. This acoustic telemetry monitoring effort would build off these baseline studies by

including five additional years of data collection, an expansion of the receiver array, and the deployment of an additional 150 acoustic transmitters for highly migratory species.

VEMCO model VR2-AR receivers would be rigged using standard procedures outlined by VEMCO for benthic deployment. Ropeless technology (AR Buoys) were selected to minimize risks to marine mammals and other protected species. The VR2-AR receivers are equipped with acoustic release mechanisms that allow instrument retrieval without the need for surface buoys and vertical lines in the water column. The receivers would be deployed approximately two meters from the benthos, and two small floats keep the receiver oriented vertically in the water column to maximize the detection radius. Retrieval is performed with wireless communication from a VR100 aboard the vessel that triggers the release, using a push-off titanium pin and an attached floatation buoy to bring the released receiver to the surface. The receivers would be rigged inside a pop-up canister (Mooring Systems Inc) to enable to moorings to be retrieved during download trips, and to enable the moorings (75 pounds steel pyramid anchors) to be removed from the study site at the end of the monitoring.

Trips to download and maintain the acoustic receivers would be conducted in the spring and fall of each year of the Project. During each trip, receivers would be summoned, downloaded, and cleaned of any biofouling. They would be re-rigged and re-deployed at sea. Receiver deployment and maintenance would be done primarily in collaboration with a local commercial fishing vessel.

Placement of pyramid anchors would minimize benthic impacts but 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 slight short-term and long-term impacts to EFH and managed species.

Acoustic Telemetry – Sunrise Wind Export Cable

Evaluating the potential impacts of EMF from undersea power transmission cables has been one of the major research priorities identified by commercial and recreational fishermen during the development of fisheries monitoring guidance related to offshore wind. In this study, an acoustic telemetry receiver network would be established along the route of the SRWEC, and dedicated telemetry tagging would occur to evaluate the potential impacts associated with the operation of the SRWEC on important marine species. The species selected for telemetry monitoring are American lobsters, horseshoe crabs, winter skates, sandbar sharks, sand tiger sharks, dusky sharks, and smooth dogfish. Positional monitoring of tagged individuals would be accomplished using two arrays of acoustic receivers to evaluate both broad-scale migratory behavior as well as fine-scale movements near the SRWEC. The offshore receiver array would include three linear gates of receivers (offshore north approach, offshore south approach, and SRWEC gate). The nearshore fine-scale positional array would be used to evaluate movement around the SRWEC with high spatial resolution. Temperature (mean, minimum, maximum) would be recorded every three hours on all VR2AR-X receivers providing information to evaluate environmental drivers of the presence/absence of telemetered individuals in the study area.

The offshore receiver array would provide the ability to track movement as telemetered individuals enter the approach field, pass over the cable area, and exit the approach region. The design provides a quasi-controlled field-experiment system where the approach gates provide movement and behavior metrics independent of potential EMF impacts, while the SRWEC gate is adjacent to the cable and can capture local changes in behavior. In the offshore receiver array each linear gate would include 10 VR2AR-X acoustic release omnidirectional hydrophones (receivers) that can detect a telemetered individual from a radius of 1,640 ft to 3,280 ft (500 to 1000 m) depending on sea conditions and

transmitter strength. The receivers in the three linear gates would be placed approximately 0.6 mi (1 km) apart.

The near-shore fine-scale positioning array would provide high-resolution information on the two-dimensional or three-dimensional movements (depending on the type of transmitter) of individuals in the vicinity of the SRWEC. The receivers in the nearshore fine-scale positional array are planned to be spaced approximately 1,312 ft (400 m) apart, but the exact receiver spacing would be informed by range testing performed by the VR2AR-X receivers are equipped with built-in transmitters to sync with adjacent receivers (Vemco Positioning System), enabling the two-dimensional position of tagged individuals to be evaluated with high precision. Additionally, telemetered elasmobranchs tagged with V16TP transmitters can be positioned in three dimensions (latitude, longitude, and depth) within the fine-scale positioning array.

The VR2AR-X receivers are equipped with acoustic release mechanisms that allow instrument retrieval without the need for surface buoys and vertical lines in the water column. Ropeless technology (Acoustic Release Buoys) was selected to minimize risks to marine mammals and other protected species. The receivers would be deployed approximately 6.5 ft (2 m) from the benthos, and two small floats keep the receiver oriented vertically in the water column to maximize the detection radius. Retrieval is performed with wireless communication from a VR100 aboard the vessel that triggers the release, using a push-off titanium pin and an attached floatation buoy to bring the released receiver to the surface.

The entire receiver array would be downloaded twice per year, during which time the receivers would be cleaned of any biofouling, and the batteries would be replaced as needed. The receivers would be rigged inside a pop-up canister (Mooring Systems Inc) to enable to moorings (75 pounds pyramid anchors) to be retrieved during download trips, and to enable to moorings to be removed from the study site at the end of the monitoring.

Placement of pyramid anchors would minimize benthic impacts but 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 negligible short-term and long-term impacts to EFH and managed species.

5.2.1.3 Scallop Survey

Sunrise Wind would partner with researchers at Coonamessett Farm Foundation (CFF) to carry out HabCam survey for scallops and other benthic organisms within the SRWF and a nearby control area, and the survey would be executed using a Before-After-Control-Impact (BACI) design. The survey would be executed once per year, targeting sampling in summer. The target is to achieve two years of pre-construction monitoring, and the survey would continue during construction, and for at least two years after construction is completed. This survey would be carried out in collaboration with a local scallop vessel(s). The primary objective of the HabCam survey is to investigate the relative abundance of scallops and other resources in the SRWF Area (“SRW impact”) and reference area (“control”) over time. Using the HabCam survey equipment and protocols would ensure that the data collected as part of this fisheries monitoring plan would be compatible and standardized with fisheries independent data that is used to inform scallop science, stock assessment, and management. The HabCam survey approach also is well-suited to sampling within the lease area following construction.

The towed-array vehicle is outfitted with dual cameras, which take 6 overlapping, paired images per second (518,400 paired images per day), continuously throughout its track. The system is towed 5 to 8 ft

(1.5 to 2.5 m) off bottom while being towed at 4-5 knots. A survey track approximately 100-120 nm long is imaged during each 24 hours of operation while at sea. The field of view of the HabCam v3 system is around 1 m² yielding approximately 180,000 - 220,000 m² of area surveyed per 24-hour period. The vehicle is equipped with strobe lights (to reduce blur in imagery) and integrated sensors to track salinity, temperature (benthic temperature and vertical casts), depth, and altitude. This type of sensor-based data is extremely valuable, as it allows for the evaluation of fine-scale variations in bottom temperature and other factors that govern productivity.

This survey technique alone would not cause any impacts to EFH or EFH-designates species.

5.2.1.4 Benthic Monitoring at SRWF

Physical disturbance associated with cable and foundation installation can temporarily affect the benthic environment, removing or damaging existing fauna. Over time, the introduction of novel hard substrata (OSW foundations, scour protection layers, and cable protection layers) can lead to extensive biological growth on the introduced surfaces with a complex pattern analogous to shoreline intertidal to subtidal zonation. This benthic monitoring plan is organized according to these prevailing hypotheses and describes the overall approach to tracking changes in both the novel hard bottom and soft bottom habitats associated with OSW development, specifically at the SRWF and SRWEC-OCS. A separate benthic monitoring survey for the SRWEC-NYS would be conducted within NYS waters, which is discussed in Section 5.2.1.5.

Visual monitoring survey would be conducted separately for hard bottom habitats and soft bottom habitats. Novel hard bottom habitat monitoring at turbine foundations, scour protection layers, and cable protection layers would focus on measuring changes in percent cover, species composition and volume of macrofaunal attached communities (native and non-native species groups) and physical characteristics (rugosity, boulder density). Soft bottom habitat monitoring would focus on measuring physical factors and indicators of benthic which would serve as proxies for functional changes in the community composition. It is expected that the introduction of fines and organic content sourced from the epibenthic community on the WTG foundations would support increased deposit feeding benthic invertebrate communities in the soft sediments around the structures. To accomplish the objectives of the novel hard bottom monitoring, high resolution video imagery captured using a Remote Operated Vehicle (ROV) would be employed. Video imagery would be used to document epifaunal community characteristics on the novel hard surfaces. Monitoring at hard bottom habitats would begin after construction is complete during late summer or early fall, and sampling would be repeated annually at time intervals of 1, 2, 3, and 5 years after construction. Sampling would occur during late summer or early fall to capture peak biomass and diversity of benthic organisms.

The soft bottom monitoring would include an examination of two OSW components: WTG foundation associated and export cable-associated soft bottom. The overall objective of the soft bottom benthic monitoring survey is 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 WTG foundations or SRWEC-OCS centerline. Benthic functioning of the soft bottom habitats would be captured by documenting physical parameters (grain size major mode) and biological factors (bioturbation and utilization of organic material) with a SPI/PV system. It is expected that the epibenthic community that colonizes the WTG foundations and OCS-DC jacket would supply organic matter to the sediments below through filtration, biodeposition, and general deposition of detrital biomass. This organic material sourced from the biological activity of the epibenthic community on the wind structures would likely alter the infaunal community activity, increasing sediment oxygen demand and

promoting the activity of deep-burrowing infauna. Based on benthic monitoring results in other offshore wind farms, the effects of the WTG foundation on the surrounding soft sediment habitat are expected to decrease with increasing distance from the WTG. SPI/PV would be used as the monitoring approach for the soft sediment habitat surveys. The SPI and PV cameras are state-of-the-art monitoring tools that capture benthic ecological functioning within the context of physical factors. The PV system captures high-resolution imagery over several meters of the seafloor, while the SPI system captures the typically unseen, sediment–water interface in the shallow seabed. SPI/PV provides an integrated, multi-dimensional view of the benthic and geological condition of seafloor sediments and would support characterization of the function of the benthic habitat, physical changes, and recovery from physical disturbance following the construction and during operation of SRWF and SRWEC. Sampling would occur during late summer or early fall to capture peak biomass and diversity of benthic organisms in alignment with previous studies.

The video survey technique alone would not cause any impacts to EFH or EFH-designates species.

5.2.1.5 Benthic Monitoring-NYS

This benthic monitoring plan includes details of the pre-construction and post-construction surveying of soft sediment habitats along the SRWEC-NYS. A combination of SPI/PV imaging and sediment grab sampling would be used to monitor these benthic environments. SPI/PV is a widely accepted approach to assess the seafloor as it provides an integrated, multidimensional view of the benthic and geological condition of the seafloor sediments. SPI/PV imagery preserves the organism-sediment relationship, it can accurately characterize benthic epifauna and infauna communities in relation to the local environmental context. Pairing SPI and PV images provides a comprehensive depiction of the seafloor that, through standardized analysis and interpretation allows for accurate comparisons to be made before and after installation activity. SPI/PV provides real-time results that can be assessed onboard during the surveys, which allows for rapid adaptive sampling to target locations of interest. Taxonomic benthic community analysis of sediment grab samples provides quantitative descriptions of soft sediment communities including community structure, abundances of taxa, and community diversity. The benthic community analysis approach would provide an assessment of potential changes in quantitative community diversity metrics and particular species abundances.

At least two field sampling events would occur after the proposed SRWEC-NYS has been installed. Post construction monitoring surveys would occur between August 1st and October 31st within 24 months of the Project's commercial operational date. During the post-cable installation surveys, three stations would be sampled with SPI/PV in a transect perpendicular to the SRWEC-NYS, with one station as close as practicable to the centerline and one station approximately 100-ft on either side. These transects would repeat at 1,000-ft (305 m) intervals from the HDD exits offshore to the territorial limit of NYS waters. At each SPI/PV station a minimum of three replicate images shall be collected and analyzed. At each SPI/PV station, a conductivity, temperature, depth sensor would be used to measure the salinity and temperature through the water column to the sediment surface. Additionally, the temperature of the sediments would be measured at each SPI/PV station. The SPI/PV sampling would be supplemented with sediment grab stations located at transects every 2,000-ft (610 m) along the SRWEC-NYS centerline, with one grab sample station as close as practicable to the centerline and one grab sample station approximately 100-ft (30.5 m) on the eastern side of the cable. At each grab station three replicate grab samples would be collected, sieved onboard, and preserved.

Benthic survey activities include a combination of SPI/PV imaging and sediment grab sampling. 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 sediment grab sampling would have similar impacts to EFH by crushing benthic organisms, disturbing soft bottom habitat, and creating a short-term increase in suspended sediment. The benthic surveys would not change the effects determination for EFH for any species in the EFH assessment.

5.2.1.6 The Protected Species Mitigation and Monitoring Plan

The Protected Species Mitigation and Monitoring Plan (PSMMP) provides protocols and requirements for mitigation and monitoring activities to minimize potential impacts on marine mammals through both visual and passive acoustic means during Project-related construction and operational activities. The PSMMP focuses on marine mammals potentially exposed to underwater sound and pressure levels and other measures intended to avoid take. The PSMMP provide Project-specific details regarding the protocols that will be implemented during vessel operations, high resolution geophysical (HRG) surveys, UXO removal, and operations and maintenance.

Passive acoustic monitoring (PAM) systems are underwater acoustic recording devices deployed during Project activities to detect the presence of marine mammal vocalizations. PAM systems proposed at the Project include moored and autonomous systems. These systems could impact EFH during deployment and retrieval by crushing benthic organisms, disturbing soft bottom habitat, and creating a short-term increase in suspended sediment.

