SouthCoast Wind Project Essential Fish Habitat Assessment with NOAA Trust Resources

For the National Marine Fisheries Service

July 2024

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

CONTENTS

TABLES

FIGURES

ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
AC	alternating current
ADLS	Aircraft Detection Lighting System
AIS	Air-insulated substation
AMM	Applicant Mitigation Measure
AUV	autonomous underwater vehicle
BAG	Before-After Gradient
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CFR	Code of Federal Regulations
CMECS	Coastal and Marine Ecological Classification Standard
COP	Construction and Operations Plan
CWIS	cooling water intake structure
dB	decibels
dB re 1 µPa	decibels referenced to a pressure of 1 microPascal
DC	direct current
DMM	discarded military munitions
DP	dynamic positioning
ECC	export cable corridor
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EMF	electromagnetic fields
FAA	Federal Aviation Administration
FMP	Fishery Management Plan
GARFO	Greater Atlantic Regional Fisheries Office
GBS	gravity-based structure
GIS	gas-insulated substation
HAPC	Habitat Area of Particular Concern
HDD	Horizontal Directional Drilling
HRG	High-Resolution Geophysical
HVAC	high-voltage alternating-current
HVDC	high-voltage direct current
Hz	hertz
IPF	impact-producing factor
ITA	Incidental Take Authorization
MA DMF	Massachusetts Division of Marine Fisheries
MAFMC	Mid-Atlantic Fishery Management Council
SouthCoast Wind	SouthCoast Wind Energy LLC
MBES	multibeam echo sounder
MGD	million gallons per day
mg/L	milligrams per liter

MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
mV/m	millivolts per meter
NARW	North Atlantic right whale
NEFMC	New England Fishery Management Council
NEPA	National Environmental Policy Act
NFR	near-field region
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
O&M	operational and maintenance
OSPs	offshore substation platforms
OCS	Outer Continental Shelf
PAM	passive acoustic monitoring
PDE	Project Design Envelope
POI	Point of Interconnection
PV	plan-view
RI/MA WEA	Rhode Island/Massachusetts Wind Energy Area
ROV	remotely operated vehicle
SAV	submerged aquatic vegetation
SPI	sediment profile imagery
SSS	side scan sonar
TSS	total suspended sediment
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
UXO	unexploded ordnance
WEA	Wind Energy Area
WTGs	wind turbine generators
µPa	microPascal

1. 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 United States Code (U.S.C.) § 1855(b)(2). This process is guided by the requirements of the EFH regulation at 50 Code of Federal Regulations (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, including in offshore and inshore coastal environments (e.g., issuance of permits by the U.S. Army Corps of Engineers [USACE] and/or the U.S. Environmental Protection Agency [USEPA]).

USACE intends to utilize this EFH assessment to meet its responsibilities under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. These permits may include the construction of offshore wind turbine generators (WTGs), scour protection around the base of the WTGs, submarine interarray cables connecting the WTGs, offshore substation platforms (OSPs), interarray cables connecting the WTGs to the OSPs, and installation of export cables from the OSPs to the onshore interconnection facilities.

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). National Oceanic and Atmospheric Administration (NOAA) 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 on the prey species' habitat, may also be considered adverse effects on EFH. Adverse effects on EFH m*ay 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.*

The EFH regulations state that for any federal action that may adversely affect EFH, federal agencies must provide NMFS with a written assessment of the effects of that action on EFH (50 CFR 600.920(e)). This EFH Assessment should include analyses of all potential impacts, including temporary and permanent and direct and indirect individual, cumulative, and synergistic impacts of the proposed project. The EFH assessment must contain the following mandatory elements: (i) a description of the action, (ii) an analysis of the potential adverse effects of the action on EFH and the managed species, (iii) the federal agency's conclusions regarding the effects of the action on EFH, and (iv) proposed mitigation, if applicable (50 CFR 600.920(e)(3)). Due to the potential for substantial adverse effects on EFH from the proposed project, an expanded EFH consultation as described in 50 CFR 600.920(f) is necessary for this project. As part of the expanded EFH consultation, the EFH Assessment for the proposed project, the assessment should also contain additional information, including: (i) the results of an on-site inspection to evaluate the habitat and the site specific effects of the project; (ii) the views of recognized experts on the habitat or species that may be affected; (iii) a review of pertinent literature and related information; (iv) an analysis of alternatives to the action; and (v) other relevant information.

The EFH expanded consultation process allows the maximum opportunity for NMFS and the federal action agency, in this case BOEM, to work together to review the action's impacts on EFH and federally managed species, and for NMFS to develop EFH conservation recommendations (CRs) to avoid, minimize, or otherwise offset adverse effects on EFH and federally managed species. Although the EFH consultation is a separate review mandated pursuant to the MSA, the EFH regulations encourage the consolidation of the EFH consultation with other interagency consultation, coordination, and environmental review procedures required by other statutes, such as the National Environmental Policy Act (NEPA), where appropriate.

SouthCoast Wind Energy LLC (SouthCoast Wind) has submitted the draft Construction and Operations Plan (COP) for their proposed Project that would be located in a Lease Area in federal waters south of Martha's Vineyard and Nantucket and two offshore export cable corridors (ECCs), collectively referred to hereafter as the Project, to BOEM for review and approval.[1] Consistent with the requirements of 30 CFR 585.620 to 585.638, COP submittal occurs after BOEM grants a lease for the Project and SouthCoast Wind completes all studies and surveys defined in their site assessment plan. SouthCoast Wind is working with BOEM to address additional information needs to finalize the COP. This EFH assessment relies on the most current information available for the Project.

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

This EFH assessment provides a comprehensive description of the Proposed Action, defines the Project area, describes EFH and EFH species potentially affected by the Proposed Action, and provides an analysis and determination of how the Proposed Action may affect EFH and EFH species. The activities being considered include approving the COP for the construction, operation, maintenance, and conceptual decommissioning of the proposed Project. A separate EFH consultation will be conducted for Project decommissioning.

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[1] On February 1, 2023, Mayflower Wind Energy LLC changed its name to SouthCoast Wind Energy LLC and changed the project name from the Mayflower Wind Project to the SouthCoast Wind Project. The Mayflower Wind name has been updated to SouthCoast Wind throughout this document, but references to certain documents may still refer to Mayflower Wind.

2. Proposed Action

Under the Proposed Action (Alternative B in the Environmental Impact Statement [EIS]), the construction, operation and maintenance, and eventual decommissioning of the Project on the OCS (Outer Continental Shelf) offshore of Massachusetts would occur within the range of design parameters described in Volume 1 of the SouthCoast Wind COP (SouthCoast Wind 2023), subject to applicable mitigation measures. The Lease Area is 127,388 acres (51,552 hectares) with up to 149 positions occupied by WTGs and OSPs. The 149 positions will conform to a 1-nautical-mile-by-1-nautical-mile grid (1.9-kilometer-by-1.9-kilometer) layout with an east–west and north–south orientation, which was agreed on across all Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA) leaseholders (i.e., Equinor Wind US, Eversource Energy, SouthCoast Wind, Orsted North America, and Vineyard Wind LLC). The WTGs, OSPs, and interarray cables will be located in BOEM Renewable Energy Lease Area OCS-A 0521 (Lease Area), part of the Massachusetts Wind Energy Area (WEA). The Lease Area is in federal waters of the OCS approximately 26 nautical miles (48 kilometers) south of Martha’s Vineyard, Massachusetts, and approximately 61 nautical miles (113 kilometers) to the east of Montauk, New York. Foundation concepts considered for WTGs and OSPs include monopile, piled jacket, and suction-bucket jacket. The interarray cable network will be 124.3 to 497.1 miles (200 to 800 kilometers) long buried 3.2 to 8.2 feet (1.0 to 2.5 meters) below the seabed. The Project will include one preferred ECC making landfall and interconnecting to the ISO New England Inc. (ISO-NE) grid at Brayton Point, in Somerset, Massachusetts. The Brayton Point ECC will be 97 to 124 miles (156 to 200 kilometers) long and may contain up to 6 direct current (DC) cables buried 3.2 to 13.1 feet (1.0 to 4.0 meters) below the seabed. The Project has also included for analysis one variant export cable corridor which, if permitted, would make landfall and interconnect to the ISO-NE grid in the town of Falmouth, Massachusetts. The Falmouth ECC will be 51.6 to 87 miles (83 to 140 kilometer) long and may contain up to five alternating current (AC) or direct current (DC) cables buried 3.2 to 13.1 feet (1.0 to 4.0 meters) below the seabed. As described below this variant is not being permitted at this time. SouthCoast Wind is conducting Lease Area build-out in two projects, Project 1 and Project 2. The Brayton Point ECC will be used for both Project 1 and Project 2 while the Falmouth variant ECC will only be used for Project 2 in the event that technical, logistical, grid interconnection, or other unforeseen challenges arise during the design and engineering phase that prevent Project 2 from making interconnection at Brayton Point. In addition to the ECCs, there will be an Aquidneck Island Onshore Export Cable Route along the ECC route to Brayton Point that contains up to four underground onshore DC cables and up to two communication cables, each 3 miles (4.8 kilometers) long.

The landfall locations being considered for each landing site include:

- Brayton Point ECC: Eastern or Western shorelines of Brayton Point
- Aquidneck Island onshore cable route intermediate landfall: Portsmouth, Rhode Island
- Falmouth ECC: Worcester Avenue, Central Park, or Shore Street

Project construction and operations and maintenance (O&M) components are summarized in Table 2-1 and described in the following sections.

While this assessment includes a description of the Falmouth ECC variant and the impact of this variant on EFH, the applicant is not seeking USACE authorization for this variant at this time. Since this variant is currently not reasonably likely to occur, it may be premature for NMFS to issue conservation recommendations for this variant at this time. If there is USACE permit action for this variant, USACE and other appropriate Federal agencies will discuss any additional information that may be necessary to issue conservation recommendations pursuant to the regulations at 50 CFR 600.920 outlining when action agencies need to reinitiate consultation for impacts to essential fish habitat.

Table 2-1. SouthCoast Wind construction and O&M project components

Project Component	Location	Project Component(s)
Layout and Project Size	Offshore	• Up to 149 WTG/OSP foundations • Up to 147 WTGs • Up to 5 OSPs • 1 nautical mile x 1 nautical mile grid (1.9 kilometers x 1.9 kilometers) grid layout with east–west and north–south orientation
Foundations	Offshore	• Monopile, piled jacket, and/or suction-bucket jacket options for WTGs and OSPs (suction-bucket jackets would only be installed for up to 85 positions in the southern portion of the Lease Area associated with Project 2) • Seabed penetration: 65.6–262.4 feet (20.0–80.0 meters) • Foundation diameters o monopiles: up to 52.5 feet (16.0 meters) o piled jackets: up to 14.7 feet (4.5 meters) o suction-bucket jackets: up to 65.6 feet (20.0 meters) • Scour protection for up to all positions
WTGs	Offshore	• Rotor diameter: 721.7–918.6 feet (220.0–280.0 meters) • Blade length of 351.0–452.8 feet (107.0–138.0 meters) • Hub height above Mean Lower Low Water (MLLW): 418.7–605.1 feet (127.6–184.4 meters)
OSPs	Offshore	• Maximum structures envisaged located on grid positions: 5 • Top of topside height above MLLW: 160.8–344.5 feet (49.0–105.0 meters) • One high voltage direct current (HVDC converter OSP would use 9.9 million gallons per day of once-through non-contact cooling water, with a maximum intake velocity of 0.5 feet per second, and a maximum end-of-pipe discharge temperature of 86ºF (30ºC). Depth of withdrawal for cooling water at 74 feet (22.6 meters) below the surface and 81 feet (24.7 meters) above the seafloor • Scour protection for all positions
Interarray Cables	Offshore	• Nominal interarray cable voltage: 60 kilovolts to 72.5 kilovolts • Length of interarray cables beneath seafloor:124.2–497.1 miles (200–800 kilometers) • Target burial depth (below level seabed): 3.2–8.2 feet (1.0–2.5 meters)
Falmouth Offshore Export Cables	Offshore	• Number of offshore export cables: up to 5 • Anticipated nominal export cable voltage (AC or DC): 200–345 kilovolts (AC) or ±525 kilovolts (DC) • Length per export cable beneath seabed: 51.6–87.0 miles (83.0–140.0 kilometers) • Cable/pipeline crossings: up to 9 • Target burial depth (below level seabed): 3.2-13.1 feet (1.0-4.0 meters)
Brayton Point Offshore Export Cables	Offshore	• Number of offshore export cables: up to 6 • Nominal export cable voltage (direct current [DC]): ±320 kilovolts • Length per export cable beneath seabed: 97–124 miles (156–200 kilometers) • Cable/pipeline crossings: up to 16 • Target burial depth (below level seabed): 3.2–13.1 feet (1.0–4.0 meters)

Project Component	Location	Project Component(s)
Aquidneck Island Onshore Export Cable Route (Intermediate landfall)	Onshore	• Portsmouth, Rhode Island • Nominal underground onshore export cable voltage for DC transmission: ±320 kilovolts • Up to 4 onshore export cables and up to 2 communications cables • Up to 3 miles (4.8 kilometers) per cable
Falmouth Landfall Site	Onshore	• Three locations under consideration: Worcester Avenue, Central Park, and Shore Street • Installation methodology: Horizontal Directional Drilling (HDD)
Brayton Point Landfall Site	Onshore	• Brayton Point: Two locations under consideration: Eastern and Western shorelines of Brayton Point • Brayton Point: Installation methodology: HDD • Aquidneck Island: Several locations under consideration for the intermediate landfall across the island • Aquidneck Island: Installation methodology: HDD
Onshore Export Cables from Landfall to Onshore Substation	Onshore	• Falmouth, Massachusetts • Nominal underground onshore export cable voltage for AC transmission: 200–345 kilovolts • Up to 12 onshore export power cables and up to five communications cables • Up to 6.4 miles (10.3 kilometers) per cable
Onshore Export Cables from Landfall to HVDC Converter Station	Onshore	• Somerset, Massachusetts • Nominal underground onshore export cable voltage for DC transmission: ±320 kilovolts • Up to 6 onshore export cables and up to 2 communications cables • Up to 0.6 miles (1.0 kilometers) per cable
Onshore Substation	Onshore	• Falmouth, Massachusetts • Two locations under consideration: Lawrence Lynch and Cape Cod Aggregates • Up to 26.0 acres (10.5 hectares) for the substation yard • Transform to 345 kilovolts • Air-insulated substation (AIS) or gas-insulated substation (GIS) configurations
HVDC Converter Station	Onshore	• Somerset, Massachusetts • Up to two HVDC converter stations • Up to 7.5 acres (3.0 hectares) • Convert the power from DC to 345 kilovolts AC for injection to the existing ISO-NE grid system
Transmission Line from Onshore Substation to Falmouth Point of Interconnection (POI)	Onshore	• Falmouth, Massachusetts • New 345-kilovolts overhead transmission line along existing utility ROW (preferred) • To be designed, permitted, constructed, and operated by transmission system owner, Eversource • New, 345-kilovolts underground transmission line (alternate) • Up to 2.1 miles (3.4 kilometers) in length

Project Component	Location	Project Component(s)
Transmission Line from HVDC Converter Station to Brayton Point POI	Onshore	• Somerset, Massachusetts • New, 345-kilovolts underground transmission line • Up to 0.2 mile (0.3 kilometer) in length
Falmouth POI	Onshore	• Falmouth, Massachusetts • Upgrades to existing Falmouth Tap (new or upgraded POI by Eversource)
Brayton Point POI	Onshore	• Somerset, Massachusetts • Existing, National Grid substation 345-kilovolts GIS breaker building at National Grid substation Station

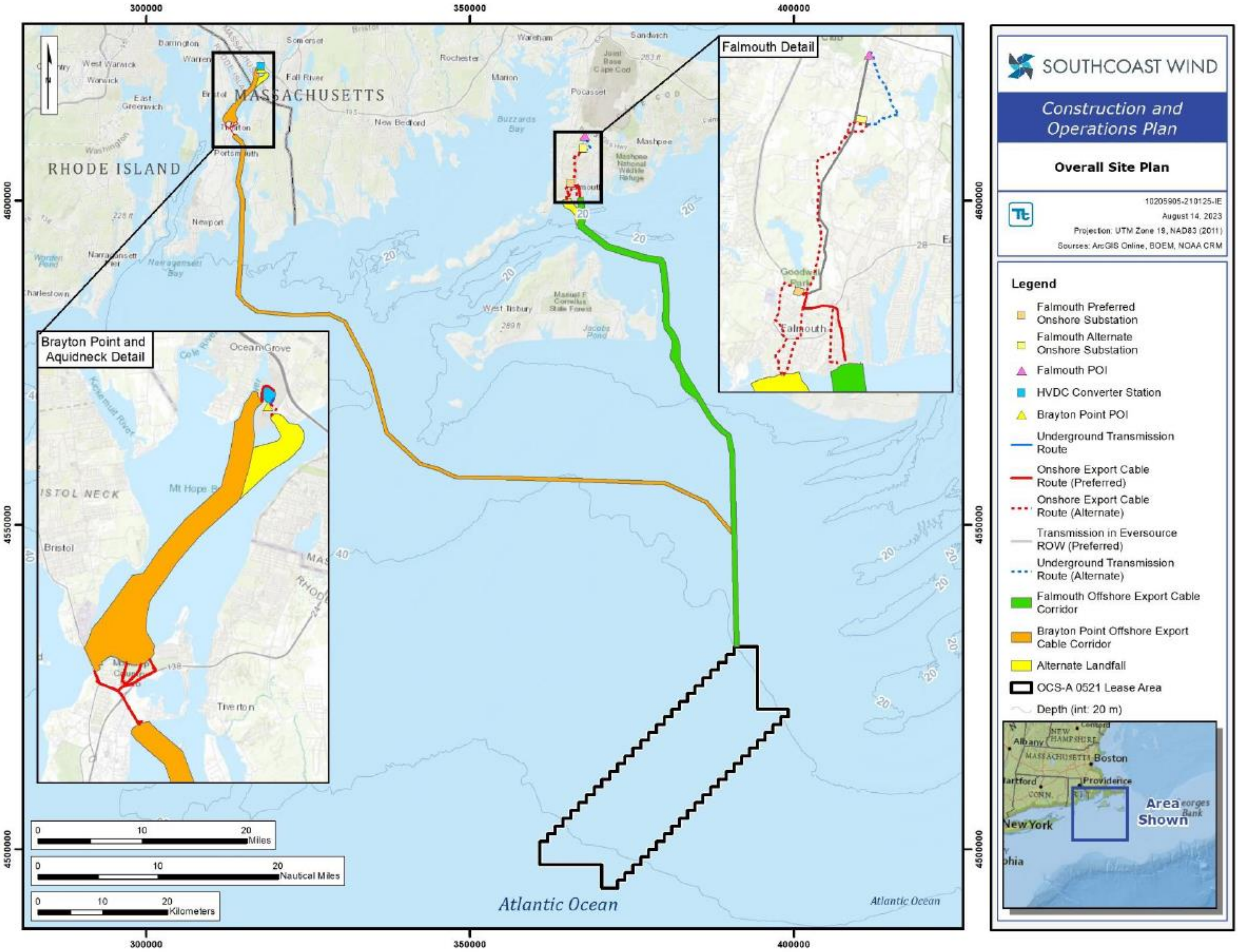
Source: COP Volume 1, Table 3-1; SouthCoast Wind 2023 with supplemental information provided by Southcoast Wind

2.1 Project Area

The Project area comprises the project footprint for the Wind Farm Area, ECCs, and all areas affected by the construction and operation of these facilities, which includes coastal nearshore habitats of the Brayton Point ECC, Falmouth Point ECC, Aquidneck Island landfalls, adjacent Rhode Island and Massachusetts state waters, and ocean habitats in the Massachusetts WEA on the OCS offshore of Massachusetts. The different components of the Project area are shown in Figure 2-1.

Ports anticipated to be used for Project construction and decommissioning activities include New Bedford, Fall River, and Salem, Massachusetts; Davisville and Providence, Rhode Island; New London, Connecticut; Sparrows Point, Maryland; Charleston, South Carolina; Corpus Christi, Texas; Altamira, Mexico; and ports in Canada (Sheet Harbor, Sydney, Argentia). Material and equipment may be delivered from vessels originating from Europe, Asia, and via the Panama Canal. O&M vessel trips would originate primarily from the ports of New Bedford and Fall River, Massachusetts and New London, Connecticut, with occasional trips originating from ports in Davisville and Providence, Rhode Island; Salem, Massachusetts; Sparrows Point, Maryland; Charleston, South Carolina; and foreign ports, if needed.

As detailed in Section 5, potential impacts that would occur in the Project area under the Proposed Action include generation of underwater noise during pile driving; release of suspended sediment plumes during cable emplacement; generation of operational WTG noise; generation of electromagnetic fields (EMF) and heat by operational transmission cables; and habitat conversion resulting from placement of the foundations, scour protection, and cable protection. Figure 2-1 depicts the geographic scope of each of the potential impacts of the Proposed Action.



Source: modified from COP Volume 1, Figure 3-1; SouthCoast Wind 2023

Figure 2-1. Project area overview including Lease Area and ECCs

2.2 Construction and Installation

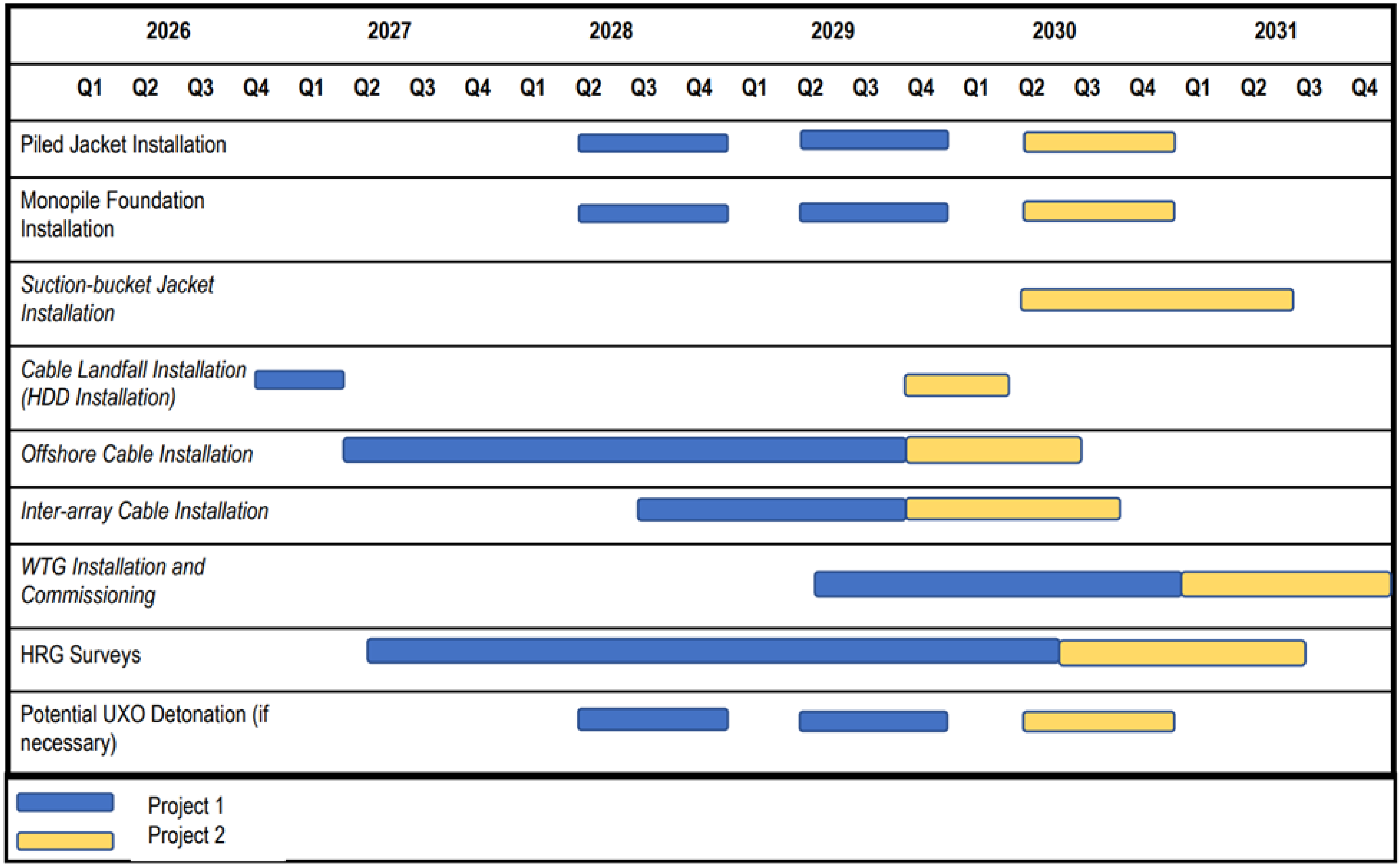
The construction of Project components will occur in the nearshore and offshore waters of the Atlantic OCS; the nearshore waters of Falmouth, Massachusetts; and Narragansett Bay. Project construction methods and estimated quantities for each design alternative are described in the following section. The potential adverse effects of project construction on the environment are discussed in Section 5.