Noise attenuation systems (NAS) include any device or suite of devices that reduces sound levels that are transmitted through the water. Sunrise proposed to deploy NAS systems that reduce the propagated sound levels. NAS systems proposed by Sunrise include big bubble curtain (BBC), Hydro-Sound Damper (HSD), and AdBm, Helmholtz resonator. The proposed BBC consists of a flexible tube(s) fitted with special nozzle openings and installed on the seabed around the pile. Compressed air is forced through the nozzles producing a curtain of rising, expanding bubbles. These bubbles effectively attenuate noise by scattering sound on the air bubbles, absorbing sound, or reflecting sound off the air bubbles. An HSD system consists of a fish net holding different sized elements arranged at various distances from each other that encapsulates the pile. HSD elements can be foam plastic or gas-filled balloons. Noise is reduced as it crosses the HSD due to reflection and absorption by air spaces contained in the elements. The AdBm system consists of large arrays of Helmholtz resonators, or air fill containers with an opening on one side that can be set to vibrate at specific frequencies to absorb noise, deployed as a “fence” around pile driving activities. These systems could impact EFH during deployment and retrieval by crushing benthic organisms, disturbing soft bottom habitat, and creating a short-term increase in suspended sediment.

5.3 Decommissioning

All facilities would need to be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 CFR § 585.910(a)). Care would be taken to handle waste in a hierarchy that prefers re-use or recycling, and leaves waste disposal as the last option. Absent permission from BOEM, Sunrise Wind would complete decommissioning within two years of termination of the Lease.

A separate EFH consultation would be conducted for the decommissioning phase of the project. Decommissioning of the Project would include removal of all structures to a depth of 15 ft. 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 OCS-DC 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 standard 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. 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 standard 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 could make the habitat

temporarily less suitable and could 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 would be 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 to EFH

The primary impact of the Project would be from the installation and operation of 94 WTG turbines and foundations, which would be constructed in the mostly sandy seafloor. Installation of the turbines would produce acoustic impacts that could cause behavioral or physical effects on EFH and species with designated EFH. For species such as Atlantic cod and other gadids, alteration of the ambient noise environment by impact pile driving could interfere with communication and alter behavior in ways that could disrupt localized cod spawning aggregations. These new structures could also affect the migration of species that are attracted to unique complex features. This could lead to retention of those species and could increase feeding and spawning opportunities for some species, but lead to increased predation risk for other species.

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 Project area, 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.

6.0 Avoidance, Minimization, and Mitigation

6.1 Avoidance and Minimization Measures

This section outlines applicant proposed measures (APMs) by Sunrise Wind and additional environmental protection measures (EPMs) that 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)². BOEM may choose to incorporate one or more EPMs in the record of decision and adopt those measures as conditions of COP approval.

² Described in Attachment A of Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan (COP) (2016).

Table 6-1. APMs and Potential Mitigation Measures for Construction and Operation of the SRWF, SRWEC-OCS, and SRWEC-NYS Project Components

APM No.	APMs to Avoid and Minimize Impacts	Project Components			Expected Effects
		SRWF	SRWEC-OCS	SRWEC-NYS	
GEN-01	Site onshore export cable corridors and landfall within existing rights-of-way or previously disturbed/developed lands to the extent practicable.	X	-	-	Minimize impacts to sensitive and slow to recover habitats utilized by EFH-designated species.
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 identified through a lengthy stakeholder and scientific review process when refining the RI-MA WEA- see Section 2.1.1 of the Sunrise Wind COP); and sensitive benthic habitat; to the extent practicable. Avoid hard-bottom habitats and seagrass communities, where practicable, and restore any damage to these communities.	X	X	X	Minimize impacts to sensitive and slow to recover habitats utilized by EFH-designated species.
GEN-03	Avoid areas that would require extensive seabed or onshore alterations to the extent practicable.	X	X	X	Minimize impacts to sensitive and slow to recover habitats utilized by EFH-designated species.
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	This measure would protect the IAC and offshore export cables from damage and further help to minimize impacts to EFH.
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	X	X	X	Provides a means of monitoring and identifying the need for taking reasonable actions to avoid and/or minimize seabed disturbance and sediment dispersion, consistent with permit conditions.

APM No.	APMs to Avoid and Minimize Impacts	Project Components			Expected Effects
		SRWF	SRWEC-OCS	SRWEC-NYS	
	consultation with resource agencies.				
GEN-07	Implement aircraft detection lighting system (ADLS) or related means (e.g., dimming or shielding) on wind turbine generators (WTGs). Comply with Federal Aviation Administration (FAA), BOEM, and U.S. Coast Guard (USCG) lighting, marking and signage requirements to aid navigation per USCG navigation and inspection circular (NVIC) 02-07 (USCG 2007) and comply with any other applicable USCG requirements while minimizing the impacts through appropriate application including directional aviation lights that minimize visibility from shore. Information will be provided to allow above water obstructions and underwater cables to be marked in sea charts, aeronautical charts, and nautical handbooks.	-	x	x	Minimize potential impacts of lighting, in-water obstructions, and vessel activity to benthic habitat, EFH species and EFH.
GEN-08	To the extent practicable, use appropriate installation technology designed to minimize disturbance to the seabed and sensitive habitat (such as beaches and dunes, wetlands and associated buffers, streams, hard-bottom habitats, seagrass beds, and the near-shore zone); avoid anchoring on sensitive habitat; and implement turbidity reduction measures to minimize impacts to sensitive habitat from construction activities.	X	X	x	Minimize impacts to sensitive and slow to recover habitats utilized by EFH-designated species; minimize water quality impacts and impacts due to anchoring and construction activities.
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. If technically feasible, Sunrise Wind will also use shutdown procedures.	X	X	X	The reduction in SPLs would reduce the area of effects to EFH species and the prey they feed upon.
GEN-10	Prepare waste management plans and hazardous materials plans as appropriate for the Project.	X	X	X	Minimizes adverse effects on EFH from impacts to water quality.
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 (prepared in accordance with applicable regulations or OCS Permit	X	X	X	Minimizes adverse effects on EFH from impacts to water quality.

APM No.	APMs to Avoid and Minimize Impacts	Project Components			Expected Effects
		SRWF	SRWEC-OCS	SRWEC-NYS	
	conditions).). Development and implementation of an Oil Spill Response Plan (OSRP, part of the SPCC plan) and SPCC plans for vessels.				
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	X	Avoids and minimizes adverse effects on EFH from impacts to water quality.
GEN-13	Restore disturbance areas in the Onshore Project Area to preexisting contours (maintaining natural surface drainage patterns) and allow vegetation to become reestablished once construction activities are completed, to the extent practicable.	X	-	-	Minimizes potential for long-term impacts
GEN-14	Develop and implement a communication plan to inform the USCG, Department of Defense (DOD) headquarters, harbor masters, public, local businesses, commercial and recreational fishers, among others of construction and maintenance activities and vessel movements, as coordinated by the Marine Coordination Center and Marine Affairs.	X	X	X	Avoids and minimizes potential navigation and other vessel confusion, accidents, fuel spills, and collisions with EFH species and habitats.
GEN-15	Develop and implement an Onshore Maintenance of Traffic Plan to minimize vehicular traffic impacts during construction. Sunrise Wind would restore roadways to pre-construction conditions in accordance with NYSDOT Standard Specifications for Construction and Materials.	-	-	X	Avoids and minimizes potential disturbance and habitat loss among coastal fauna, EFH, and EFH species, and potential mortality among coastal fauna, listed species, and EFH species.
GEN-16	Prior to the start of operations, Sunrise 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	X	X	X	Avoid and minimize habitat disturbance and loss and species injury and/or mortality from machinery, vehicles, and vessels.

APM No.	APMs to Avoid and Minimize Impacts	Project Components			Expected Effects
		SRWF	SRWEC-OCS	SRWEC-NYS	
	conditions. Sunrise Wind will make a copy of the standard operating conditions available to each project-related vessel operator.				
GEN-17	Implement Project and site-specific safety plans (Safety Management System, Appendix E2).	X	X	X	Avoid and minimize accidents that may result in fuel releases and/or direct collision with coastal and benthic habitats, EFH, and EFH species.
GEO-01	Avoid identified shallow hazards, to the extent feasible	X	X	X	Avoid and minimize potential direct impacts to EFH habitat and species.
GEO-02	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	X	X	This measure would minimize impacts on EFH and EFH species from turbidity and water quality reduction.
GEO-03	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.
GEO-04	Conduct periodic and routine inspections to determine if non-routine maintenance is required.	X	X	X	Avoid and minimize potential impacts to EFH habitat and species by avoiding facility failures that may result in physical damage and/or fuel/hazardous substance releases.

APM No.	APMs to Avoid and Minimize Impacts	Project Components			Expected Effects
		SRWF	SRWEC-OCS	SRWEC-NYS	
TCHF-01	Coordinate with the New York Department of Environmental Conservation (NYSDEC), National Oceanic Atmospheric Administration (NOAA) Fisheries, 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	Avoid and minimize potential disturbance and/or loss of habitats, and potential mortality of species by avoiding sensitive areas.
TCHF-02	Conduct maintenance and repair activities in a manner to avoid or minimize impacts to sensitive species and habitat such as beaches, dunes, and the near-shore zone.	-	-	X	Avoid or minimize impacts to sensitive species and habitat such as beaches, dunes, and the near-shore zone.
BENTH-01	Sunrise Wind is conducting appropriate pre-siting surveys to identify and characterize potentially sensitive seabed habitats and topographic features.	-X	X	-	Minimize impacts to sensitive and slow to recover habitats used by EFH-designated species.
BENTH-02	To the extent feasible, installation of the Inter-Array Cables will be buried using equipment such as mechanical plow, jet plow, and/or mechanical cutter. Sunrise Wind will conduct a cable burial risk assessment.	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.
BENTH-03	Conduct a submerged aquatic vegetation (SAV) survey of the proposed inshore export cable route.	-	-	X	Minimize impacts to sensitive and slow to recover habitats used by EFH-designated species.
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	Avoid and minimize impacts to sensitive habitats utilized by EFH species.

APM No.	APMs to Avoid and Minimize Impacts	Project Components			Expected Effects
		SRWF	SRWEC-OCS	SRWEC-NYS	
FISH-02	Sunrise Wind will coordinate with NYSDEC, NMFS and USACE regarding time of year restrictions for summer flounder habitat areas of particular concern (HAPC).	X	X	X	Avoid and minimize impacts to summer flounder HAPC
MMST-03	Vessel operators will monitor NMFS North Atlantic right whale (NARW) reporting systems (e.g., the Early Warning System, Sighting Advisory System) [daily] for the presence of NARW during planning, construction, and operations within or adjacent to Seasonal Management Areas and/or Dynamic Management Areas.	X	X	X	Timing restriction is also protective of EFH and EFH-designated species.
Noise mitigation systems (NMS) during impact pile driving	The Project will use NAS (e.g., bubble curtain, hydro-damper, AdBm, Helmholtz resonator) to reduce noise propagation during monopile foundation pile driving. The Project is committed to achieving ranges associated with 10 dB of noise attenuation. The final selection of the single or suite of technologies that comprise NAS will be dependent upon the pile and environmental characteristics of the piling location.	-	X	X	Avoid and minimize impacts to EFH and EFH species
PAM for impact pile driving	4-hour PAM operator rotations for 24-hour operation vessels. There will be a PAM operator on duty conducting acoustic monitoring in coordination with the visual PSOs during all pre-start clearance periods, piling, and post-piling monitoring periods. Passive acoustic monitoring will include and extend beyond the largest shutdown zone for low- and mid-frequency cetaceans. Mitigation zones established for all species, including NARW will be applied accordingly depending on the season in which work is performed, summer (May-November) or winter (December-April).	X	X	X	Also protective of EFH and EFH-designated species
Impact pile-driving time-of-year restriction	No pile installation will occur from 01 January to 30 April.	X	X	X	Timing restriction is also protective of EFH and EFH-designated species.
Noise attenuation for UXO detonations	Sunrise Wind will use an NAS for all UXO detonation events and is committed to achieving the modeled ranges associated with 10 dB of noise attenuation. If a NAS system is not feasible, Sunrise Wind	X	X	-	Avoid and minimize impacts to EFH and EFH species

APM No.	APMs to Avoid and Minimize Impacts	Project Components			Expected Effects
		SRWF	SRWEC-OCS	SRWEC-NYS	
	will implement mitigation measures for the larger unmitigated zone sizes, with deployment of vessels or use of an aerial platform adequate to cover the entire clearance zones				
UXO Time of Year/Nighttime Restrictions	No UXO detonations are planned from December through April. No UXO will be detonated during nighttime hours.	X	X	X	Avoids and minimizes impacts to EFH and EFH species.

EFH = essential fish habitat; APM = applicant proposed measures; HDD = horizontal directional drill; HRG = high- resolution geophysical survey; SRWEC-OCS = Sunrise Wind Export Cable – Federal Waters; SRWEC-NYS = Sunrise Wind Export Cable – NY State Waters; SRWF = Sunrise Wind Farm area

Table 6-2. EPMs that BOEM Could Impose: General Avoidance/Minimization of Potential Impacts to EFH

EPMs and Mitigation Measures to Avoid and Minimize Impacts	Project Components				Expected Effects
	SRWF	SRWFEC-OCS	SRWFEC-NYS	SRWF 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 impacted 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 impacted 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
Take Screens on Pump Intakes for Inshore 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	-	-	X	-	This measure minimizes potential for impingement or entrainment of fish species.