The total number of construction days for each project component will depend on a number of factors, including environmental conditions, planning, and construction and installation logistics. The general installation schedule is provided in Table 2-2 and Figure 2-2. This schedule is approximated based on several assumptions, including the estimated timeframe in which permits are received, anticipated regulatory seasonal restrictions, environmental conditions, planning, and logistics. The installation schedule includes both pile-driving and non-pile-driving activities. Installation of scour protection is included in the foundations/structures timeline while horizontal directional drilling (HDD) installation is included in the export cable installation timeline.

Table 2-2. SouthCoast Wind indicative construction schedule

Construction Activity	SouthCoast Wind Indicative Construction Schedule
HVDC – Onshore Scope	Q1 of 2025 to Q2 of 2029
HVDC – Fabrication/Installation and Commissioning	Q2 of 2026 to Q4 of 2030
Foundations/Substructures – Scour Protection and Seabed Preparation	Q1 of 2027 to Q3 of 2029
Foundations/Substructures – Substructure Installation – Piled Jackets/Monopiles	Q2 of 2028 to Q4 of 2030
Foundations/Substructures – Substructure Installation – Suction Bucket Jacket	Q2 of 2030 to Q3 of 2031
Interarray Cable – Installation and Commissioning	Q2 of 2028 to Q3 of 2030
Export Cable – Install – Onshore, Offshore, and Commissioning	Q4 of 2026 to Q3 of 2030
WTG – Installation and Commissioning	Q2 of 2029 to Q4 of 2031

Source: COP Volume 1, Figure 3-6; SouthCoast Wind 2023 with supplemental information provided by Southcoast Wind
Q = quarter



Source: Petition for Incidental Take Regulations for the Construction and Operations of the SouthCoast Wind Project (LGL 2024)
Note: Project 1 refers to Project components associated with the Brayton Point POI. Project 2 refers to Project components associated with either the Brayton Point POI or Falmouth variant POI.

Figure 2-2. Anticipated construction schedule for the Wind Farm Area and ECCs

2.2.1 Installation of WTG/OSP Structures and Foundations

Within the 127,388-acre (51,552-hectare) Wind Farm Area, SouthCoast Wind would construct up to 149 substructures that support a combination of WTGs and OSPs in a 1-by-1-nautical mile grid layout with east–west and north–south orientation (Figure 2-3). SouthCoast Wind is considering three types of substructures: monopile (Figure 2-4), piled jacket (Figure 2-5), and suction-bucket jacket (Figure 2-6).[2] SouthCoast Wind has removed gravity-based foundation structures from the Project Design Envelope for both Project 1 and Project 2. The Project will develop and install up to two different substructure concepts for the WTGs and may use a third different concept for the OSPs. Project 1 will have one type of WTG foundation, either monopiles or piled jackets. Project 2 will likely also have one type of WTG foundation, either monopiles, piled jackets, or suction bucket jackets. Monopile and piled jacket foundations are the two types primarily under consideration for WTG and OSP substructures, and selection will be based on site conditions and the design of the OSP topside structure. Suction-bucket jacket foundations may also be used as substructures for WTGs and OSPs but would be restricted to up to 85 WTG positions in the southern portion of the Lease Area (Figure 2-7). WTGs would extend up to 1,066.3 feet (325.0 meters) at the highest blade tip height with a minimum tip clearance above highest astronomical tide of 53.8 feet (16.4 meters) (Figure 2-4). A summary of foundation design parameters is provided in Table 2-3.

The proposed Project would include up to five OSPs to collect the energy generated by the WTGs and would be located on the same 1-by-1-nautical-mile grid layout as the WTGs. OSPs help stabilize and maximize the voltage of power generated offshore, reduce potential electrical losses, and transmit energy to shore. Interarray cables would transfer electrical energy generated by the WTGs to the OSPs. Three OSP designs are under consideration: Option A – Modular (Figure 2-8), Option B – Integrated (Figure 2-9), Option C – HVDC Converter (Figure 2-10). Each OSP design would include a topside that houses electrical equipment and a foundation substructure to support the topside. The smallest topside structure would be Option A – Modular and would likely hold a single AC transformer with a single export cable. It would sit on any type of substructure design considered for the WTGs (i.e., monopile, piled-jacket, suction-bucket jacket). Option B – Integrated is also an AC solution but is designed to support a high number of interarray cable connections, as well as multiple export cable connections, and would contain multiple transformers in a single topside structure. Depending on the weight of the topside structure and soil conditions, a piled-jacket substructure with four to six legs that requires one to three piles per leg may be used. Because of its larger size, if Option B is selected, a smaller number of OSPs would be required to support the proposed Project. SouthCoast Wind does not intend to use load balancing cables to connect OSPs under OSP options A and B. Option C – HVDC Converter would convert electric power from high-voltage alternating-current (HVAC) to high voltage direct current (HVDC) for transmission to the onshore grid system and would serve as a gathering platform for interarray cables or be connected to one or more HVAC gathering units, which would be similar to the Modular and Integrated OSP designs. Due to its size, the HVDC Converter OSP would be installed on piled jacket substructures. SouthCoast Wind's preferred OSP design is Option C – HVDC Converter with piled jacket foundations as substructures to meet the specific engineering requirements of this design (Figure 2-10).

SouthCoast Wind has selected an HVDC converter OSP (Option C) for Project 1 (Brayton Point interconnection). For Project 2 (Brayton Point interconnection or the Falmouth variant interconnection), SouthCoast Wind will select an OSP design, which may entail one or more OSPs, based on future offtake agreements and through its supplier/equipment contracting process. Selection of HVDC for Project 2

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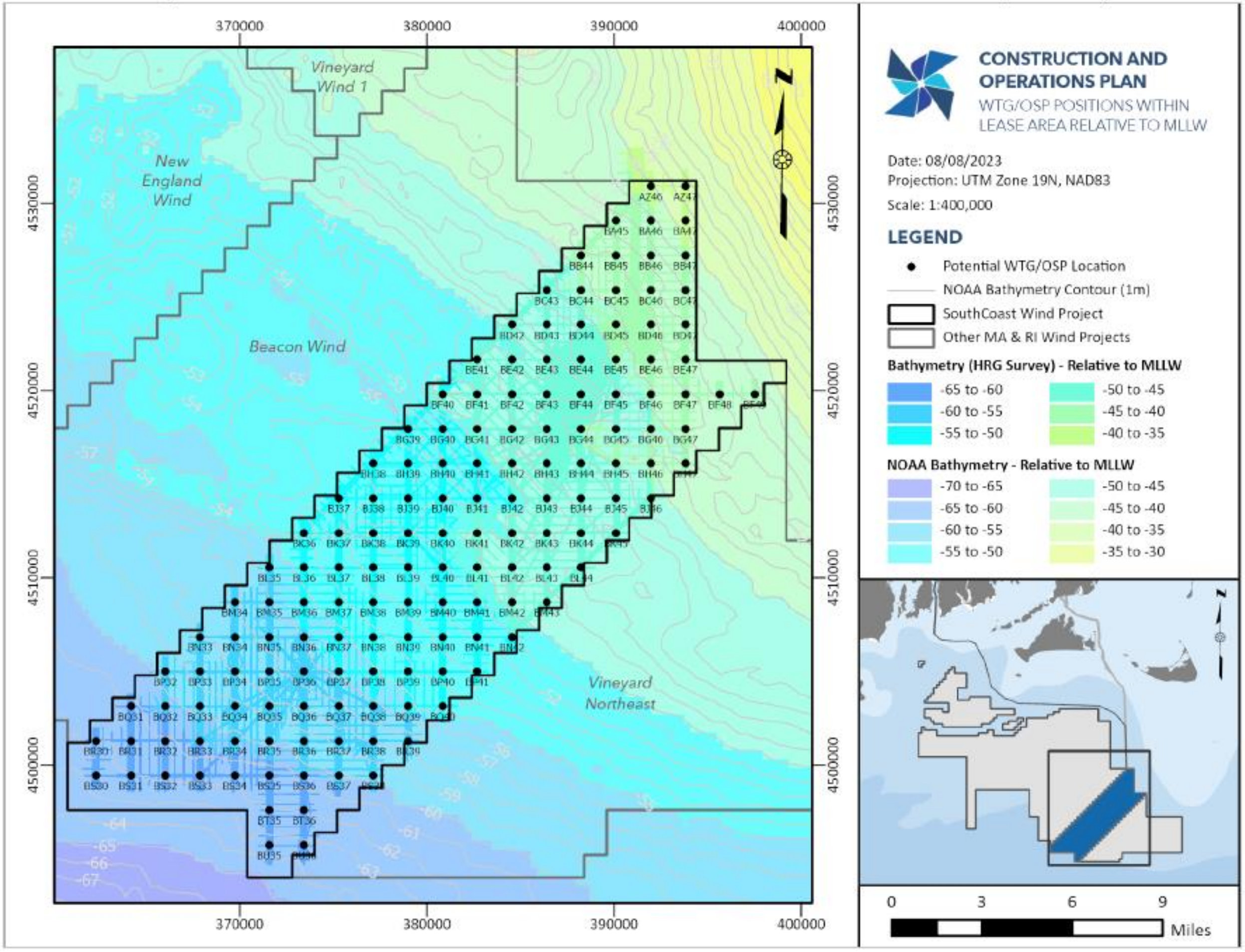
[2] In May 2023, SouthCoast Wind informed BOEM that it was removing gravity-based structures (GBS) as a potential foundation for WTGs and OSPs from its PDE due to the technical, economic, and ecological challenges and greater impact levels associated with GBS substructures. SouthCoast Wind also informed BOEM that it would restrict possible locations of WTGs and OSPs with suction-bucket jacket foundations to the southern portion of the Lease Area associated with Project 2. The EFH Assessment has been revised to reflect these changes to the Proposed Action.

would mean a total of two OSPs would be required, while selection of HVAC may require additional OSPs (up to four). SouthCoast Wind filed a National Pollutant Discharge Elimination System (NPDES) permit application for the HVDC converter OSP for Project 1 on October 31, 2022 and revised in August 2023 (TetraTech and Normandeau Associates, Inc. 2023). Figure 2-11 shows the location of the OSP with converter station for Project 1 (Latitude = 40° 48' 18.16" N, Longitude = -70° 19' 29.41" W). An overview of the characteristics of the cooling water intake structure (CWIS) in the HVDC converter OSP is provided in Table 2-4. If HVDC design is selected for Project 2, which is SouthCoast Wind’s current preference, the second OSP would be installed in the southern portion of the Lease Area; the indicative location of the OSP (Latitude = 40° 40' 34.81" N, Longitude = -70° 28' 41.60" W) is shown in Figure 2-11. The parameters identified in Table 2-4 for Project 1 are representative of the second OSP, although the OSP would be in deeper water in the southern portion of the Lease Area (refer to Figure 2-3 for WTG position depths). SouthCoast Wind would be required to apply for a separate NPDES permit for a second HVDC converter OSP.