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.					
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
Post-UXO Detonation Monitoring – will include PAM operator on duty conducting acoustic monitoring in coordination with the visual PSOs during all post-detonation monitoring periods. Monitoring will include the use of reticle binoculars, mounted big-eye binocular, data collection software system, PSO-dedicated VHF radios, and digital single-lens reflex camera with 300 mm lens.	X	X	X	-	This measure maximizes recovery of disturbed areas and protect EFH and EFH species from additional impacts

EFH = essential fish habitat; EPM = environmental protection measure; HDD = horizontal directional drill; HRG = high-resolution geophysical survey; SRWFEC-NYS= Export Cable Corridor in State Waters; SRWEC-OCS = Export Cable Corridor in OCS; SRWF = Sunrise Wind Farm Area

6.2 Environmental Monitoring

During the permitting process and in consultation with the resource agencies, Sunrise 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.

The Sunrise Wind Fisheries and Benthic Monitoring Plan is detailed in Appendix AA1 and AA2 of the COP (Sunrise Wind 2022). Monitoring would be used to avoid, minimize, and/or mitigate Project effects to EFH. This Fisheries and Benthic Research Monitoring Plan has been developed in accordance with recommendations set forth in *Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf* (BOEM 2019).

6.2.1 Sunrise Wind Monitoring Plan – OCS

Monitoring would commence in 2022, and continue through 2027, encompassing all three phases of cable installation (before, during, and after installation). OCS surveys would include trawl surveys, acoustic telemetry for highly migratory species (HMS), scallop surveys, and benthic monitoring for soft- and hard bottom habitats.

6.2.1.1 Trawl Surveys

Sunrise Wind has contracted with scientists at the University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST) and the Commercial Fisheries Research Foundation (CFRF) to execute a seasonal (i.e., four sampling events per year, approximately three months apart) trawl survey using an asymmetrical BACI experimental design. The trawl survey at Sunrise Wind would be carried out synoptically with the trawl survey at the Revolution Wind Farm lease area.

Using the same survey vessel and scientific crew would improve the consistency of the monitoring and data collection between the two projects/lease areas. As discussed below, the same reference areas would be used for both lease sites. The trawl survey would be conducted in collaboration with the F/V Gabrielle Elizabeth. The otter trawl fishery is active within the Sunrise Wind lease area, and this gear type generates the greatest revenue within the Lease Area. An otter trawl survey is an appropriate sampling gear for the Sunrise Wind Lease Area and the nearby control sites because this gear had broad selectivity and would effectively sample for multiple species, including groundfish (e.g., winter flounder, windowpane flounder, yellowtail flounder, Atlantic cod), monkfish, skates (e.g., winter and little skates), red hake, longfin squid, and others. The objectives associated with the trawl survey would be as follows:

- **Objective 1:** Evaluate changes in the relative abundance of commercially important fish and invertebrate species between SRWF and the control areas pre-construction, during construction, and post-construction
- **Objective 2:** Assess changes in the size structure of commercially important fish and invertebrate species between SRWF and the control areas pre-construction, during construction, and postconstruction.

- Objective 3: Investigate changes in the composition of fish and invertebrate species between SRWF and the control areas pre-construction, during construction, and post-construction.
- Objective 4: Evaluate changes in the diet composition of black sea bass and summer flounder between SRWF and the control areas pre-construction, during construction, and post-construction.

The use of an asymmetrical BACI sampling design would allow for quantitative comparisons of relative abundance and demographics to be made before and after construction, and between the reference areas and SRWF area. Further, the replication of sampling across both time and space increases the ability to demonstrate that a change in abundance was caused by a human activity. A sample size of 15 trawl tows per area would be targeted per season in each year at the start of the survey. This level of sampling is expected to have at least 80 percent power to detect a 33 percent temporal decrease for those species with Coefficient of Variations (CVs) ≤ 1.2 , and approximately a 40 percent temporal decrease for species with CVs ≤ 2.0 . Further, the use of an asymmetrical BACI design, with two rather than one reference areas, leads to gains in power for a given level of sampling intensity at the SRWF. Sample size may be refined, if necessary, in later years.

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 include:

- Multi-Method Survey for Structure-Associated Fishes
- Pelagic Fish Survey
- Clam Survey

6.2.1.2 Acoustic Telemetry for HMS

This acoustic telemetry monitoring effort would build on baseline studies by including five additional years of data collection, an expansion of the receiver array, and the deployment of an additional 150 acoustic transmitters for HMS. The project would be overseen by Anderson Cabot Center for Ocean Life (ACCOL) at the New England Aquarium, with Dr. Jeff Kneebone serving as the Principal Investigator. ACCOL would partner with INSPIRE Environmental to execute the field work, data analysis, and reporting. The primary objectives associated with the acoustic telemetry monitoring would be as follows:

- Objective 1: Evaluate changes in HMS presence, residency, and movements between pre-construction, construction, and post-construction.
- Objective 2: Evaluate HMS connectivity among Orsted/Eversource lease sites.
- Objective 3: Monitor tagged HMS at spatial scales greater than the Orsted/Eversource Project areas.

The current HMS receiver array (supported by other offshore wind developers) would be expanded from 17 to 32 receivers starting in 2022 and would achieve monitoring across the Orsted / Eversource lease sites (Sunrise Wind, Revolution Wind, and South Fork Wind) within the MA/RI WEA (Sunrise Wind 2022). The array would be comprised of 13 Vemco VR2-AR (acoustic release) receivers that were purchased through the INSPIRE Environmental/ACCOL MassCEC project, and 19 additional VR2-AR receivers that

would be purchased by Orsted specifically for this monitoring activity. The full receiver array would be maintained year-round continuously through at least 2026. This would permit monitoring throughout the pre-construction, construction, and post-construction periods of the Sunrise Wind, Revolution Wind, and South Fork Wind projects. The receivers would also gather valuable pre-construction data at popular recreational fishing grounds within the OCS-A 0500 lease area. In addition, the HMS receiver array deployed during this monitoring study would continue to allow for detection of tagged cod, and all detections of tagged cod would be shared with that research team. The receivers would remain in the water year-round throughout the duration of the study to provide monitoring during the presumed cod spawning period of December through March (Cadrin et al. 2020; Dean et al. 2020).

6.2.1.3 Acoustic Telemetry for the Sunrise Wind Export Cable

The Sunrise Wind Project would use one DC submarine export cable (SRWEC), within an up to 105-mi (169-km) corridor to transmit power to shore at Smith Point County Park in the Town of Brookhaven, New York. The DC magnetic field generated by the SRWEC would combine via vector addition with the Earth's geomagnetic field. In other words, the DC field from the SRWEC may affect both the magnitude and direction of the natural DC field in proximity to the cable. The cable would use materials such as grounded metallic sheaths and steel armoring, to shield the electric current from entering the marine environment (Snyder et al. 2019). However, the SRWEC would be a source of a static magnetic field that would modify the ambient static geomagnetic field. The movement of electric charges in a static magnetic field around the cable would produce a weak electric field. The strength of the magnetic field, and the induced electrical field, depend upon the amount of electrical current (Amperes) flowing through the cable.

In this study, an acoustic telemetry receiver network would be established along the route of the SRWEC, and dedicated telemetry tagging would occur to evaluate the potential impacts associated with the operation of the SRWEC on important marine species. The focal species for this study were chosen based on several factors including their known sensitivity to EMF, their ecological significance or importance to regional commercial and recreational fisheries, and their geographic overlap with the SRWEC. Monitoring efforts would focus on species associated with the benthos, given that they would experience the greatest potential impacts from EMF (Snyder et al. 2019). The species selected for telemetry monitoring are; American lobsters, horseshoe crabs, winter skates, sandbar sharks, sand tiger sharks, dusky sharks, and smooth dogfish.

The specific objectives associated with this monitoring study are as follows:

- Implant or attach acoustic transmitters on lobsters, horseshoe crabs, winter skates, smooth dogfish, sandbar sharks, dusky sharks, and sand tiger sharks.
- Deploy two arrays of acoustic receivers at the nearshore areas of the SRWEC landfall that extend outside of the existing receiver arrays deployed by Stony Brook University at Rockaway, Jones Beach, Fire Island, East Hampton, and Montauk that are designed to capture both broad-scale migratory behavior and fine-scale behaviors.
- Evaluate effects of EMF on behavior and movement on targeted species before, during, and after construction.
- Estimate movement metrics including depth, two-dimensional position, and residency for telemetered individuals.

- Maintain the offshore and nearshore Sunrise Wind Receiver Arrays and collect data on the individuals tagged by Stony Brook University and partnering organizations along the east coast.

The study would commence in 2022, and continue through 2027, encompassing all three phases of cable installation (before, during, and after installation). The receiver array would be deployed in June or July of 2022, and dedicated tagging trips would commence shortly after the receiver array has been deployed.

6.2.1.4 Scallop Survey

Sunrise Wind would partner with researchers at Coonamessett Farm Foundation (CFF) to carry out HabCam survey for scallops and other benthic organisms within the SRWF and a nearby control area, and the survey would be executed using a BACI design. Similar to other fisheries-independent surveys for scallops in the region, the survey would be executed once per year, targeting sampling in summer. The target is to achieve two years of pre-construction monitoring, and the survey would continue during construction, and for at least two years after construction has been completed. This survey would be carried out in collaboration with a local scallop vessel(s). The primary objective of the HabCam survey is to investigate the relative abundance of scallops and other resources in the SRWF Area (“SRW impact”) and reference area (“control”) over time. Using the HabCam survey equipment and protocols would ensure that the data collected as part of this fisheries monitoring plan would be compatible and standardized with fisheries-independent data that are used to inform scallop science, stock assessment, and management. The HabCam survey approach also is well-suited to sampling within the lease area following construction.

The objectives associated with the HabCam survey would be as follows:

- Objective 1: Evaluate changes in the relative abundance of scallops between SRWF and the control area pre-construction, during construction, and post-construction.
- Objective 2: Assess changes in the size structure of scallops between SRWF and the control areas pre-construction, during construction, and post-construction.
- Objective 3: Investigate changes in the composition of fish and invertebrate species (e.g., skates, flounder, hake, lobster, Jonah crab, monkfish) between SRWF and the control area pre-construction, during construction, and post-construction.

Sunrise Wind is currently working with researchers at CFF to develop the sampling protocols and statistical analyses associated with this survey, and those details would be included in a future iteration of the monitoring plan once they are available.

6.2.1.5 Benthic Monitoring

Hard Bottom Habitat

Novel hard bottom habitat monitoring at WTG foundations, scour protection layers, and cable protection layers would focus on measuring changes in percent cover, species composition and volume of macrofaunal attached communities (native and non-native species groups) and physical characteristics (rugosity, boulder density). These parameters would serve as proxies for resulting changes to the complex food web. Soft bottom habitat monitoring would focus on measuring physical factors and indicators of benthic function (bioturbation and utilization of organic deposits; Simone and

Grant 2020), which would serve as proxies for functional changes in the community composition. It is expected that the introduction of fines and organic content sourced from the epibenthic community on the WTG foundations would support increased deposit feeding benthic invertebrate communities in the soft sediments around the structures.

To accomplish the objectives of the novel hard bottom monitoring, high resolution video imagery captured using a remotely operated vehicle (ROV) would be employed. Video imagery would be used to document epifaunal community characteristics on the novel hard surfaces (WTG foundations and scour protection layers, OCS-DC jacket, cable protection layers).

An ROV video survey is planned to monitor novel hard bottom habitats (WTG foundations and scour protection layers, OCS-DC jacket, cable protection layers) within subareas of the SRWF. A stratified random design, with benthic habitat types as strata, would be used to select the WTG foundations and cable protection areas that would be monitored. There is only one OCS-DC jacket in the project design; it would be selected for monitoring. The same WTG foundations and the OCS-DC jacket selected for this novel hard bottom survey would be monitored as part of the soft sediment survey (see below). This would help facilitate synthesis between the degree of enrichment in the surrounding soft sediments and the epifaunal community composition and density colonizing the foundations at any given time and location.

Soft Bottom Habitat

The soft bottom monitoring would include an examination of two project components: WTG foundation-associated and export cable-associated soft bottom. The overall objective of the soft bottom benthic monitoring survey would be 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 WTG foundations or SRWEC-OCS centerline. A high density of fishing activity (trawling and dredging) occurs in the SRWF area. Frequent trawling and dredging activity could likely be a significant source of disturbance on the soft sediment habitats in the area. Fishing activity would be considered during survey planning and would be accounted for during data interpretation as a potential disturbance.

Benthic functioning of the soft bottom habitats would be captured by documenting physical parameters (grain size major mode) and biological factors (bioturbation and utilization of organic material) with a sediment profiling imaging/plan view (SPI/PV) system. It is expected that the epibenthic community that colonizes the WTG foundations and OCS-DC jacket would supply organic matter to the sediments below through filtration, biodeposition, and general deposition of detrital biomass. This organic material sourced from the biological activity of the epibenthic community on the foundation structures would likely alter the infaunal community activity, increasing sediment oxygen demand and promoting the activity of deep-burrowing infauna. Based on benthic monitoring results in other offshore wind farms, the effects of the WTG foundation on the surrounding soft sediment habitat would be expected to decrease with increasing distance from the WTG.

6.2.2 Sunrise Wind Benthic Monitoring Plan – New York State Waters

The benthic monitoring plan for state waters includes details of the pre-construction and post-construction surveys of soft sediment habitats along the SRWEC-NYS (Sunrise Wind 2022). A combination of SPI/PV imaging and sediment grab sampling would be used to monitor these benthic environments. SPI/ PV is a widely accepted approach to assess the seafloor as it provides an integrated, multi- dimensional view of the benthic and geological condition of the seafloor sediments. Specifically,

SPI/PV imagery provides insight into benthic functioning such as organic matter remineralization (e.g., the depth of bioturbation, aRPD depth) and small-scale biogenic structures (low-relief tubes, burrows, and emergent fauna). Since this method preserves the organism-sediment relationship, it can accurately characterize benthic epifauna and infauna communities in relation to the local environmental context. Pairing SPI and PV images provides a comprehensive depiction of the seafloor that, through standardized analysis and interpretation (e.g., using the BOEM-recommended Coastal and Marine Ecological Classification Standard (CMECS) allows for accurate comparisons to be made before and after installation activity. SPI/PV provides real-time results that can be assessed onboard during the surveys, which allows for rapid adaptive sampling to target locations of interest.

Taxonomic benthic community analysis of sediment grab samples provides quantitative descriptions of soft sediment communities including community structure (beta diversity), abundances of taxa, and community diversity (species richness, alpha diversity). Populations of soft sediment taxa are often dynamic and patchy in nature. The benthic community analysis approach would provide an assessment of potential changes in quantitative community diversity metrics and particular species abundances.

The pre-cable installation survey was conducted 12-13 August 2020 (SPI/PV collection) and 18 August 2020 (sediment grab collection), prior to commencement of cable installation activities in the area (Sunrise Wind 2022).

At least two field sampling events would occur after the proposed SRWEC-NYS has been installed. Post-construction monitoring surveys would occur between August 1st and October 31st each year within 24 months of the Sunrise Wind Farm Project's commercial operational date. During the post-cable installation surveys, three stations would be sampled with SPI/PV in a transect perpendicular to the SRWEC-NYS, with one station as close as practicable to the centerline and one station approximately 100 feet on either side. These transects would repeat at 1,000-ft intervals from the HDD exits offshore to the territorial limit of NYS waters.

At each SPI/PV station a minimum of three replicate images shall be collected and analyzed. At each SPI/PV station, a conductivity, temperature, depth sensor would be used to measure the salinity and temperature through the water column to the sediment surface. Additionally, the temperature of the sediments would be measured at each SPI/PV station. The SPI/PV sampling would be supplemented with sediment grab stations located at transects every 2,000-ft along the SRWEC-NYS centerline, with one grab sample station as close as practicable to the centerline and one grab sample station approximately 100-ft on the eastern side of the cable. At each grab station three replicate grab samples would be collected, sieved onboard, and preserved. One replicate grab sample from each grab station would be analyzed for benthic community analysis by standard Environmental Protection Agency approved protocols; the other two replicate grab samples would be archived and analyzed if greater precision is needed to determine if an ecological meaningful difference exists between pre-construction and post-construction communities (see below).

Benthic community data would be statistically compared across years and distance from the cable, with a specific focus on total infaunal abundances, Shannon-Weiner Index, and total number of species as response variables. SPI/PV imagery-derived metrics would be statistically compared across years and distance from the cable. The water column profile data would be used as potential explanatory variables to inform the post-construction comparison between the benthic habitat and community at stations along the centerline of the cable versus those located 100-ft from the cable centerline. Sediment temperature measurements collected during the post-construction monitoring surveys at stations along the centerline of the cable would be compared to those measurements collected 100-ft from the cable centerline, using distance from shore and depth as potential covariates.

6.2.3 Impacts of 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 that would cause them to leave the area.

6.3 Alternative Project Design that Could Avoid/Minimize Impacts

The following section discusses alternative turbine layouts proposed for the Project. One alternative (Alternative C) to the proposed design has been analyzed to minimize impacts to fisheries habitats. Under Alternative C, the construction, operation, maintenance, and eventual decommissioning of 81-102 11 MW WTGs and an OCS within the proposed Project area and associated IAC and export cables would occur within the range of design parameters outlined in the COP (Sunrise Wind 2022), subject to applicable mitigation measures. However, to reduce impacts to complex fisheries habitats that are the most vulnerable to long-term impacts as compared to the Proposed Project, certain WTG positions would be excluded from development.

Alternative C considered and prioritized contiguous areas of complex habitat to be excluded from development to avoid and minimize impacts to complex fisheries habitats, while still meeting BOEM's purpose and need for the Project. Areas for prioritization were identified by NMFS based upon on detections of Atlantic cod spawning activity in the vicinity of the Project Area, assumed hard bottom complex substrate, and the presence of large boulders (see Figure 6-2). Priority Area 1 is considered the highest priority for conservation and includes 16 WTG positions as well as the OCS-DC. With only 8 positions to exclude for Alternative C, all were eliminated from Priority Area 1. To identify which 8 positions to remove, BOEM relied on the locations and densities of boulders, which can be considered a critical element of potential sensitive habitat (Gardline 2021). Gardline (2021) identified boulders as objects that 1) returned a strong backscatter signal indicative of hard substrates; 2) were observed to have a distinct shadow or measurable height; and (3) had diameters greater than 0.5 m. The density of boulders (number of boulders/250 km²) on the seafloor surrounding each WTG position was calculated using the ESRI ArcGIS Pro Spatial Analyst Density function (Table 6-3; Figure 6-3). Then, boulder densities within NMFS's Priority Area 1 were ranked and the eight contiguous WTG positions with the highest boulder densities within Priority Area 1 were identified for exclusion in Alternative C (Figure 6-1).

Boulder densities were highest in WTG position 87 to 94, with the exception of WTG position 91, and were identified for exclusion from development (Figure 6-1). WTG position 91 has slightly lower boulder density (15.6/250 km²) when compared to WTG position 96 (16.0/250 km²); however, WTG position 91 was chosen for exclusion to provide contiguous fisheries habitat without disturbance. While low densities of boulders occur within Priority Areas 2 and 4, Priority Area 1 was deemed the higher priority by NMFS due to close proximity to Cox Ledge, and documented cod spawning activity based upon recent acoustic and telemetry data. The positions identified for exclusion within Alternative C were determined to be most optimal for minimizing fisheries habitat impacts. Alternative C consists of two sub-alternatives that vary in the placement, number and capacity of the WTGs installed. The sub-alternatives are described below:

Alternative C-1: Sunrise Wind’s proposed layout includes 102 WTG positions; however, only 94 11-MW WTGs would be needed to meet the Project’s maximum capacity of 1,034 MW. Under Alternative C-1, the construction and installation, O&M, and eventual decommissioning of a wind energy facility, and an OSS would occur within the design parameters outlined in the Sunrise Wind Farm COP (Sunrise Wind 2022) subject to applicable mitigation measures. However, certain WTG positions would be excluded from the identified priority areas in order to reduce impacts to sensitive benthic habitat and areas near where cod spawning has been detected. Under this alternative the Project would maintain a uniform east-west and north-south grid of 1 x 1 nm spacing between WTGs. Alternative C-1 would result in the exclusion of up to 8 WTG positions from the identified priority areas.

Alternative C-2: Under Alternative C-2, the 8 WTG positions identified for exclusion from development in Alternative C-1 would remain the same, and an additional 12 WTG positions would be removed from the Priority Areas and relocated to the eastern side of the lease area. The construction and installation, O&M, and eventual decommissioning of a wind energy facility, and an OSS would occur within the design parameters outlined in the Sunrise Wind Farm COP (Sunrise Wind 2022) subject to applicable mitigation measures. The Project would maintain a uniform east-west and north-south grid of 1 x 1 nm spacing between WTGs. Alternative C-2 assumes that habitat on the eastern side of the lease area is suitable for development. Geotechnical and geophysical surveys conducted in 2022 will help inform the feasibility of Alternative C-2.

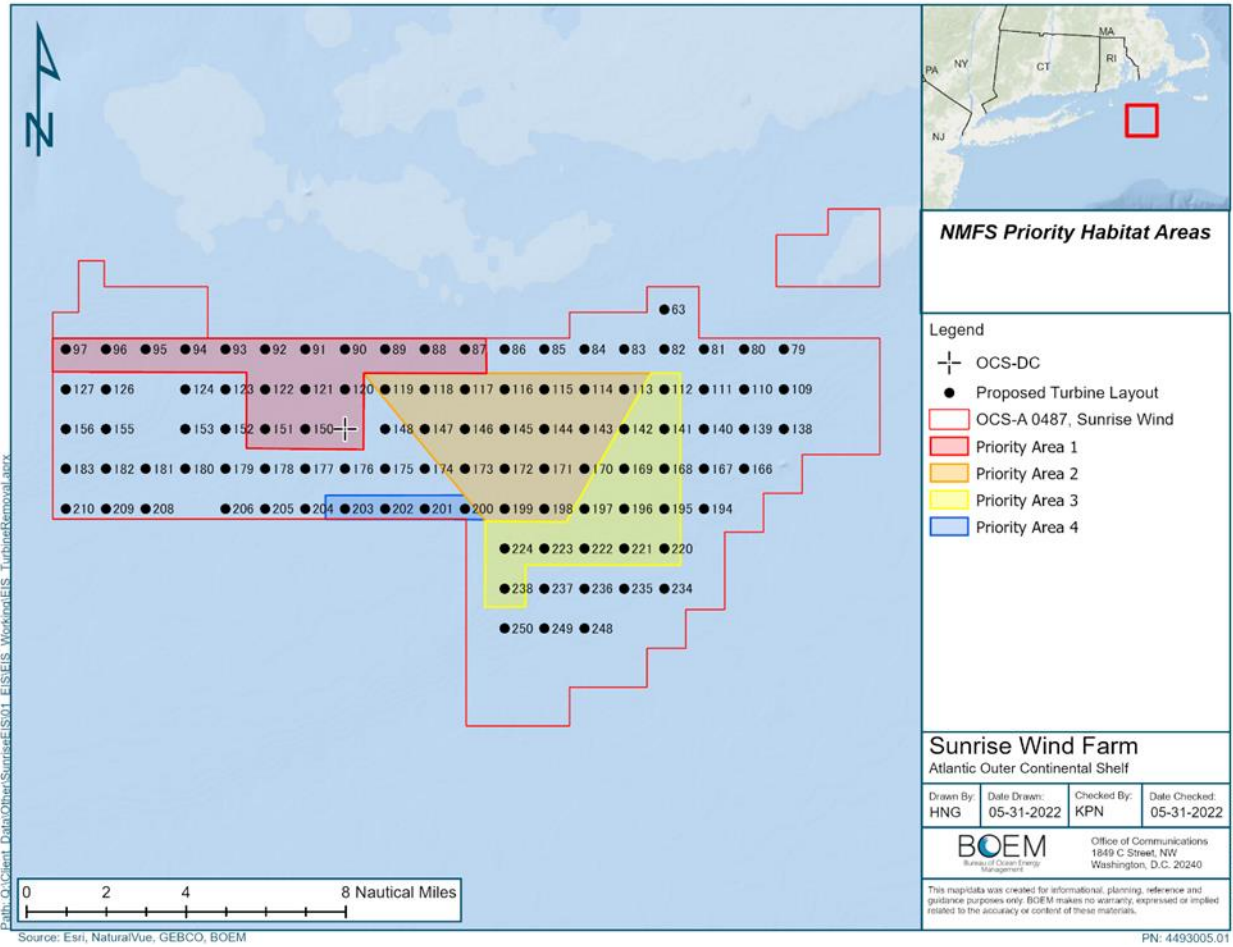


Figure 6-1. Priority Areas Identified by NMFS for WTG Exclusion

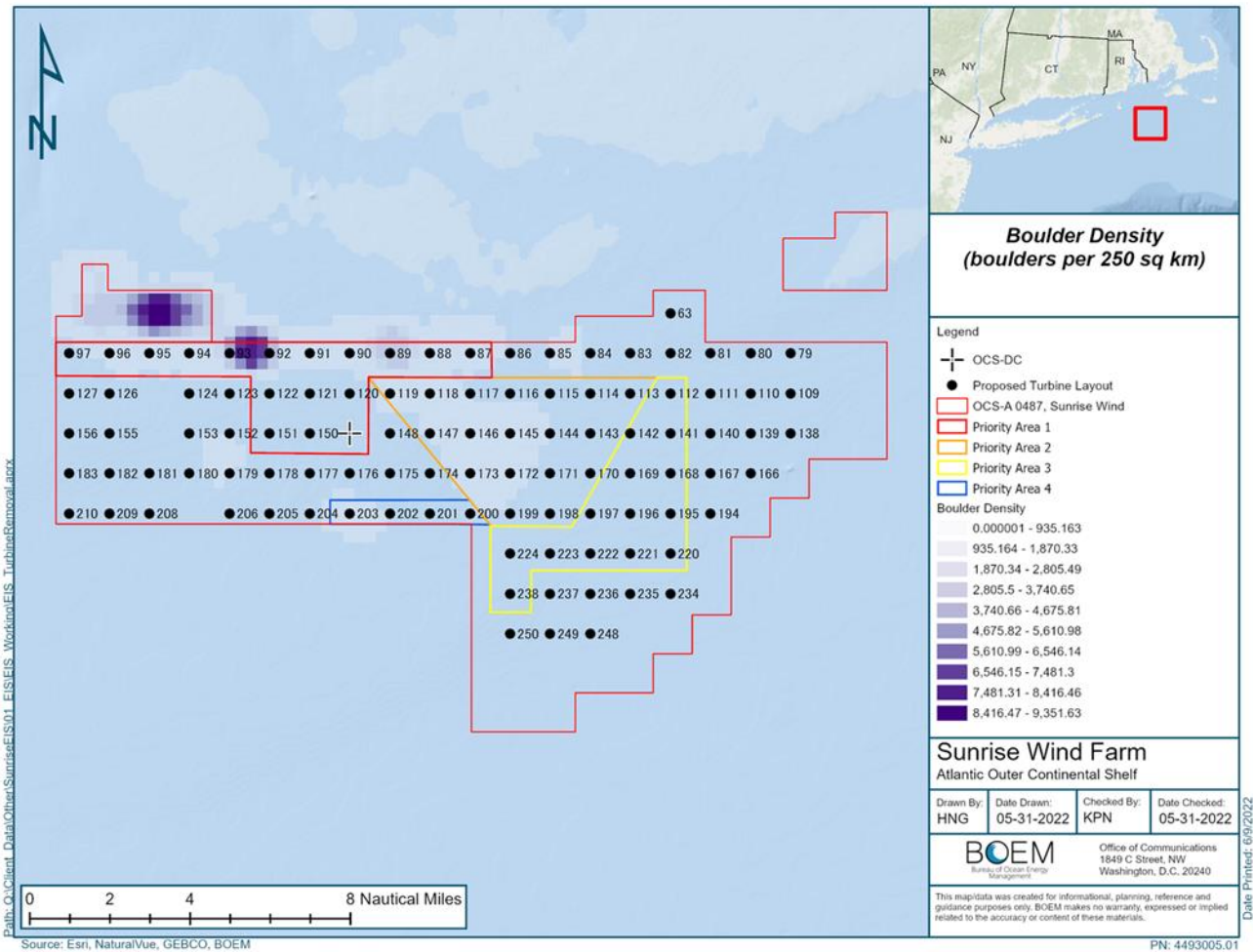


Figure 6-2. Boulder Density within the Priority Areas in the Sunrise Wind Lease Area