As summarized in Table 2-2 and Figure 2-2, installation and commissioning of the OSPs will occur from Q2 of 2026 to Q4 of 2030, substructure installation from Q2 to Q4 in 2028, 2029, and 2030, and WTG installation and commissioning from Q2 of 2029 to Q4 of 2031.



Source: COP Volume 1, Figure 3-2; SouthCoast Wind 2023

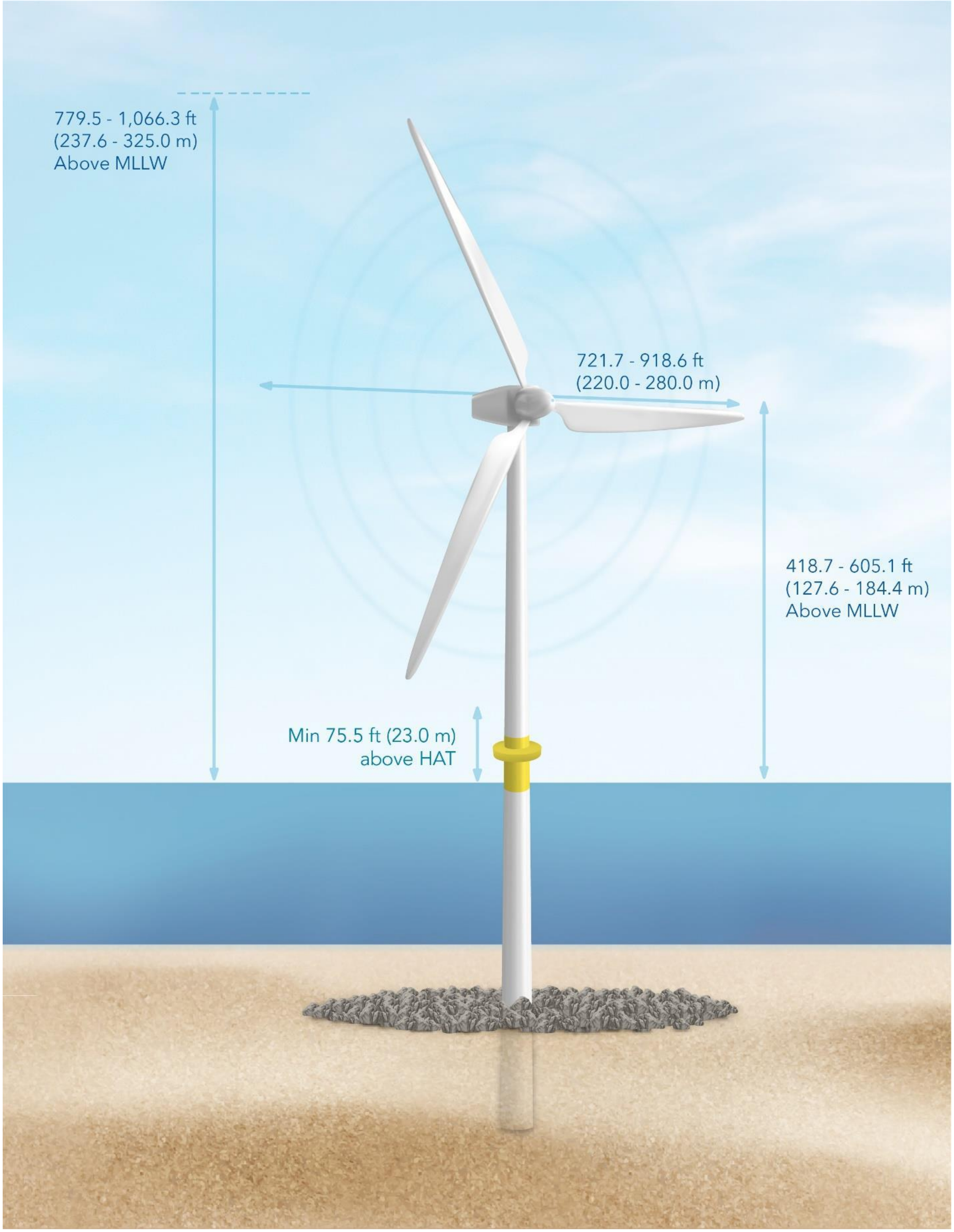
Figure 2-3. Layout for full Lease Area build-out with maximum number of foundations

Table 2-3. SouthCoast Wind foundation design parameters

Foundation Type	Number of Legs	Footprint Diameter [a]	Footprint Area [a]
WTG Pin-Piled Jacket	4	380.5 feet (116.0 meters)	2.61 acres (1.05 hectares)
WTG Monopile	1	374 feet (114.0 meters)	2.52 acres (1.02 hectares)
WTG Suction-Bucket Jacket	4	521.6 feet (159.0 meters)	4.91 acres (1.99 hectares)
OSP Pin-Pile Jacket – Option A Modular	3 to 4	380.5 feet (116.0 meters)	2.61 acres (1.05 hectares)
OSP Monopile – Option A Modular	1	374 feet (114.0 meters)	2.52 acres (1.02 hectares)
OSP Suction-Bucket Jacket – Option A Modular	4	521.6 feet (159.0 meters)	4.90 acres (1.98 hectares)
OSP Pin-Pile Jacket – Option B Integrated	4 to 6	213 feet x 105 feet (65 meters x 32 meters)	7.54 acres (3.05 hectares)
OSP Pin-Pile Jacket – Option C DC Converter	4	279 feet x 197 feet (85 meters x 60 meters)	9.79 acres (3.96 hectares)

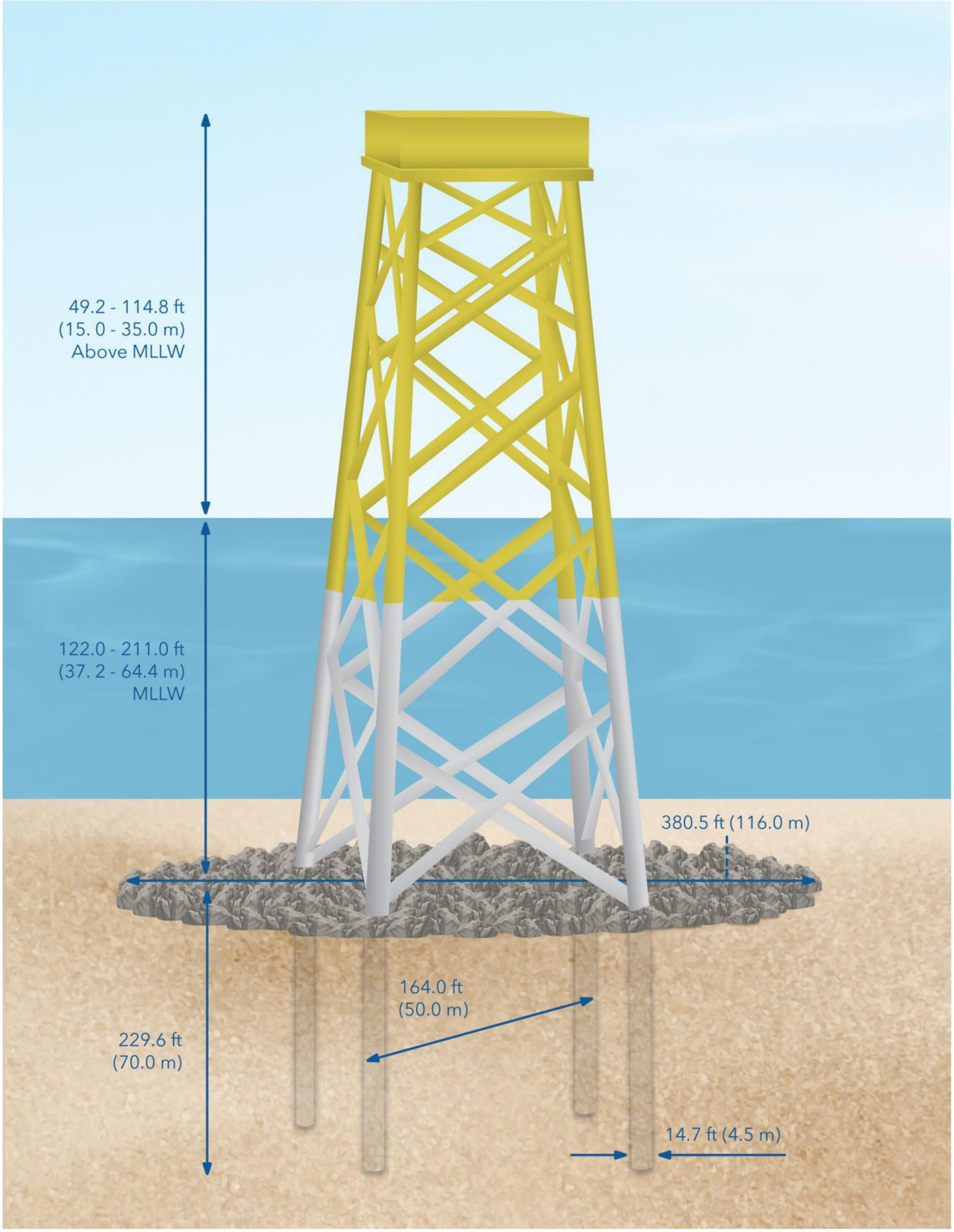
Source: modified from COP Volume 1, Tables 3-2, 3-3, and 3-6; SouthCoast Wind 2023

[a] Footprint includes combined area of foundation, scour protection, and mud mats.