Table 6-3. Boulder Densities Surrounding WTG Positions in Priority Area 1

WTG Position No.	Boulder Density (#/250 km ²)	Exclude Position?	Benthic Habitat	Bedforms	Habitat Type
87	321.8	Yes	Coarse Sediment - Mobile	Ripples	Complex
88	261.9	Yes	Coarse Sediment - Mobile	Ripples, Trawl marks	Complex
89	2450.8	Yes	Glacial Drift	Ripples	Large Grained Complex
90	166.4	Yes	Coarse Sediment - Mobile	Ripples, Trawl marks	Complex
91	15.6	Yes	Coarse Sediment - Mobile	Ripples, Trawl marks	Complex
92	4665.5	Yes	Coarse Sediment - Mobile	Ripples, Trawl marks	Complex
93	4398.4	Yes	Coarse Sediment - Mobile	Ripples	Complex

WTG Position No.	Boulder Density (#/250 km²)	Exclude Position?	Benthic Habitat	Bedforms	Habitat Type
94	243.5	Yes	Sand and Muddy Sand	Linear Depressions, Ripples, Trawl marks	Soft Bottom
95	38.8	No	Sand and Muddy Sand	Linear Depressions, Ripples, Trawl marks	Soft Bottom
96	16.0	No	Coarse Sediment - Mobile	Ripples	Complex
97	0	No	Coarse Sediment - Mobile	Ripples	Complex
120	0	No	Sand and Muddy Sand	Ripples	Soft Bottom
121	0	No	Sand and Muddy Sand	Linear Depressions, Ripples	Soft Bottom
122	0	No	Coarse Sediment - Mobile	Ripples	Complex
150	0	No	Sand and Muddy Sand	Linear Depressions, Ripples, Trawl marks	Soft Bottom
151	0	No	Sand and Muddy Sand	Linear Depressions, Ripples, Trawl marks	Soft Bottom

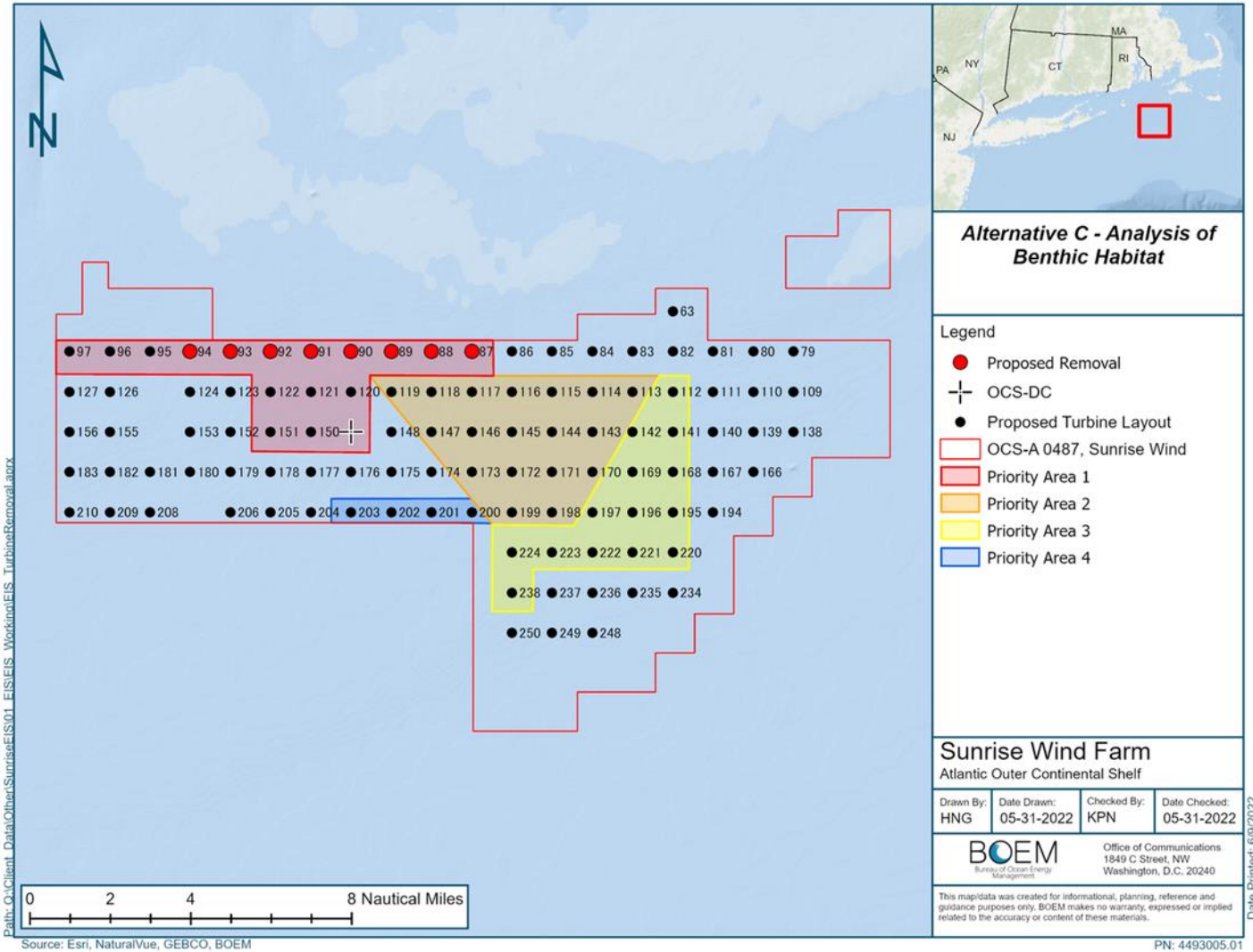


Figure 6-3. Boulder Densities Surrounding WTG Positions in Priority Area 1

7.0 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 Project. 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 blueback 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.*)

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	Limited short-term, long-term, and permanent impacts	<p>Short-term disturbance effects would occur with 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. 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.</p> <p>Short-term noise disturbance from pile driving associated with monopile installation would reduce habitat suitability for these species. Habitat conditions would be unaffected after construction is complete. Operational noise effects are below established behavioral and injury effects thresholds for fish.</p> <p>Collectively, areas affected by short-term construction related impacts would rapidly return to baseline conditions after the project is completed. Long-term and permanent habitat alterations and operational effects on habitat would be small because:</p> <ul style="list-style-type: none"> • impacts are limited in intensity and extent, • species occurrence is limited, and • long-term impacts may produce new suitable habitats.
American eel	Larvae, Juvenile, Adult	Limited short-term, long-term, and permanent impacts	
Striped bass	Juvenile, Adult	Limited short-term, long-term, and permanent impacts	
Blackfish/tautog	Juvenile, Adult	Limited short-term, long-term, and permanent impacts	
Weakfish	Juvenile, Adult	Limited short-term, long-term, and permanent impacts	
Spot	Juvenile, Adult	Limited short-term, long-term, and permanent impacts	

Species	Life Stage within Project Area	Impact Determination	Rationale for Determination
Atlantic croaker	Juvenile, Adult	Limited short-term, long-term, and permanent impacts	
Spotted hake	Juvenile, Adult	Limited short-term, long-term, and permanent impacts	
Smallmouth flounder	Juvenile, Adult	Limited short-term, long-term, and permanent impacts	
Bobtail squid	Juvenile, Adult	Limited short-term, long-term, and permanent impacts	
Northern kingfish	Juvenile, Adult	Limited short-term, long-term, and permanent impacts	
Sea robins	Juvenile, Adult	Limited short-term, long-term, and permanent impacts	
Forage species (Atlantic menhaden, bay anchovy, sand eel)	All	Limited short-term, long-term, and permanent impacts	

Species	Life Stage within Project Area	Impact Determination	Rationale for Determination
American shad	Juvenile, Adult	Limited short-term, long-term, and permanent impacts	Short-term noise disturbance from pile driving associated with monopile installation monopile installation would reduce habitat suitability for this species as its hearing is connected to its swim bladder. 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, long-term, and permanent impacts	Both of these species are known to occur within the Project area. Adults 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, or limited in spatial extent.
Horseshoe crab	All	Short-term, long-term, and permanent impacts	
Bivalves (blue mussel, eastern oyster, ocean quahog, soft-shell clam)	All	Short-term, long-term, and permanent impacts	<p>Short-term disturbance effects would occur over benthic habitat. However 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. 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).</p> <p>Project 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.</p>

8.0 Conclusions/Determination(s)

A total of 42 species of finfish, elasmobranchs, and invertebrates with designated EFH occur in the Project area. The Proposed Project, 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 associated with construction activities, such as pile driving and jet plowing, are likely to be greater than those associated with operation and maintenance. 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 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 quality. Depending on the nature, extent, and severity of each effect, this may temporarily reduce the suitability as EFH for multiple life stages of Atlantic cod and longfin squid. However, APMs such as sound attenuation and soft start procedures could minimize such acoustic impacts. Additional APMs are described in Table 6-1. The implementation of APMs (Table 6-1) would likely result in the avoidance and minimization of some of the intermediate to long-term (permanent) project impacts to EFH described above.

The operation and maintenance of the Project would result in intermediate to long-term adverse effects on EFH for some life stages of EFH-designated species (Section 5.2). Long-term adverse effects are those that would last over the approximately 35-year lifespan of the Project. These impacts include alteration of the water column and benthic habitats, 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 the habitat. Benthic habitat within the entire lease area includes 24,913 acres of complex, and 35,283 acres of non-complex benthic habitat (see Table 3-2). WTG and OCS Foundations would displace 2.39 acres (0.97 hectares) of complex habitat, 0 acres of large grained complex habitat, and 2.25 acres (0.91 hectares) of soft bottom habitat. An additional estimated 47.89 acres (19.38 hectares) of complex habitat, 0.11 acres (0.04 hectares) of large grained complex habitat, and 62.76 acres (25.4 hectares) of soft bottom habitat would be modified by placement of scour protection around the WTG and OCS foundations. The potential increase in abundance of epibenthic and demersal fishes resulting from the reef effect may offset some impacts to EFH of those species over the life of the wind farm, although it may take a decade or more for the reef effect to fully develop. The implementation of APMs (Table 6-1) would likely result in the avoidance and minimization of some of the intermediate to long-term (permanent) project impacts to EFH described above.

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

9.0 References

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10.0 Appendices

10.1 List of Supporting Documents

The following documents and information support this EFH assessment:

- Sunrise Wind Construction and Operations Plan, April 2022
 - <https://www.boem.gov/renewable-energy/state-activities/sunrise-wind-activities>
- The following documents are available in the Sunrise Wind PDEIS Cooperating Agency Review Folder on the third-party contractor's SharePoint site:
 - Acoustic Report: Underwater Noise and Exposure Modeling (COP Appendix I)
 - Benthic Monitoring Plan, New York State (COP Appendix AA2)
 - Benthic Resources Characterization Report – Federal Waters (COP Appendix M1)
 - Benthic Resources Characterization Report – New York State Waters (COP Appendix M2)
 - Benthic Habitat Mapping Report (COP Appendix M3)
 - EMF: Offshore EMF Assessment (COP Appendix J1)
 - Fisheries and Benthic Monitoring Plan (COP Appendix AA1)
 - NPDES Permit Application, December 2021
 - Ichthyoplankton Entrainment Assessment (COP Appendix N2)
 - Protected Species Mitigation and Monitoring Plan, draft May 2022
 - UXO Acoustic Modeling Report (COP Appendix P4)
- Access to the Sunrise Wind Popup Mapper was provided to NMFS on November 5, 2021. Please contact BOEM if new credentials are needed.

10.2 Benthic Habitat Mapping Methods

Benthic habitat mapping for Sunrise Wind was conducted by Inspire Environmental. The following information is from their benthic habitat report, COP Appendix M3, Sunrise Wind (2022). All tables, figures, and citations in the methodology below can be found in COP Appendix M3.

10.2.1 Input Data and Approach

Multiple sources of geophysical and ground-truth data were used as input for mapping benthic habitats within the study 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 (Sunrise Wind LLC 2021b) and benthic assessment reports (INSPIRE 2021a, 2021b) appended to the Sunrise Wind COP (Sunrise Wind LLC 2021a).

10.2.2 Input Data

10.2.2.1 Geophysical Data

To support Sunrise Wind Site Investigations, Fugro USA Marine, Inc. (Fugro) conducted high-resolution multibeam echosounder (MBES) and side-scan sonar (SSS) surveys within the study area in 2019, 2020, and 2021 (Sunrise Wind LLC 2021b). An additional geophysical survey was conducted by Gardline in 2019 in the southeast portion of the SRWF. Geophysical data collected during surveys completed by Bay State Wind, LLC were also utilized to support and align interpretations where these data overlap with the SRWF (Sunrise Wind LLC 2021b). MBES and SSS are collected using different instruments deployed from the same survey vessel (Figure 2-1). The MBES is mounted to the vessel and provides the highest degree of positional accuracy; the MBES can be optimized for either bathymetric or backscatter data, but 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 (Sunrise Wind LLC 2021b). Bathymetric data provide information on depth and seafloor topography (Figures 2-2 and 2-3). Bathymetric data were used to create a model of seafloor slope for the study area with a cell size of 3 m (Figures 2-4 and 2-5).

Backscatter data were derived from the MBES and processed to a resolution of 25 cm (Sunrise Wind LLC 2021b). Backscatter data are based on the strength of the acoustic return to the instrument and provide information on seafloor sediment composition and texture. Backscatter data are best interpreted in concert with hill-shaded bathymetry (Figures 2-6 and 2-7). 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 compaction or ripples.

Backscatter decibel values are also influenced by water temperature, salinity, sensor settings, seafloor rugosity, and MBES operating frequency, among other factors (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. This scenario is common and does not nullify the data; methods to optimize processing (as appropriate to the sensors) and to display the data optimal for interpretation are well developed (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, should not rely solely on these data (see Table 1 in Brown et al. 2011). The manner in which the suite of data were used for habitat delineations is described further in Section 2.2.

SSS data were generated from a towed instrument (Figure 2-1) and, thus, have a lower positional accuracy than MBES data. However, because the SSS towfish is closer to the seafloor with a lower angle of incidence, the resolution, signal to noise ratio, and intensity contrast of SSS images are higher than

those of MBES backscatter images (Lurton and Jackson 2008). The processed SSS images provide the highest resolution data on sediment textures and objects on the seafloor (boulders, debris) (Figure 2-8). Thermoclines and haline variations affect the acoustic signal and result in data artifacts, presenting as sinuous rippling of alternating low and high returns that cannot be removed from the data; these artifacts are visible when viewed at very close range. SSS data were processed to a resolution of 10 cm; this resolution permits detection of medium to large boulders but does not permit the reliable detection of individual cobbles (6.4 cm to 25.6 cm). Although individual small boulders and cobbles cannot be detected in 10-cm resolution SSS, SSS textures and patterns can indicate the presence or absence of higher densities of these features.

Individual boulders greater than or equal to 50 cm (0.5 m) in diameter were identified from the MBES and SSS data using manual detection methods to generate a “boulder pick” data set to accompany the boulder field dataset (Figure 2-9). Boulder fields were generated using heatmaps in Global Mapper and were reviewed manually to finalize the boulder field polygons. Boulder fields represent aggregations of boulders where they were present in low (20 – 99 per 10,000 m²), medium (100 – 199 per 10,000 m²), or high (>199 per 10,000 m²) densities (Sunrise Wind LLC 2021b). These density values were set by the Sunrise Wind Site Investigations team and are consistent with values used for the nearby Revolution Wind project. Boulder fields are defined as a geoform by the federal Coastal and Ecological Marine Classification Standard (CMECS; FGDC 2012), however no density values are provided in CMECS. 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. A combination of backscatter over hillshaded bathymetry and SSS data was used to detect large- and small-scale bedforms, such as megaripples and ripples (*sensu* BOEM 2020a) (Figure 2-10).

10.2.2.2 Ground-Truth Data

Sediment profile and plan view images (SPI/PV; Figure 2-11) were collected in triplicate at 244 stations within the SRWF in April and May 2020 (Figure 2-12), at 76 stations along the SRWEC–OCS in April and May 2020, and at 35 stations along the SRWEC–NYS in August 2020 (Figure 2-13). In addition, PV were collected at 8 stations within the vicinity of the ICW HDD in September 2020 (Figure 2-14). In addition, a total of 3,447 m across 22 transects were sampled with towed video within the ICW HDD area to identify the presence of SAV and benthic macroalgae (Figure 2-14). A follow-on survey was conducted in August 2020 at the SRWF to further delineate areas of complex hard bottom habitat and areas of high backscatter returns identified by NOAA Habitat as of additional interest. During this survey, a towed video system was used to sample ~8,700 m across 17 transects in four areas of interest (Figure 2-15). An additional area of interest was sampled using a “Pogo” PV approach when sea states precluded video sampling; 87 PV images were captured along 1,080 m (Figure 2-15). This approach mimics a continuous transect by deploying the PV system in quick succession along a transect. Summarized data results are presented in Attachments A (SPI/PV), B (Pogo PV), C (Offshore Video), and D (SAV).

SPI/PV images were used to ground-truth sediment types, bedform dynamics, presence of sensitive habitats and taxa, and to characterize benthic biological communities. SPI/PV images were analyzed for a suite of variables (Table 2-1) and were classified using CMECS Substrate and Biotic components (Tables 2-2, 2-3, 2-4, and 2-5). CMECS Substrate Subgroup was particularly useful as ground-truth data for purposes of delineating seafloor sediments and benthic habitats (Figure 2-16). CMECS Biotic Subclasses, listing of common taxa present at higher densities (e.g., cerianthids, sand dollars), and notations of

sessile and mobile epifauna present (Figure 2-17) were used to provide detail about the biological communities observed within each mapped habitat type. All ICW video footage was analyzed post-collection with a focus on the detection of SAV, and, if detected, the spatial extent of the SAV patch or bed was determined. Additional parameters were analyzed where SAV was present including SAV bed extent, in accordance with federal agency protocols (Colarusso and Verkade 2016). The video analyst also documented the presence of macroalgal beds, with qualitative notes on the density of the macroalgae observed. Detailed descriptions of each SPI/PV variable analyzed and full data analysis results for the SPI/PV and ICW HDD PV and video survey can be found in the COP Benthic Assessment Appendices (INSPIRE 2021a, 2021b).

For the Sunrise Wind Project, a macrohabitat variable was generated from several SPI and PV variables to create a single variable to serve as a construct to describe repeatable physical-biological associations (Figures 2-18 and 2-19; INSPIRE 2021a). Using the methodology detailed in Figure 2-18 ensured that the presence of any gravel was detected; the “Max Gravel Size” variable is the maximum gravel size detected across all three analyzed replicate images at each station. Given the spatial scale of the SPI/PV data, benthic habitat types derived from replicate SPI/PV images are considered macrohabitats (sensu Greene et al. 2007). Each PV replicate image is between 0.2 and 0.5 m² and the replicate images were collected within approximately 10 m of each other at each station. Thus, this design can provide insight into the degree of patchiness of habitat features, such as boulders and cobbles, within this spatial context. This sampling approach cannot capture larger habitat features such as sand waves or smaller habitat features such as cracks and crevices on a boulder. Recognizing scale is a critical component to habitat descriptions and delineations, the habitat types derived from the SPI/PV approach are most accurately described as macrohabitats, which is defined by Greene et al. 2007 as encompassing a scale of one to 10 meters. The macrohabitat type derived from SPI/PV at each station cannot be extrapolated beyond the scale of the station; however, this variable served as a key variable for ground-truthing benthic habitat types and informing full characterization of each mapped habitat polygon.

Videos collected within the SRWF were analyzed using Behavioral Observation Research Interactive Software (BORIS), an event logging software. Scaling lasers spaced at 10 cm were used in video collection and permitted feature identification and sizing. Videos were reviewed and analyzed by a single trained analyst, then reviewed for quality assurance by senior staff. Adjustments (e.g., pause, viewing speed) were made during analysis to optimize identification of seafloor features and increase reviewer efficiency. Features were logged to an interactive timeline to aid quality assurance checks. Video imagery was examined along the length of the entire transect for a single variable used to capture sediment composition and bedforms, terms from the CMECS Substrate component and SPI/PV macrohabitat variable were used (Gravels, Sandy Gravel, Gravelly Sand, sand with ripples, sand and mud). With the video at standard height off the seafloor, it is possible to distinguish the smallest gravel size (granule) from sand. In addition, point locations where boulders were observed were marked in BORIS as single point events and were mapped as such. Visual determination of boulders was possible as the minimum size of a boulder (256 cm) is approximately 2.5 times greater than the spacing of the scaling lasers. When the seafloor was not visible due to changes in the camera position or turbidity in the water column, an “Off Bottom” value was entered into the data record.

10.2.3 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 (~1:10,000) to identify large-scale facies – areas of sedimentary characteristics (reflectance, bedform, slope) distinct from those adjacent (Figure 2-20). These initial delineations were further refined at “zoomed in” scales (~1:2,000 or finer) using the MBES data in combination with SSS, boulder picks, and ground-truth data (Figure 2-20). Delineations must be of a size appropriate both to the resolution of the data and to the subject of interpretation. The resolution of the geophysical data, delineation size, and the CMECS Substrate Component agency recommendations (NOAA Habitat 2021).

10.2.3.1 Geological Seabed Characterization

Sunrise Wind developed information on the geological seabed to characterize the geological provenance and stratigraphic conditions of the seafloor inclusive of surface and subsurface features (Sunrise Wind LLC 2021b). Methods used to collect this information included MBES bathymetry and backscatter, SSS, sub-bottom profile, magnetometer, and seismic profile data. For the purposes of defining geological seabed types present at the sediment surface, the Folk classification (Folk 1954) was used, which aligns with CMECS Substrate classifications (Figure 2-21). Seabed types present within the study area based solely on this scheme are mud and sandy mud, sand and muddy sand, coarse sediment, and mixed sediment. In addition, areas of the seabed of unconsolidated or consolidated stratified glacial deposits were mapped as glacial drift.

10.2.3.2 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 more fully characterize and map benthic habitats within the study area. Multibeam 50-cm resolution bathymetry, 25-cm resolution backscatter, and 10-cm SSS data were examined along with boulder fields and picks, and ground-truth SPI/PV and video data (Figures 2-22 and 2-23) to delineate new habitat polygons and to refine the seabed classifications for the purposes of evaluating benthic habitats (Figure 2-24).

Specifically, modifiers were used to provide additional descriptive information about the benthic habitats found within the study area; CMECS modifiers 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, such as megaripples and ripples, indicating frequent physical disturbance of the seafloor was observed across the majority of a habitat polygon, the “Mobile” modifier was used (Figure 2-25). Boulder fields mapped by Sunrise Wind Site Investigations were used to refine habitat boundaries and were applied as modifiers (Figure 2-26), except where they overlapped with glacial drift habitats, as this habitat type is always characterized by medium and high densities of boulders. SAV provides unique habitats for certain species of benthic

invertebrates and demersal fish; modifiers were applied for both recent and historical (modifier of “potential”) areas of SAV in the ICW HDD area.

All habitats and their distributions within the study area are described in more detail in Section 3.0. For the purposes of aiding interpretation and presentation of data in ground-truth tables, individual benthic habitat types with modifiers have been grouped and color-coded to consolidate types of related habitats that are present in very small areas (Table 2-6). In addition to the primary habitat data on types and modifiers, 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 (2020a): megaripples = 5 - 60 m wavelength and 0.5 - 1.5 m height; ripples = <5 m wavelength and <0.5 m height; other bedforms such as linear depressions and trawl marks were noted where present. The presence of isolated boulders and debris identified by Sunrise Wind Site Investigations in the geophysical analysis (boulder picks and debris contacts) were noted as “scattered boulders and debris” in the habitat data. Additionally, further characterizations of coarse sediment habitat polygons were recorded as “coarse sediment refinements” to provide additional detail on the nature of coarse sediment (e.g., gravelly sand or sandy gravel) where it could be reliably determined from ground-truth and geophysical data. These refinements were only applied to polygons in which ground-truth SPI/PV stations and/or video transects were located.

10.2.3.3 Benthic Habitat to EFH Crosswalk

Essential fish habitat (EFH) is implemented through the Magnuson-Stevens Fishery Conservation and Management Act. In the Mid-Atlantic and northeastern United States, the New England and Mid-Atlantic Fishery Management Councils (Councils) work with NOAA Fisheries to identify and describe EFH in published fisheries management plans. To evaluate the potential impacts to EFH for individual species/life stages resulting from activities that directly impact benthic habitats, it is important to identify which benthic habitat types fit the descriptions of habitat use for each EFH species/life stage. Therefore, a crosswalk between benthic habitat types and EFH was conducted. For the purposes of this analysis, a crosswalk is defined as the process of reviewing species with mapped EFH in the study area and comparing their habitat preferences with the mapped benthic habitat types described in Sections 3.1 and 3.2 to identify where EFH for those species are likely to be found. Primary benthic habitat types were used for the crosswalk with additional columns for boulders and SAV (Attachment E); habitats with modifiers were not used for the crosswalk because the level of detail supporting EFH designations is rarely available at a level that matches the detail provided by modifiers. The crosswalk includes all four components of the study area: the SRWF, the SRWEC–OCS, the SRWEC–NYS, and the ICW HDD.