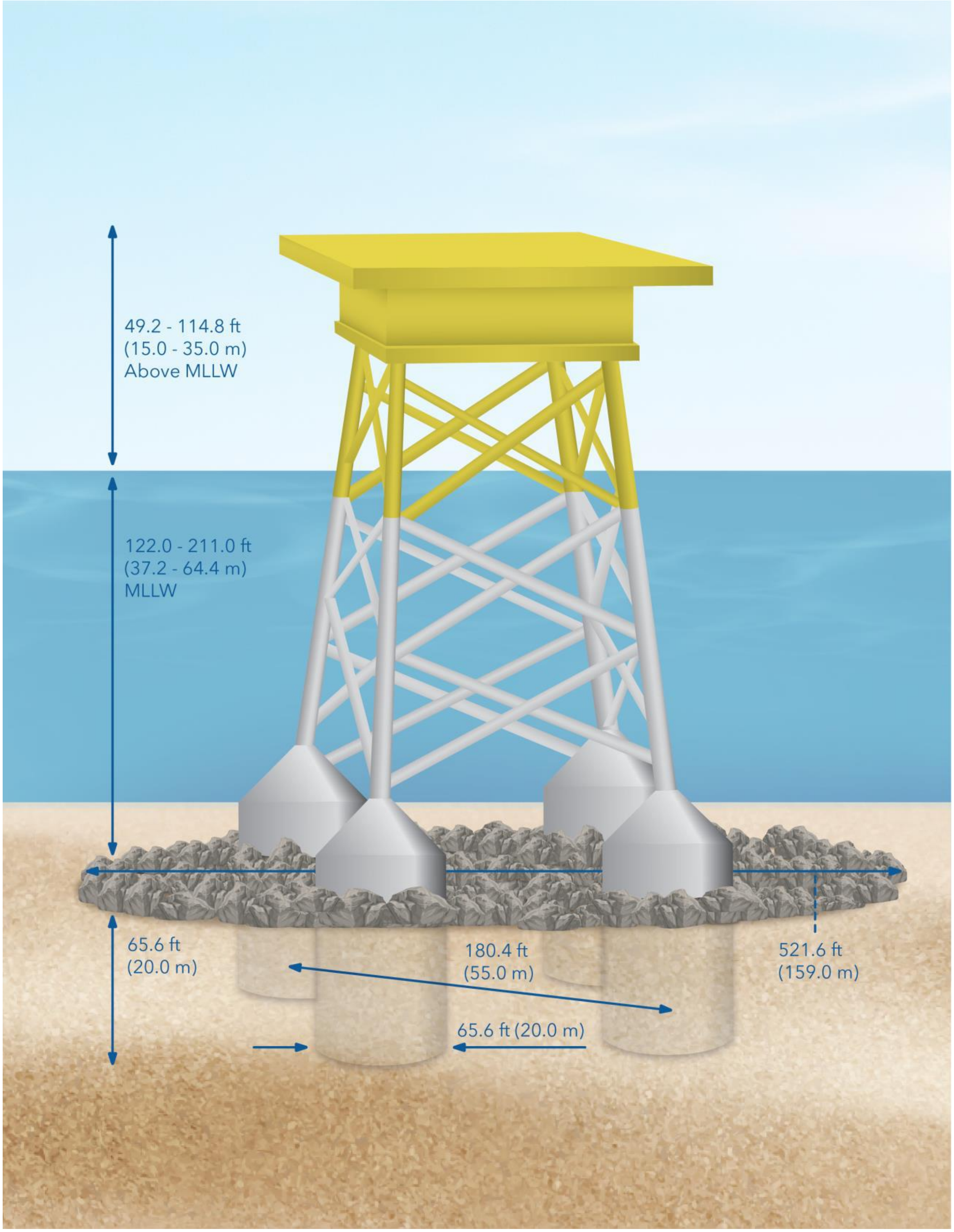
Source: COP Volume 1, Figure 3-13; SouthCoast Wind 2023

Figure 2-4. Representative wind turbine generator diagram with monopile foundation



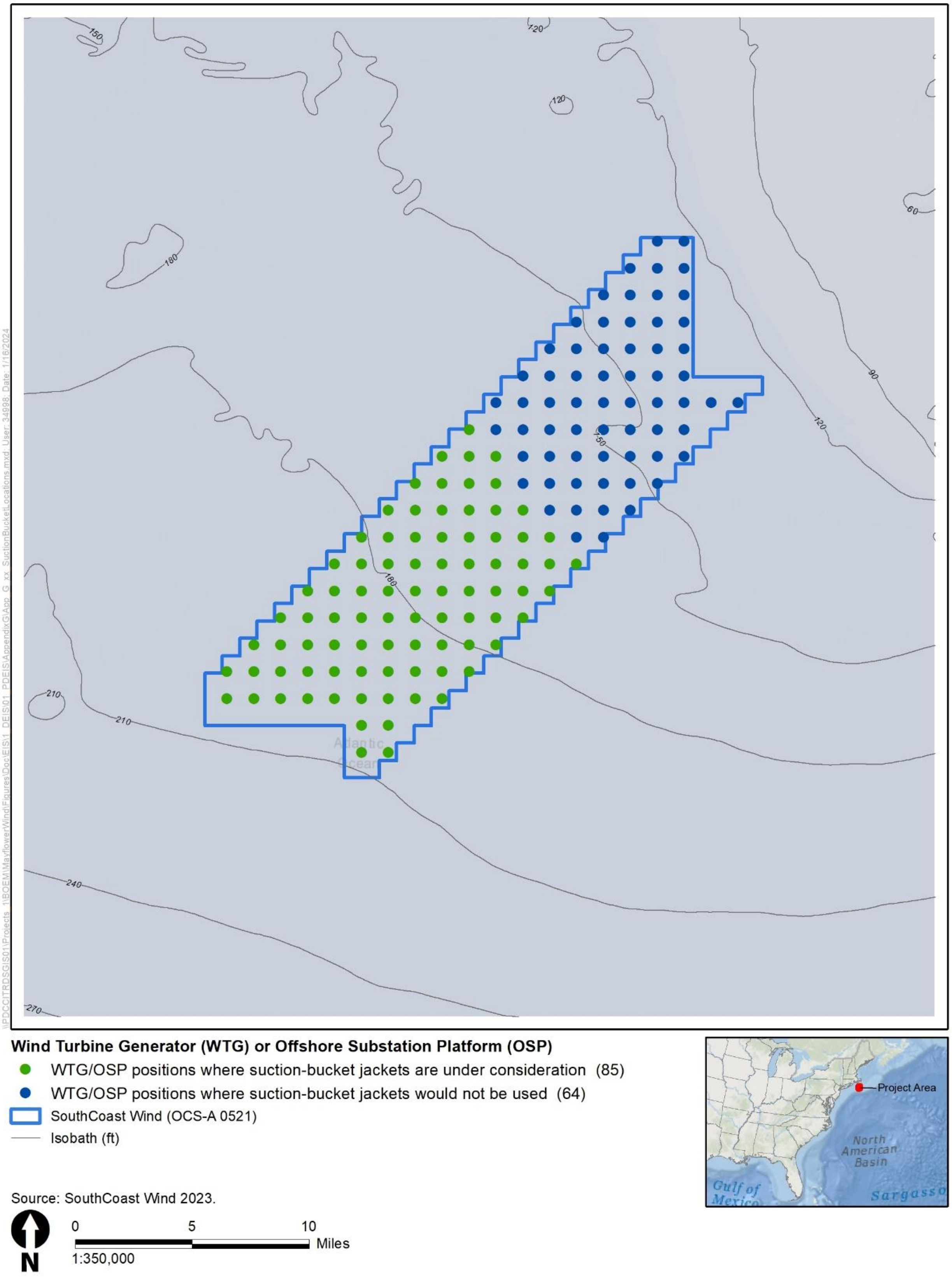
Source: COP Volume 1, Figure 3-8; SouthCoast Wind 2023

Figure 2-5. Representative piled-jacket foundation



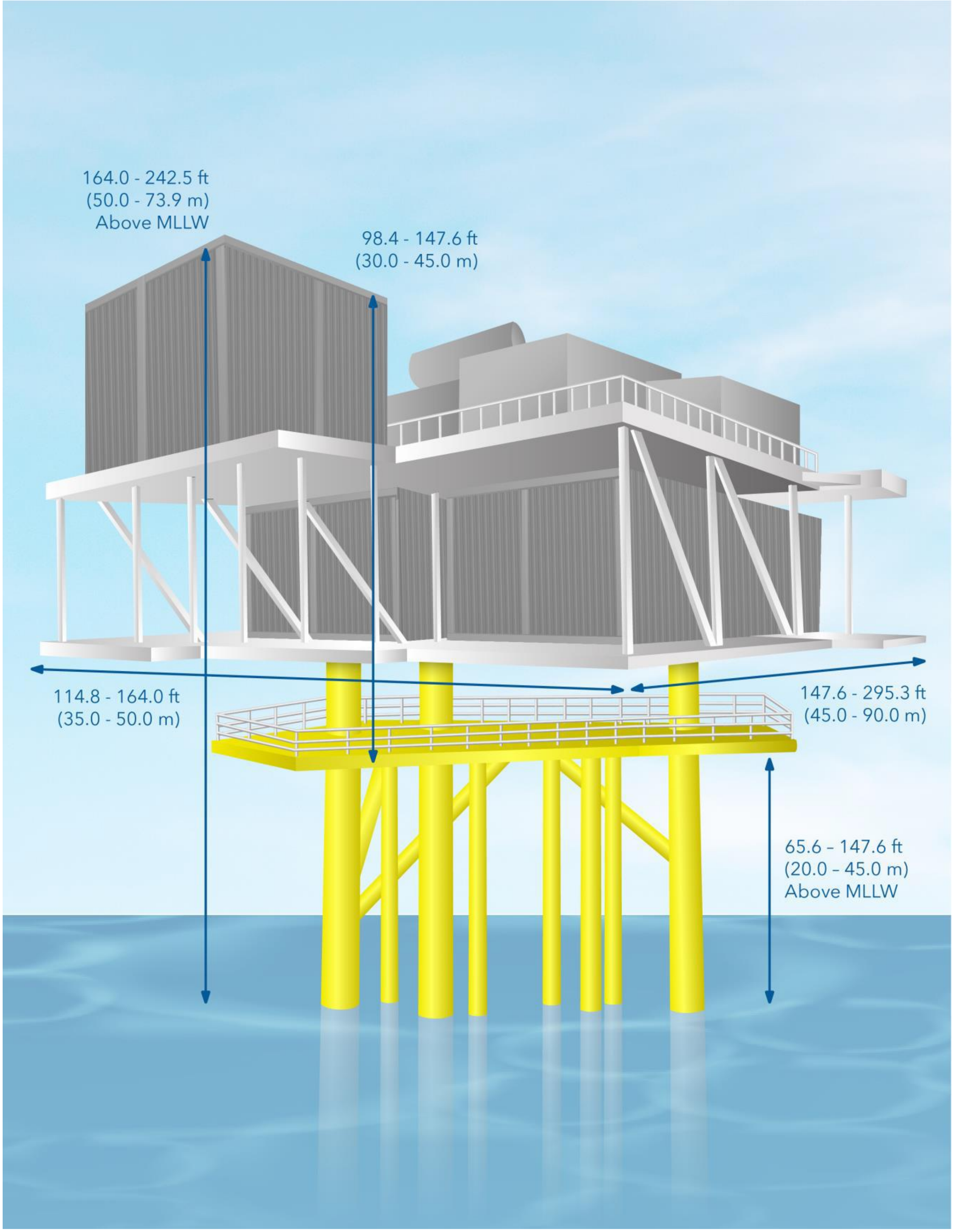
Source: COP Volume 1, Figure 3-9; SouthCoast Wind 2023