EFH maps, data, and text descriptions were downloaded from the NOAA Habitat Conservation EFH Mapper, an online mapping application (NOAA Fisheries 2021a). Additional EFH source information was gathered from the Northeast Fisheries Science Center’s series of “EFH source documents” that contain a compilation of available information on the distribution, abundance, and habitat requirements for each species managed by the Councils (NOAA Fisheries 2021b). EFH is defined by temperature, salinity, pH, physical structure, biotic structure, depth, and currents. While all these habitat variables are important to consider in the greater context of fisheries management, the focus for this report was to create a crosswalk among individual species EFH and mapped benthic habitats. The crosswalk focused on the

mapped variables of physical structure, biotic structure, and depth. In addition, only demersal species and life stages were cross-walked for this report.

EFH data for all Council-managed species were queried using Geographic Information System software to determine where each species' EFH overlaps with the study area. Available EFH source information was then reviewed to determine habitat requirements for each demersal species/life stage. These requirements were then cross-walked to each of the study area habitats based on detailed characterizations and spatial distributions (See Sections 3.1 and 3.2) to determine if the substrate, biotic structure, and depth requirements for each species/ life stage were likely to be found within a given mapped benthic habitat type.

10.2.3.4 Calculating Potential Project Impacts to Benthic Habitats

NOAA Habitat recently provided updated habitat mapping recommendations (March 2021), which request that the maximum potential acres that may be impacted by the Project be inventoried in terms of the NOAA Habitat Complexity Categories outlined in these recommendations. These habitat complexity categories were defined by NOAA Habitat for the purposes of EFH consultation. 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 as SAV and sediments with >5% cover of gravel of any size (CMECS Substrate Class Rock, CMECS Substrate Groups of Gravelly, Gravel Mixes, and Gravels, as well as Shell Substrate CMECS classifications). Heterogeneous complex is used for habitats with a combination of soft bottom and complex features. To provide an impact assessment of the study area in terms of NOAA Habitat Complexity Categories, the benthic habitats delineated by Sunrise Wind and detailed here have been cross-walked to the NOAA Habitat Complexity Categories. This crosswalk was used to calculate acres of each habitat category that may be impacted by Project activities.

Project activities with the potential to impact the seafloor during construction include installation of foundations for up to 102 WTGs and 1 OCS-DC, connected by a network of up to 180 mi (290 km) of IACs, and one DC submarine export cable bundle comprised of two cables located within an up to 106 mi (170 km)-long corridor. During Operations & Maintenance, disturbance to the seafloor could result from the presence of infrastructure and temporarily anchored maintenance vessels. Over the life of the Project, the placement of foundations and scour protection will alter the seabed and associated habitat by replacing the existing seabed and habitat with hard structures that create a reefing effect, which results in colonization by assemblages of both sessile and mobile animals. Decommissioning activities will have similar impacts to the seafloor as construction.

11.0 Appendix A

Table A- 1. Summary of Impacts of EFH Species with Benthic Life Stages within the Project Area

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Adverse Impact
American Plaice	Juvenile	Benthic habitat with soft substrates.	SRWEC-OCS	Short-term direct
Atlantic Cod	Egg	Pelagic habitats and high-salinity zones of bays and estuaries	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Larvae	Pelagic habitats and high-salinity zones of bays and estuaries	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Juvenile	Demersal and structure oriented (cobble to fine substrates).	SRWF, SRWEC-OCS	Short-term direct
	Adult	Structurally complex hard bottom composed of gravel, cobble, and boulder substrates with and without epifauna and macroalgae	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
Atlantic Wolfish	Egg	Subtidal benthic habitats.	SRWF	Short-term direct
	Larvae	Pelagic and subtidal benthic habitats.	SRWF	Short-term direct
	Juvenile	Subtidal benthic habitats of mixed substrate.	SRWF	Short-term direct

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Adverse Impact
	Adult	Subtidal benthic habitats of mixed substrate.	SRWF	Short-term direct
Atlantic Sea Scallop	Egg	Sand and gravel substrate in inshore areas and on the continental shelf	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct Long-term indirect
	Larvae	Benthic and water column in inshore and offshore areas	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct Long-term indirect
	Juvenile	Benthic habitat with firm sand, gravel, shell, or rock	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
				Long-term indirect
Adult	Benthic habitat with firm sand, gravel, shell, or rock	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct Long-term indirect	
Barndoor Skate	Adult	Benthic habitats of a variety of substrates.	SRWF, SRWEC-OCS	Short-term direct
	Juvenile	Benthic habitats of a variety of substrates.	SRWF, SRWEC-OCS	Short-term direct
Black Sea Bass	Juvenile	Demersal waters over the continental shelf, inland bays, and estuaries	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short- term, long- term, permanent direct
	Adult	Demersal waters over the continental shelf, inland bays, and estuaries	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short- term, long- term, permanent direct
Haddock	Larvae	Pelagic habitats in coastal and offshore waters.	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Juvenile	Subtidal benthic habitats with firm sand.	SRWF, SRWEC-OCS	Short-term direct

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Adverse Impact
	Adult	Subtidal benthic habitats with firm sand.	SRWEC-OCS	Short-term direct
Monkfish	Egg	Surface waters	SRWF, SRWEC-OCS	Short-term direct
	Larvae	Initially pelagic and transition to benthic habitat	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Juvenile	Subtidal benthic habitat on hard sand, pebbles, gravel, broken shell, soft mud, and rocky substrate	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Adult	Benthic habitat on hard sand, pebbles, gravel, broken shell, soft mud, and rocky substrate	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
Ocean Quahog	Juvenile	Offshore sandy substrates	SRWF, SRWEC-OCS	Short-term direct Long-term indirect
	Adult	Pelagic habitats on continental shelf	SRWF, SRWEC-OCS	Short-term direct
Offshore Hake	Larvae	Offshore habitats on the continental shelf.	SRWEC-OCS	Short-term direct
Red Hake	Egg	Pelagic habitats on the continental shelf	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Larvae	Free floating at surface with debris, sargassum, and jellyfish	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Juvenile	Depression in substrate on fine, silty sand; eelgrass, deep areas offshore in sea scallops	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Adverse Impact
Scup	Juvenile	Demersal waters over the continental shelf and inshore estuaries; found in mud, sand, mussel beds	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct Long-term indirect
	Adult	Soft, sandy substrate on or near structures such as rocky ledges, wrecks, artificial reefs, and mussel beds	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct
Spiny Dogfish	Juvenile	Pelagic habitats on continental shelf	SRWEC-OCS	Short-term direct
	Adult	Pelagic habitats on continental shelf	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct
Summer Flounder	Egg	Pelagic habitats on continental shelf	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Larvae	Buried in inshore coastal and marine sandy bottom substrate	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Juvenile	Estuaries, soft-bottom habitat such as mudflats, seagrass beds, marsh creeks, open bays	SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct
	Adult	Demersal waters over the continental shelf and sandy or muddy bottoms of inshore estuaries	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct Long-term indirect
Atlantic Surfclam	Juvenile	Medium sands, fine and silty-fine sands	SRWEC-OCS	Short-term direct Long-term indirect

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Adverse Impact
	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	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Larvae	Pelagic habitat on the continental shelf	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Juvenile	Benthic habitat of all substrate types	SRWF, SRWEC-OCS,	Short-term direct
	Adult	Silt-sand substrate, sandwave crests, shell, and biogenic depressions	SRWEC-OCS	Short-term direct
White Hake	Juvenile	Pelagic and benthic habitat in coastal bays, estuaries and continental shelf.	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	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	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct
	Larvae	Pelagic habitat on the continental shelf, coastal bays, and estuaries	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct
	Juvenile	Mud and sandy substrates in intertidal and sub-tidal habitat	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct Long-term indirect

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Adverse Impact
	Adult	Mud and sandy substrates in intertidal and subtidal habitat	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct Long-term indirect
Winter Flounder	Egg	Sand, muddy sand, mud, macroalgae, gravel bottom substrates	SRWEC-NYS, Onshore Cable	Short-term direct Long-term indirect
	Larvae	Pelagic habitat on the continental shelf, estuarine, and coastal areas	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct
	Juvenile	Mud, sand, rocky substrates, tidal wetlands, eelgrass habitat	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct Long-term indirect
	Adult	Mud and sandy substrates; hard-bottom	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct Long-term indirect
Witch Flounder	Egg	Pelagic habitat on the continental shelf	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Larvae	Pelagic habitat on the continental shelf	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Juvenile	Subtidal benthic habitat on the outer continental shelf and slope, with mud and muddy sand substrates	SRWEC-OCS	Short-term direct
	Adult	Subtidal benthic habitat on the outer continental shelf	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Adverse Impact
		and slope, with mud and muddy sand substrates		
Yellowtail Flounder	Egg	Coastal and continental shelf in water column	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Larvae	Coastal and continental shelf in water column	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Juvenile	Sandy substrates	SRWF, SRWEC-OCS	Short-term direct
	Adult	Sand, sand with mud, shell hash, gravel, and rocks	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
Little Skate	Juvenile	Sand and gravel substrates, but also on mud	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct
	Adult	Sand and gravel substrates, but also on mud	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct
Winter Skate	Juvenile	Sand and gravel substrates, but also on mud	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct
	Adult	Sand and gravel substrates, but also on mud	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct

Source: NOAA Habitat 2021

SRWF = Sunrise Wind Farm , SRWEC-OCS = Sunrise Wind Export Cable – Offshore Converter Station, SRWEC-NYS = Sunrise Wind Export Cable – New York State, Onshore Cable = Onshore Cable

Table A- 2. Summary of Impacts of EFH Species with Pelagic Life

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	SRWF, SRWEC-OCS, SRWEC-NYS	No short or long-term direct or indirect
Atlantic Butterfish	Egg	Pelagic habitats in inshore estuaries and embayment and over bottom depths of 1,500 feet (457 meters) or less	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Larvae	Pelagic habitats in depths between 101.7 and 1,148.2 feet (31 and 350 meters)	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
	Juvenile	Surface waters associated with flotsam and large jellyfish	SRWF, SRWEC-OCS	No short or long-term direct or indirect
	Adult	Bottom depths between 32.8 and 820 feet (10 and 250 meters)	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct
Atlantic Herring	Egg	Inshore and offshore benthic habitats	SRWF	Short-term direct Long-term indirect
	Larvae	Water column within inshore and estuarine waters	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct Long-term indirect
	Juvenile	Pelagic and bottom waters of inland bays	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	No short or long-term direct or indirect
	Adult	Pelagic and bottom waters of inland bays	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	No short or long-term direct or indirect
Atlantic Mackerel	Egg	Pelagic in upper water column	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct Long-term indirect

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Impact
	Larvae	Bottom waters ranging between 32.8 to 426.5 feet (10 to 130 meters)	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct Long-term indirect
	Juvenile	Bottom waters ranging from surface to 1,115 feet (340 meters)	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	No short or long-term direct or indirect
	Adult	Bottom waters ranging from surface to 1,115 feet (340 meters)	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	No short or long-term direct or indirect
Basking Shark	Neonate, Juvenile, and Adult	Coastal and oceanic deep-water habitat	SRWF, SRWEC-OCS	No short or long-term direct or indirect
Blue Shark	Neonate, Juvenile, Adult	Offshore pelagic habitat	SRWF, SRWEC-OCS	No short or long-term direct or indirect
Bluefin Tuna	Juvenile	Inshore and pelagic surface waters	SRWF, SRWEC-OCS, SRWEC-NYS	No short or long-term direct or indirect
	Adult	Offshore and coastal pelagic habitat	SRWF, SRWEC-OCS	No short or long-term direct or indirect
Common Thresher Shark	Neonate, Juvenile, and Adult	Inshore, coastal, and oceanic waters	SRWF, SRWEC-OCS, SRWEC-NYS	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	SRWF, SRWEC-OCS	Short-term direct Long-term indirect
		to 70 meters)		

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Impact
	Larvae	Oceanic waters no deeper than 49.2 feet (15 meters) in water column; transported to estuarine nurseries	SRWF, SRWEC-OCS	Short-term direct Long-term indirect
	Juvenile	Pelagic nearshore areas and estuaries with sand, mud, or clay substrate	SRWEC-OCS, SRWEC-NYS, Onshore Cable	No short or long-term direct or indirect
	Adult	Oceanic, nearshore, and continental shelf waters; inland bays; not associated with specific substrate	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	No short or long-term direct or indirect
Dusky Shark	Neonate	Water column depth of 4.3 to 15.5 meters	SRWF, SRWEC-OCS, SRWEC-NYS	No short or long-term direct or indirect
	Juvenile	Coastal and pelagic waters inshore of the continental shelf break	SRWF, SRWEC-OCS, SRWEC-NYS	No short or long-term direct or indirect
	Adult	Coastal and pelagic waters inshore of the continental shelf break	SRWF, SRWEC-OCS, SRWEC-NYS	No short or long-term direct or indirect
Long Fin Squid	Egg	Inshore and offshore bottom habitats at depth in less than 50 meters	SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct Long-term indirect
	Juvenile	Bottom depths between 6 and 160 meters	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	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	SRWF, SRWEC-OCS	No short or long-term direct or indirect