Figure 2-6. Representative suction-bucket jacket foundation



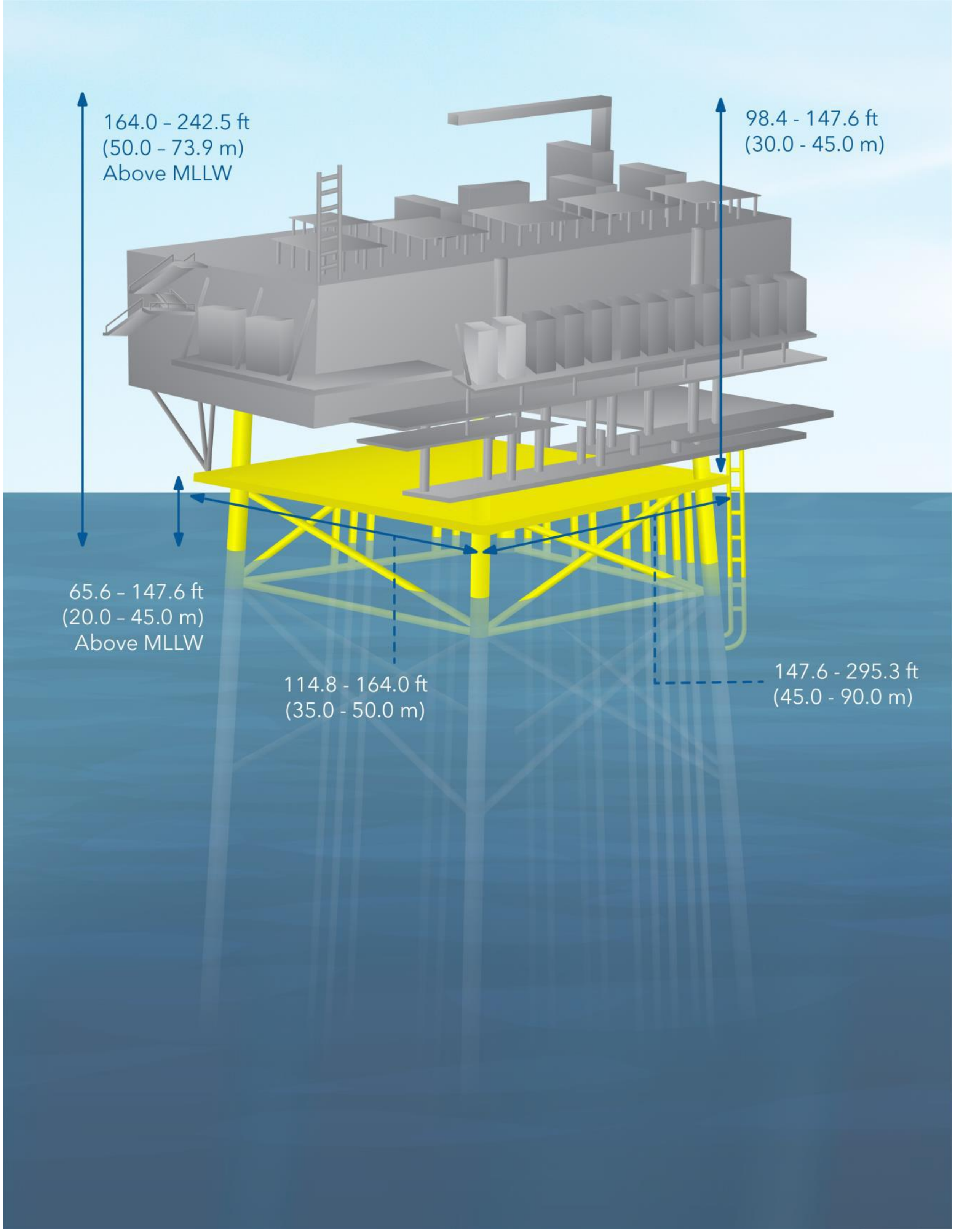
Source: SouthCoast Wind 2023.

Figure 2-7. WTG/OSP positions where suction-bucket jacket foundations are under consideration



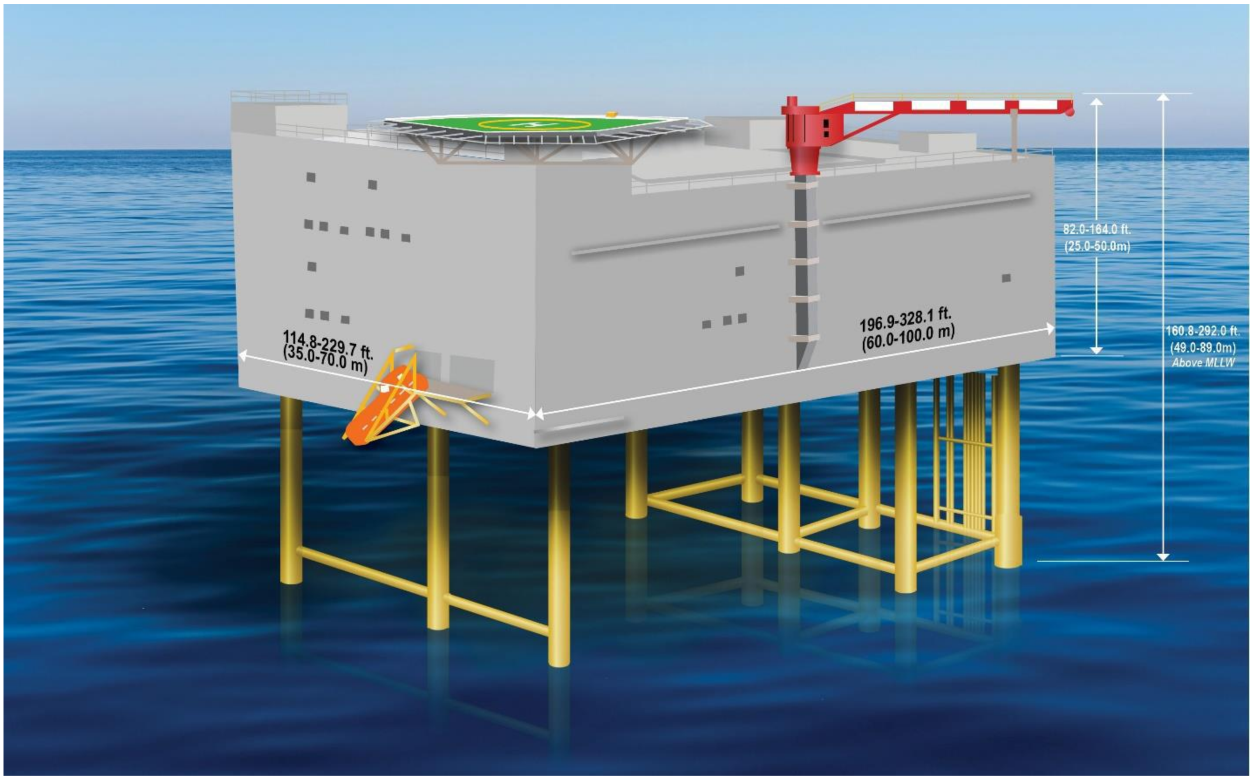
Source: COP Volume 1, Figure 3-15; SouthCoast Wind 2023

Figure 2-8. Representative modular OSP diagram



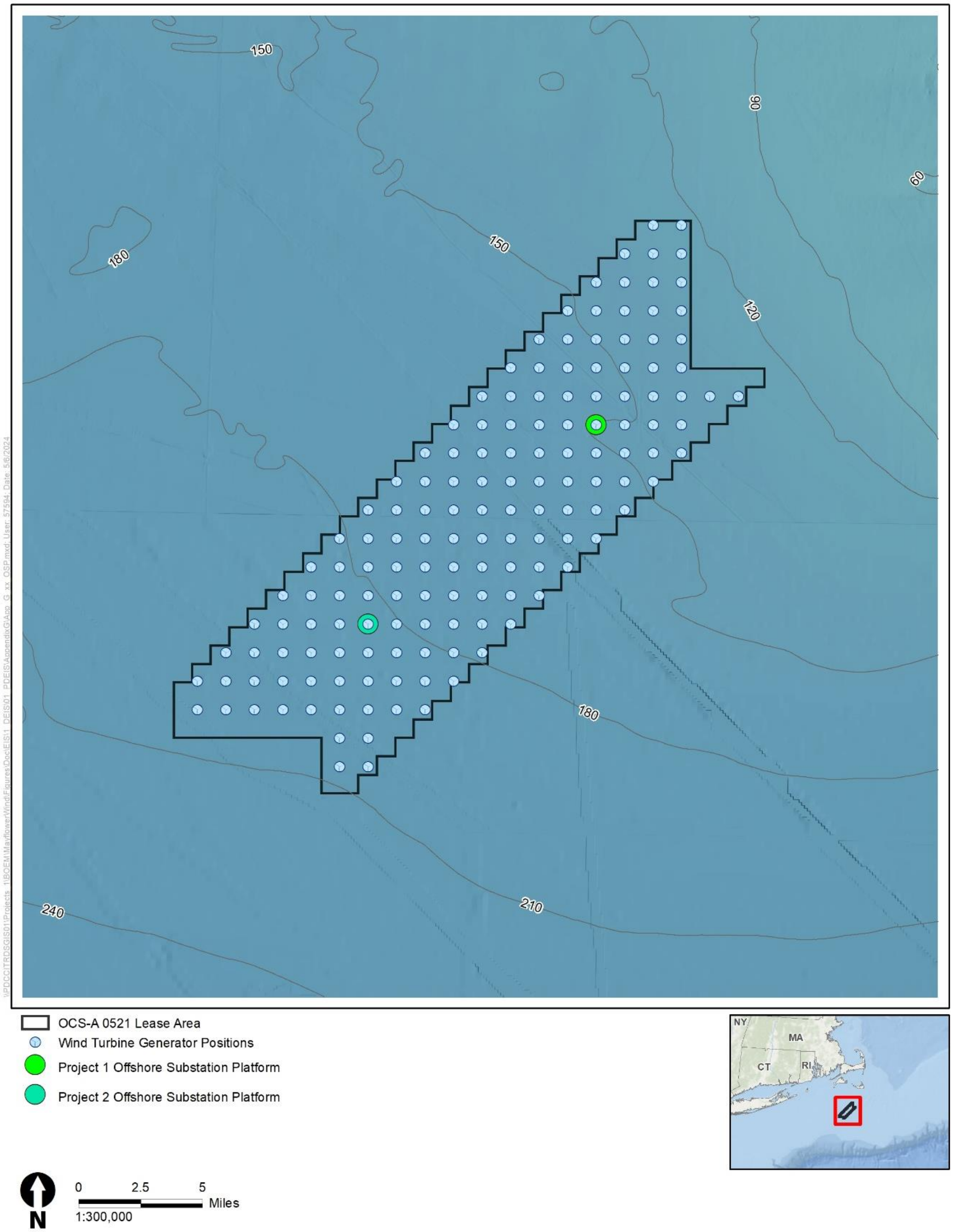
Source: COP Volume 1, Figure 3-16; SouthCoast Wind 2023

Figure 2-9. Representative integrated OSP diagram



Source: COP Volume 1, Figure 3-17; SouthCoast Wind 2023

Figure 2-10. Representative DC converter OSP diagram with piled-jacket foundations



Source: TetraTech and Normandeau Associates, Inc. 2023 with supplemental data provided by SouthCoast Wind

Figure 2-11. Location of the OSP with converter station in the Lease Area from SouthCoast Wind Offshore Converter Station NPDES permit application for Project 1 and indicative location of the OSP for Project 2

Table 2-4. Characteristics of the CWIS for one SouthCoast Wind OSP converter station

Configuration Parameter	SouthCoast Wind OSP CWIS
Water Source	Atlantic Ocean
Cooling Water Intake System (CWIS)	Non-contact, once-through cooling. Each of the three intakes pipes (caissons) operates independently with its own seawater lift pump. No common entrance or shared piping between each intake caisson. Typical operations utilize no more than two seawater lift pumps, with the third serving only as a backup to the other two pumps (no operating scenario will utilize three seawater lift pumps simultaneously).
Configuration of intake	Three, approximately 28-inch (0.7-meter)-diameter vertical-shaft intake caissons, with flared ends to accommodate intake velocity requirements, set perpendicular to the seafloor, in the middle portion of the water column, located within the jacketed foundation structure. The three intake caissons on the OSP are separated by approximately 3.3 feet (1 meter) distance from each other, with the first caisson located approximately 91.9 feet (28 meters) distance from the center of the platform coordinates. Note that the three intake caissons are independently operating structures with no common intake or entrance.
Configuration of discharge	The cooling water discharge includes one 36-inch (0.91-meter)-diameter vertical-shaft discharge caisson, located in the middle portion of the water column, and set perpendicular to the seafloor, located within the jacketed foundation structure. The discharge depth is 42.7 feet (13 meters) below the surface and the location of discharge is within a 20-meter radius from the center of the platform coordinates. This location/depth ensures sufficient distance is maintained between the lift pump caisson and the overboard water caisson.
Trash/debris bar rack	The intake caisson(s) will be equipped with a stainless steel trash or debris bar rack. The proposed bar rack will be similar in concept and analogous to a turtle exclusion device (TED), utilized by some commercial fisheries to prevent sea turtles from becoming entrapped within a trawl net; in this case the bar rack would exclude large marine organisms from entering the intake caisson. The bar rack will consist of three stainless steel bars approximately 0.8 inches (20 millimeters) wide, or similar, fixed to the bell mouth opening of the intake caisson. SouthCoast Wind will require the bar rack to be incorporated into the specific design elements of the OSP fabricator. However, the use of trash or debris bar racks is not optimal for a seawater lift pump caisson installed in an offshore environment. The use of a bar rack at the intake of the pump caisson will create maintenance concerns over time; the bar rack will biofoul with encrusting/fouling organisms and will require direct access to the pump caisson intake periodically for cleaning campaigns. The original design did not include a bar rack for this reason, but a bar rack will be added for compliance requirements of the NPDES permit application.
Pump screens/strainers	Each seawater intake caisson is equipped with an in-built pump strainer with a typical outer screen size of 3/8 inches (9.5 millimeters) intended to protect the seawater lift pump impeller from debris in the water column. The strainers are retractable on the seawater lift pump for cleaning. At deck level 1 of the OSP, each pump flowline is also equipped with a dedicated filter (typical mesh size of 250 micrometers), intended to protect the equipment and ensure reliable operation of the CWIS. The filter is provided with an automated backwash cleaning system. No chemicals are involved in the cleaning cycles.

Configuration Parameter	SouthCoast Wind OSP CWIS
Number of traveling screens/ screen wells	N/A – no traveling screens
Water depth of withdrawal, below surface at MLLW	74 feet (22.6 meters) below the surface
Water depth of withdrawal, above seafloor	81 feet (24.7 meters) above the seafloor
Through-screen velocity (calculated from Design Intake Flow [DIF])	**Intake velocity will not exceed 0.5 feet (0.2 meters) per second** to meet the velocity-based impingement compliance option. A maximum velocity of less than or equal to 0.5 feet (0.2 meters) per second will be integrated into the engineering design of the CWIS to ensure compliance. The intake velocity of 0.5 feet (0.2 meters) per second (or less) will be ensured to be the design limit velocity at the bar rack, accomplished by ensuring the CWIS intake bell mouth diameter is sized in relation to the lift pump maximum flow rate (i.e., determined at the maximum power of the motor driving the pump or the pump curve, whichever is greater) and that the bell mouth face velocity is not exceeding 0.5 feet (0.2 meters) per second. See NPDES permit Section 6.2 (Tetratech and Normandeau Associates Inc., 2023) for intake velocity calculation, based on parameters below, including pump data from a submersible seawater lift pump deployed on another project with a similar cooling duty requirement of 50.16 Btu/h (14.7 megawatts): • Maximum cooling seawater flow required DIF: 9.9 MGD (2 x 780 m^3/h = 1,560 m^3/h), including contingency • Selected pump maximum operational flow (Qmax): (780 m^3/h), based on representative pump data • Typical pump configuration: 2 x up to 50% of operational flow, or 1 x up to 100% of operational flow • Minimum pump flow (Qmin): 1.3 MGD (200 m^3/h) • Minimum pump head (Hmin at Qmax): 160.8 ft (49 m) • Maximum pump head (Hmax at Qmin): 239.5 ft (73 m) • CWIS intake bell mouth diameter: 4.74 ft (1.445 m) • CWIS intake bell mouth area: 17.66 ft2 (1.64 m^2) • CWIS intake velocity (face velocity): < 0.5 ft/s (0.15 m/s)
Seawater lift pumps (intake pumps)	The seawater cooling system is a once-through (open loop) system. The maximum heat duty of the OSP is 50.16 Btu/h (14.7 MW). This maximum heat duty of 50.16 Btu/h (14.7 MW) requires a maximum seawater flow of 9.9 MGD (i.e.,1,560 m3/h, including contingency) for cooling. Up to two raw seawater vertical lift pumps are required to fulfill the cooling duty. Each seawater lift pump has a rated maximum nameplate flow capacity of 900 cubic meters per hour, but maximum operational flow would not exceed 780 cubic meters per hour per pump, resulting in a maximum design intake flow (DIF) of 9.9 MGD, with two pumps operating. Only two of the three pumps would be used under normal operating conditions, with the third pump serving only as a spare/backup. Each seawater lift pump supplies once-through, non-contact cooling water to a plate heat exchanger, to facilitate heat exchange/cooling with the seawater cooling system (of 7.35 megawatt heat duty capacity per heat exchanger). Internal cooling flow is controlled with the use of a 3-way valve while maintaining a constant speed with seawater once-through (open loop) cooling. In addition, a variable frequency drive (VFD) on each of the seawater lift pump motors, to accomplish the following:

<table>
<tr><th>Configuration Parameter</th><th>SouthCoast Wind OSP CWIS</th></tr>
<tr><td></td><td>1. The seawater lift pumps are equipped with VFDs for slow start-up of the seawater supply lines.
2. Fine-scale control of the flow volume, based on cooling requirements.
3. In order to prevent freezing of the standby line, a VFD is used to operate the standby seawater lift pump at minimum flow capacity during the winter season (still within the maximum 9.9 MGD DIF for the facility)</td></tr>
<tr><td>Maximum Discharge Temperature</td><td>86°F (30°C)</td></tr>
<tr><td>Total Design Intake Flow (DIF)</td><td>9.9 MGD = maximum design intake flow required for cooling of the OSP.
Two of the seawater lift pumps operating at approximately 87% of their rated nameplate capacity will each provide up to 9.9 MGD (DIF) during normal operating conditions (up to 4.95 MGD each to supply the required cooling water).
During normal operating conditions, each individual seawater lift pump will provide up to 4.95 MGD to ensure reliable, safe operating conditions at the unmanned OSP. Seawater Lift Pump settings can be controlled with or without a variable frequency drive (VFD). Internal cooling flow is controlled by use of a 3-way valve while maintaining a constant speed with the seawater once-through (open loop cooling). The system is designed for a rated nameplate capacity of each seawater lift pump of 900 m3/h. However, SouthCoast Wind is seeking 9.9 MGD maximum design intake flow (DIF) in the NPDES permit to align with the expected maximum operational conditions (two pumps operating at up to 780 m^3/h each), as the seawater lift pumps are not designed to operate at 100% of their total rated nameplate capacity to meet the cooling needs of the OSP.</td></tr>
<tr><td>Actual Intake Flow (AIF)</td><td>The summary below represents expected maximum, average, and minimum flows during operations for each month. However, the actual AIF will be determined based on CWIS conditions, once operational. To be determined based on average CWIS operational conditions. Per §125.92(a), AIF represents the average volume of water withdrawn on an annual basis by the cooling water intake structures over the past three years. After October 14, 2019, AIF means the average volume of water withdrawn on an annual basis by the cooling water intake structures over the previous five years.
<table>
<tr><th>Month</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>Max DIF (MGD)</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td></tr>
<tr><td>Average Intake Flow (MGD)</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td></tr>
<tr><td>Min Intake Flow (MGD)</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td></tr>
</table></td></tr>
<tr><td>Flow Reduction from Design Capacity</td><td>While 9.9 MGD is the DIF, a 50% flow reduction potential from DIF could be achieved by use of single-pump operation (5.1 MGD), or dual-pumps each operating at reduced capacity during low-load operating conditions.</td></tr>
<tr><td>Closed-cycle recirculating cooling</td><td>None. Closed-cycle (closed-loop) cooling utilizing air or seawater is not an available technology for this type of unmanned offshore facility.</td></tr>
<tr><td>Monitoring parameters and sensor locations</td><td>The three intake structures will include the following instrumentation:
• Temperature & water conductivity monitoring devices installed at the seawater lift pump intake.
• The intake seawater flowline has an inline flow meter installed upstream of the seawater filter at the topside of the converter station.
• Temperature and flow monitoring devices are installed at the feed line and at the discharge outlet of the seawater heat exchanger.</td></tr>
</table>

Configuration Parameter	SouthCoast Wind OSP CWIS
	• Mechanical sampling connections located at the return line of seawater. The samples will be taken as required per NPDES permit conditions, to a laboratory for the analysis of required parameters, per the final NPDES permit.
Chlorination System	The CWIS is equipped with an antifouling system to prevent marine growth in the pump caissons and the Seawater System, which consists of Hypochlorite Generator Packages. The Hypochlorite Generator Packages produces Sodium Hypochlorite (NaOCl) by seawater electrolysis. The hypochlorite is injected into the pump caissons near the suction level of the Seawater Lift Pumps. Hypochlorite Generator Packages are designed to achieve a hypochlorite solution flow rate of sufficient concentration, corresponding with a 0 to 2 parts per million equivalent free chlorine concentration in the seawater intake lines. This method of continuous injection into the pump caisson is preferred because at a low dosage of NaOCl (i.e., 2 milligrams per liter, 95 kilograms per day), the residual free chlorine at the outlet would be negligible and oxidized in the water with no negative impact.

Source: TetraTech and Normandeau Associates, Inc. 2023
Btu/h = British thermal unit per hour; cm = centimeter; CWIS = cooling water intake structure; DIF = Design Intake Flow; °F = degrees Fahrenheit; °C = degrees Celsius; f = feet; ft/s = feet per second; GPM = gallons per minute; m/s = meters per second; m = meter; m^2 = square meter; m^3/h = cubic meter per hour; MLLW = Mean Lower Low Water MGD = million gallons per day; NaOCl = sodium hypochlorite; NPDES = National Pollutant Discharge Elimination System; OSP = offshore substation platform

2.2.1.1 Vessel Activity

Probable vessel classes used to construct the WTGs include heavy lift and derrick barge cranes, jack-up barges, material transport barges, a jack-up crane work vessel, transport and anchor handling tugs, and safety vessels (Table 2-5). It is estimated that the Project will require approximately 15 to 35 vessels per day on average, with an expected maximum peak of 50 vessels in the Lease Area at one time, depending on construction activities. SouthCoast Wind is currently developing a comprehensive vessel anchoring plan which will include details on how vessels will be anchored, and the estimated area of substrate affected by anchoring.

2.2.1.2 Pile Driving and Jacket Installation

The amount of pile driving needed depends on the foundation type chosen for installation; SouthCoast Wind is considering three foundation types, of which two require pile driving. Monopile foundations typically consist of a single steel cylindrical pile with a maximum diameter of 52 feet (16-meter) that is embedded into the seabed and is made up of sections of rolled steel plate welded together. A transition piece is fitted over the monopile and secured via bolts or grout. Monopiles can be used to support both the WTGs and the Option A – Modular OSP. Piled jacket structures are large lattice structures fabricated of steel tubes (pin piles) with a maximum pile diameter of 14.7 feet (4.5 meters) that are welded together and consist of three- or four-legged structures to support WTGs and four- to six-legged structures to support OSPs. Suction-bucket jackets have a similar steel lattice design as the piled jacket structures, but these substructures use suction-bucket jackets instead of piles to secure the structure to the seabed. Renderings of the substructure types are presented in Figure 2-4 to Figure 2-6 and included in the SouthCoast Wind COP Volume 1, Section 3.3.1 (SouthCoast Wind 2023).

WTG and OSP monopile foundations with a maximum diameter of 52-foot (16-meter) monopiles would be installed within the Lease Area using an impact pile driver with a maximum hammer energy of 6,600 kilojoules and/or a vibratory hammer (vibratory is proposed for Project 2 only). Monopiles would be installed to a maximum depth of 164 feet (50 meters). Under normal conditions, installation of a single monopile foundation is estimated to require approximately 4 hours of piling. It is anticipated that a maximum of one monopile foundation can be driven into the seabed per day assuming 24-hour pile-driving operation. The time required to install each pile would also include a 1-hour pre-start clearance period and then 4 hours to move to the next piling location.

WTG piled jacket foundations, with four legs and one pin-pile per leg, with a maximum pile diameter of 14.7 feet (4.5 meters) would be installed using an impact pile driver with a maximum hammer energy of 3,500 kilojoules and/or a vibratory hammer (vibratory is proposed for Project 2 only) to a maximum penetration depth of 229.6 feet (70 meters). Installation of a single pin-piled jacket substructure is estimated to require approximately 8 hours of pile driving (2 hours of pile driving per pin pile foundation, four piles per jacket substructure). It is anticipated that a single piled jacket substructure involving four pin-pile foundations can be driven into the seabed per day assuming 24-hour pile-driving operation. Piled jacket installation is multi-stage where the seabed is prepared and then a reusable template is placed on the seabed for accurate positioning of piles. Pin piles will be individually lowered into the template and driven to the target penetration depth using an impact hammer. Then the template is picked up and moved to the next location. In the subsequent stage of the installation process, a vessel installs the jacket to the piles. This could occur directly after the piling vessel completes operations, or a year later.