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Impact
Northern Shortfin Squid	Adult	Highly migratory pelagic species.	SRWEC-OCS	No short or long-term direct or indirect
Pollock	Egg	Pelagic inshore and offshore habitat	SRWF, SRWEC-OCS	Short-term direct Long-term indirect
	Larvae	Pelagic inshore and offshore habitat	SRWF, SRWEC-OCS, SRWEC-NYS	Short-term direct Long-term indirect
	Juvenile	Rocky bottom habitats with attached macroalgae (rockweed and kelp).	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	Short-term direct
Porbeagle Shark	Neonate, Juvenile, Adult	Offshore waters in the mid-Atlantic Bight to George's Bank	SRWF, SRWEC-OCS	No short or long-term direct or indirect
Sand Tiger Shark	Neonate and Juvenile	Pelagic and coastal habitat	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	No short or long-term direct or indirect
Sandbar Shark	Neonate,	Pelagic and coastal habitat	SRWEC-OCS SRWEC-NYS	Short-term indirect
	Juvenile, and Adult		SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	
Shortfin Mako Shark	Neonate, Juvenile, and Adult	Pelagic wasters from Southern New England though Cape Lookout, North Carolina	SRWF, SRWEC-OCS	No short or long-term direct or indirect
Skipjack Tuna	Juvenile	Offshore and coastal pelagic habitat	SRWF, SRWEC-OCS, SRWEC-NYS	No short or long-term direct or indirect
	Adult	Pelagic habitat associated with birds, drifting objects, whales, and sharks	SRWF, SRWEC-OCS, SRWEC-NYS	No short or long-term direct or indirect

Species	Life Stage	Preferred Habitat Description	Presence in Project Area	Impact
Smooth Dogfish	Neonate, Juvenile, and Adult	Coastal shelves and inshore waters	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	No short or long-term direct or indirect
Tiger Shark	Juvenile and Adult	Offshore pelagic habitat	SRWF, SRWEC-OCS	No short or long-term direct or indirect
White Shark	Neonate	Inshore waters out to 65 miles (105 km)	SRWF, SRWEC-OCS, SRWEC-NYS, Onshore Cable	No short or long-term direct or indirect
	Juvenile	Pelagic habitat between 82 and 328 feet (25 and 100 meters)	SRWF, SRWEC-OCS, SRWEC-NYS	No short or long-term direct or indirect
	Adult	Pelagic habitat between 82 and 328 feet (25 and 100 meters)	SRWF, SRWEC-OCS, SRWEC-NYS	No short or long-term direct or indirect

Source: NOAA Habitat 2021

SRWF = Sunrise Wind Farm , SRWEC-OCS = Sunrise Wind Export Cable – Offshore Converter Station, SRWEC-NYS = Sunrise Wind Export Cable – New York State, Onshore Cable = Onshore Cable

Table A- 3. Habitat Table Group Referenced Against CMECS (Class, Subclass and Groups)

Habitat Table Group	Class	Subclass	Group(s)
Rocky (general, to include all: granule-pebble, cobble, boulder, ledge/bedrock) <i>Please note that CMECS Biotic Subclasses Benthic Macroalgae and Attached Fauna should be addressed in the characterization of rocky habitats.</i>	Substrate Class: Rock Substrate	Substrate Subclass: Bedrock	N/A
		Substrate Subclass: Megaclast	N/A
	Substrate Class: Unconsolidated Mineral Substrate - with 5 percent or greater of particles 2 mm to < 4,096 mm	Substrate Subclass: Coarse Unconsolidated Substrate	Substrate Group: Gravels
		Substrate Group: Gravel Mixes	
		Substrate Group: Gravelly	
Soft bottom mud (intertidal, shallow-water, and deep) <i>Please note that CMECS Biotic Subclasses Soft Sediment Fauna and Inferred Fauna should be addressed in the characterization of mud habitats.</i>	Substrate Class: Unconsolidated Mineral Substrate - with < 5% or greater of particles 2 mm to < 4,096 mm	Substrate Subclass: Fine Unconsolidated Substrate - with > 50 percent of particles < 0.625 mm	Substrate Group: Slightly Gravelly (<i>please note: this CMECS category label is not used in the Recommendations for Mapping Fish Habitat, but it is incorporated into the classification of the Fine Unconsolidated Substrate substrates</i>)
			Substrate Group: Sandy Mud
			Substrate Group: Mud
Soft bottom sand (with and without sand ripple, shoals, waves/ridges) <i>Please note that CMECS Biotic Subclasses Soft Sediment Fauna and Inferred Fauna should be addressed in the characterization of sand habitats.</i>	Substrate Class: Unconsolidated Mineral Substrate - with < 5 percent or greater of particles 2 mm to < 4,096 mm	Substrate Subclass: Fine Unconsolidated Substrate - with >= 50 percent of particles 0.625 mm to < 2 mm	Substrate Group: Slightly Gravelly (<i>please note: this CMECS category label is not used in the Recommendations for Mapping Fish Habitat, but it is incorporated into the classification of the Fine Unconsolidated Substrate substrates</i>)
			Substrate Group: Sand
			Substrate Group: Muddy Sand
Submerged Aquatic Vegetation (SAV)	Biotic Class: Aquatic Vegetation Bed	Biotic Subclass: Aquatic Vascular Vegetation	Biotic Group: Seagrass Bed
			Biotic Group: Freshwater and Brackish Tidal Aquatic Vegetation

Habitat Table Group	Class	Subclass	Group(s)
Tidal Marsh (e.g., saltmarsh and brackish marsh)	Biotic Class: Emergent Wetland	Biotic Subclass: Emergent Tidal Marsh	Biotic Group: Brackish Marsh
			Biotic Group: Freshwater Tidal Marsh
			Biotic Group: High Salt Marsh
			Biotic Group: Low and Intermediate Salt Marsh
		Biotic Subclass: Vegetated Tidal Flats	Biotic Group: Vegetated Freshwater Tidal Mudflat
			Biotic Group: Vegetated Salt Flat and Panne
	Biotic Class: Scrub-Shrub Wetland	Biotic Subclass: Tidal Scrub-Shrub Wetland	Biotic Group: Brackish Tidal Scrub-Shrub
			Biotic Group: Freshwater Tidal Scrub-Shrub
			Biotic Group: Saltwater Tidal Scrub-Shrub
			Biotic Group: Tidal Mangrove Shrubland
	Biotic Class: Forested Wetland	Biotic Subclass: Tidal Forest/Woodland	Biotic Group: Brackish Tidal Forest/Woodland
			Biotic Group: Freshwater Tidal Forest/Woodland
			Biotic Group: Saltwater Tidal Forest/Woodland
			Biotic Group: Tidal Mangrove Forest
	Shellfish reefs and beds (e.g., hard clams, Atlantic surfclam, mussels, oysters)	Substrate Class: Shell Substrate	Substrate Subclass: Shell Reef Substrate
Substrate Group: Crepidula Reef Substrate			
Substrate Group: Mussel Reef Substrate			
Substrate Group: Oyster Reef Substrate			
Substrate Subclass: Shell Rubble if dominated by living shells			Substrate Group: Clam Rubble
			Substrate Group: Crepidula Rubble
			Substrate Group: Mussel Rubble
			Substrate Group: Oyster Rubble
Biotic Class: Faunal Bed		Biotic Subclass: Mollusk Reef Biota	Biotic Group: Mussel Reef
			Biotic Group: Oyster Reef
			Biotic Group: Gastropod Reef
		Biotic Subclass: Attached Fauna	Biotic Group: Attached Mussels
			Biotic Group: Attached Oysters
		Biotic Subclass: Soft Sediment Fauna	Biotic Group: Clam Bed
			Biotic Group: Mussel Bed
	Biotic Group: Oyster Bed		
		Biotic Group: Scallop Bed	

Habitat Table Group	Class	Subclass	Group(s)
Shell accumulations	Substrate Class: Shell Substrate	Substrate Subclass: Shell Hash	Substrate Group: Clam Hash
			Substrate Group: Crepidula Hash
			Substrate Group: Mussel Hash
			Substrate Group: Oyster Hash
		Substrate Subclass: Shell Rubble if dominated by non-living shells	Substrate Group: Clam Rubble
			Substrate Group: Crepidula Rubble
			Substrate Group: Mussel Rubble
			Substrate Group: Oyster Rubble
Other biogenic (e.g., cerianthids, corals, emergent tubes – polychaetes) <i>Areas with corals or dense aggregations of epifauna or emergent infauna should be identified and characterized.</i>	Biotic Class: Reef Biota	Biotic Subclass: Deepwater/Coldwater Coral Reef Biota	Biotic Group: Deepwater/Coldwater Stony Coral Reef
			Biotic Group: Deepwater/Coldwater Stylasterid Coral Reef
			Biotic Group: Colonized Deepwater/Coldwater Reef
		Biotic Subclass: Shallow/Mesophotic Coral Reef Biota	Biotic Group: Branching Coral Reef
			Biotic Group: Columnar Coral Reef
			Biotic Group: Encrusting Coral Reef
			Biotic Group: Foliose Coral Reef
			Biotic Group: Massive Coral Reef
			Biotic Group: Plate Coral Reef
			Biotic Group: Table Coral Reef
			Biotic Group: Turbinate Coral Reef
			Biotic Group: Mixed Shallow/Mesophotic Coral Reef
	Biotic Group: Colonized Shallow/Mesophotic Reef		
	Biotic Class: Faunal Bed	Biotic Subclass: Glass Sponge Reef Biota	Biotic Group: Glass Sponge Reef
			Biotic Subclass: Mollusk Reef Biota
		Biotic Subclass: Worm Reef Biota	Biotic Group: Sabellariid Reef
			Biotic Group: Serpulid Reef
		Biotic Subclass: Attached Fauna	Biotic Group: Attached Corals
		Biotic Subclass: Soft Sediment Fauna	Biotic Group: Diverse Soft Sediment Epifauna
			Biotic Group: Larger Tube-Building Fauna
Biotic Group: Small Tube-Building Fauna			

Habitat Table Group	Class	Subclass	Group(s)
			Biotic Group: Burrowing Anemones
			Biotic Group: Brachiopod Bed
			Biotic Group: Soft Sediment Bryozoans
			Biotic Group: Hydroid Bed
			Biotic Group: Pennatulid Bed
			Biotic Group: Sponge Bed
			Biotic Group: Tunicate Bed
Pelagic (offshore and estuarine)			
Habitat for sensitive life stages (i.e., demersal eggs, spawning activity-discrete areas)	Not defined by CMECS but by managed spp. that occur in the project area		
Habitat Areas of Particular Concern (HAPCs)	Not defined by CMECS but by managed spp. that occur in the project area		

Please note the following substrate classes and groups should not be defined as substrate classes and should be addressed as biotic components under appropriate habitat type (see Tables A2 and A3 below):

- Substrate Class: Algal substrate,
- Substrate Class: coral substrate
- Substrate Subclass: shell sand
 - Substrate Subgroup: coquina hash
- Substrate Class: Worm Substrate
 - Substrate Subclass: Sabellariid Substrate
 - Substrate group: Sabellariid Reef Substrate
 - Sabellariid Rubble,
 - Sabellariid Hash
 - Serpulid Substrate
 - Serpulid Reef Substrate
 - Serpulid Rubble
 - Serpulid Hash

**Table A- 4. Table of Biotic Subclasses that Should be Addressed in the Characterization of Rocky Habitat
(see note under Rocky)**

Biotic Subclass	Biotic Group
Benthic Macroalgae	Calcareous Algal Bed Canopy-Forming Algal Bed Coralline/Crustose Algal Bed Filamentous Algal Bed Leathery/Leafy Algal Bed Mesh/Bubble Algal Bed Sheet Algal Bed Turf Algal Bed
Attached Fauna	Biotic Group: Attached Sea Urchins Biotic Group: Attached Tunicates Biotic Group: Attached Starfish Biotic Group: Attached Sponges Biotic Group: Attached Hydroids Biotic Group: Sessile Gastropods Biotic Group: Mobile Crustaceans on Hard or Mixed Substrates Biotic Group: Attached Crinoids Biotic Group: Chitons Biotic Group: Attached Bryozoans Biotic Group: Brittle Stars on Hard or Mixed Substrates Biotic Group: Attached Brachiopods Biotic Group: Attached Basket Stars Biotic Group: Barnacles Biotic Group: Attached Anemones Biotic Group: Vent/Seep Communities – Biotic Group: Attached Tube-Building Fauna Biotic Group: Diverse Colonizers Biotic Group: Wood Boring Fauna Biotic Group: Mineral Boring Fauna

**Table A- 5. Table of Biotic Subclasses that should be Addressed in the Characterization of Mud and Sand Habitat
(see notes under soft bottom mud and soft bottom sand)**

Biotic Subclass	Biotic Group
Soft Sediment Fauna	Larger Deep-Burrowing Fauna Small Surface-Burrowing Fauna Tunneling Megafauna Oligozoic Biota Soft Sediment Brittle Stars Soft Sediment Crinoids Mobile Crustaceans on Soft Sediments Echiurid Bed Holothurian Bed Mobile Mollusks on Soft Sediments Sand Dollar Bed Starfish Bed Burrowing Urchins Sea Urchin Bed Egg Masses Fecal Mounds Pelletized, Fluid Surface Layer Tracks and Trails