OSP piled jacket foundations would be similar to the WTG piled jacket foundations described above. However, OSP piled jackets would be installed using a post-piling installation sequence. Post-piling installation is a sequence where the seabed is prepared and the jacket is set on the seafloor, then the piles are driven through the jacket legs to the designed penetration depth (depending on which OSP design is used). The piles are connected to the jacket via grouted or swaged connections or a combination of the two. OSP piled jackets may have up to six legs, and each leg could be anchored by up to four pin piles. The number of jacket legs and pin piles would vary depending on the OSP design being supported as follows:

- Option A (modular) OSP design would be the smallest and include three to four legs with one to two pin piles per leg (three to eight total pin piles per pile jacket). Pin piles would have a diameter of up to 14.7 feet (4.5 meters) and would be installed using up to a 3,500-kilojoule hammer to a target penetration depth of 229.6 feet (70 meters) below the seabed.
- Option B (integrated) OSP design would include four to six legs with one to three piles per leg (4 to 12 total pin piles per jacket). The pin pile diameter would be up to 11.7 feet (3.57 meters), and they would be installed using up to a 3,500-kilojoule hammer to a target penetration depth of 277.2 feet (84.5 meters) below the seabed.
- Option C (HVDC converter) OSP design with a piled jacket substructure would include four legs with one to four pin piles per leg (4 to 16 total pin piles per jacket) with a pile diameter of 12.8 feet (3.9 meters) installed using a 3,500-kilojoule hammer to a target penetration depth of 262.4 feet (80 meters) below the seabed.

For all three OSP piled jacket options (modular, integrated, and HVDC-converter), installation of a single pin pile is anticipated to take up to 2 hours of pile driving. A maximum of eight pin piles could be driven into the seabed per day during 24-hour pile driving operation.

During installation of suction-bucket jacket substructures for WTGs and OSPs, the jacket is lowered to the seabed, the open bottom of the bucket and weight of the jacket embeds the bottom of the bucket in the seabed. To complete the installation and secure the foundation, water and air are pumped out of the bucket at an approximate rate of 300 to 500 cubic meters per hour to create negative pressure within the bucket of approximately five bar, which embeds the foundation bucket into the seabed. The jacket can also be leveled at this stage by varying the applied pressure. The pumps will then be released from the suction buckets once the jacket reaches its designed seabed penetration depth of 65.6 feet (20 meters) (Figure 2-6). The connection of the required suction hoses is typically completed using a remotely operated vehicle (ROV). A typical duration for suction bucket jacket installation is 15 to 20 hours per foundation. Suction bucket jackets remain in the Project 2 foundations PDE, but currently are not preferred over monopiles and piled jackets. Pump parameters (such as flow rate) depend on the final design of the suction bucket foundation. However, the flow rate will be designed so that seabed disturbance is avoided. Each bucket would have a diameter of up to 65.6 feet (20 meters) and a maximum volume of up to ~8,894 cubic yards (6,800 cubic meters).

A maximum total of 147 WTGs and five OSPs at a maximum of 149 WTG/OSP positions are anticipated for the Proposed Action. For two substructure types, monopiles and piled jackets, impact pile driving may occur 24 hours per day (including nighttime pile driving) to complete installation within as few years as possible during the multiple-year installation campaign expected for the entire Lease Area build-out (Project 1 and Project 2) (LGL 2024). Pile installation procedures would use a soft-start method with a gradual increase in hammering energy levels to warn marine and avian animals, allowing them to distance themselves from the construction activity. Suction-bucket jackets may be used for up to 85 WTG/OSP positions in the southern portion of the Lease Area associated with Project 2. Substructure installation is scheduled to take place from Q2 to Q4 in 2028, 2029, and 2030 for piled jackets and monopiles, and Q2 of 2030 to Q3 of 2031 for suction-bucket jackets (Table 2-2).

For monopiles and piled jacket foundations, pile-driving activity would be limited to between June 1 to October 15 within 20 kilometers of the 30-meter isobath on the west side of Nantucket Shoals and between May 15 to December 31 anywhere in the Lease Area to reduce impacts on North Atlantic right whale (NARW) and other marine mammals, which are most present in the Project area from January to April. While this mitigation measure was proposed to ensure that no NARW are exposed to injurious levels of noise from pile driving activity, it also protects EFH species and NOAA Trust Resources that may occur in the Lease Area during the winter and spring. Due to concerns around pile driving in the vicinity of Nantucket Shoals and the larger ensonified area associated with vibratory piling, no vibratory pile driving is planned for foundation installation for the construction of Project 1 (LGL 2024). Prior to conducting nighttime pile driving, SouthCoast Wind would be required to submit a Nighttime Pile Driving Plan to BOEM and NMFS for approval. The Nighttime Pile Driving Plan will describe the methods, technologies, monitoring zones, and mitigation requirements for any nighttime pile driving activities. Nighttime pile driving activities would be those occurring between 1.5 hours before civil sunset to one hour after civil sunrise.

Table 2-5. Indicative Offshore Project vessels and data

Project Phase	Vessel Type	Number of Each Type of Vessel	Operational Speed/Max Speed (knots)	Estimated Work Duration (days)			Supply Trips to Port (one-way)	Estimated Number of Nautical Miles Traveled (mileage includes all round-trip mileage for entire buildout)
				Federal Waters	Massachusetts Waters	Rhode Island Waters		
Construction	Airplane	1–2	100–120	240	240	130	260	42,640
Construction	Anchor Handling Tug	1–10	10/15	30	240	240	16	4,288
Construction	Cable Lay Barge	1–3	<5/15	30	420	420	20	10,200
Construction	Cable Transport and Lay Vessel	1–5	2/11.5	990	110	108	88	30,248
Construction	Crew Transfer Vessel	2–5	10/35	2,690	2,690	2,400	1,608	294,532
Construction	Dredging Vessel	1–5	2/15	100	20	20	100	20,930
Construction	Drones (Fixed wing, single and/or multi–rotor)	1–5	0–100	800	84	84	12	1,608
Construction	Heavy Lift Crane Vessel	1–5	0/15	1,130	90	90	70	25,076
Construction	Heavy Transport Vessel	1–20	12/15	650	30	30	65	67,086
Construction	Helicopter	1–4	100–145	365	365	290	348	49,648
Construction	Jack-up Accommodation Vessel	1–2	0/15	960	50	50	14	22,258
Construction	DP Accommodation Vessel	1–2	0/15	1,440	30	30	16	23,028
Construction	Multipurpose Support Vessel	1–8	10/15	4,300	3,000	3,000	660	161,604
Construction	Scour Protection Installation Vessels	1–2	2/15	400	40	40	40	13,600
Construction	SOV	1–4	10/25	1,610	300	300	480	91,200
Construction	Survey Vessel	1–5	2/12	120	24	24	26	8,840
Construction	Tugboat	1–12	5/16	5,460	5,460	5,460	655	207,286
Construction	Barge	1–6	N/A	2,640	2,640	2,640	510	159,684
O&M	Maintenance Crew/CTVs	1–4	10/35	15,015	15,015	15,015	15,015	2,614,260
O&M	Multipurpose Support Vessel	1	10/25	6,420	3,997.5	3,997.5	1980	530,640
O&M	SOV	1	10/25	15,015	1,584	1,584	1,638	311,220
O&M	Anchor Handling Tugs	1–2	10/15	2,970	792	792	250	47,500

Project Phase	Vessel Type	Number of Each Type of Vessel	Operational Speed/Max Speed (knots)	Estimated Work Duration (days)			Supply Trips to Port (one-way)	Estimated Number of Nautical Miles Traveled (mileage includes all round-trip mileage for entire buildout)
				Federal Waters	Massachusetts Waters	Rhode Island Waters		
O&M	ROV	1–2	2/5	2,700	2,700	2,700	N/A	N/A
O&M	Heavy Lift/Jack Up Vessel with Crane	1–2	0/12.5	2,970	231	231	33	14,256
O&M	Scour Vessel or Barge	1	2/15	100	10	10	10	3,400
O&M	Inspection/Survey Vessel (Potentially ROV)	1–2	10/14	1,500	1,282.5	1,282.5	660	176,880
O&M	Self-Propelled ROV/AUV	1–2	6	8,100	900	900	N/A	N/A
O&M	Helicopter	1–2	100–145	1,980	1,980	1,980	1,980	324,720
O&M	Drone	1–4	0–100	2,700	0	0	0	N/A
O&M	Cable Transport and Lay Vessel	1-5	2-11.5	930	110	108	25	17,130
O&M	Barge	1-6	1-6	880	492	492	150	31,290
O&M	Tugboat	1-12	5-16	908	512	512	300	102,000
Totals				**86,143**	**45,439**	**44,960**	**27,029**	**5,407,052**

Source: modified from COP Volume 1, Table 3-21 and Table 3-23; SouthCoast Wind 2023
O&M = operations and maintenance; DP = dynamic positioning; SOV = service operations vessel; CTV = crew transfer vessel; ROV = remotely operated vehicle; AUV = autonomous underwater vehicle

2.2.1.3 Seabed Preparation (Including UXO Removal)/Boulder Relocation

Seabed preparation may be required prior to the installation of WTG and OSP foundations in certain areas depending on seabed condition and the foundation type. Seabed preparation activities may include removal of surface or subsurface debris and boulders and in-situ UXO/Munitions and Explosives of Concern disposal. There is an absence of boulder fields and individual boulders from the 2020 and 2021 High-Resolution Geophysical (HRG) mapping of the Lease Area (SouthCoast Wind 2023, Appendix E); however, a boulder relocation plan is currently in development for the ECCs (Section 2.2.2.2) and would apply to the interarray cables in the Lease Area should boulder removal and relocation become necessary. Seabed leveling and dredging would not be required for any foundation types.

SouthCoast Wind is conducting a three-phase UXO study to assess possible UXO presence and impact within the Lease Area and ECCs. Phase one, which has been completed, included a desktop study on publicly available data covering the full Project area including both the Lease Area and the ECCs. Based on the conclusions of the research and risk assessment undertaken, the risk of encountering UXOs was found to be moderate throughout all of the Lease Area and low to moderate within the ECCs (SouthCoast Wind 2023, Appendix E.7). The identified risk is primarily due to the presence of Allied HE Bombs, Torpedoes, and Depth Charges. Phase two included further study in areas of potential interest identified during phase one and utilized select available survey data to assess UXO mobility and burial and develop a risk mitigation strategy (SouthCoast Wind 2023, Appendix E.8). The final phase will include identification of any potential areas of further interest and data gaps. Additionally, phase three will present suggestions for the path forward on further reducing risk to as low as reasonably practicable, consistent with standard industry practice, prior to construction activities.

Positively identified unexploded ordnances (UXOs) in proximity to planned activities on the seabed may be addressed by relocating the activity away from the UXO (avoidance), moving the UXO away from the activity (lift and shift), cutting the UXO open to apportion large ammunition or deactivate fused munitions, using shaped charges to reduce the net explosive yield of a UXO (low-order detonation), using shaped charges to ignite the explosive materials and allow them to burn at a slow rate rather than detonate instantaneously (deflagration), or detonating the identified UXO in place (LGL 2024). Decision on removal method will be made in consultation with a UXO specialist and in coordination with the agencies with regulatory oversight of UXOs. For detonations that cannot be avoided due to safety considerations, a number of mitigation measures will be employed by SouthCoast Wind which include the use of noise abatement systems (e.g., bubble curtains) for noise attenuation during UXO detonations, limiting UXO detonations to no more than one in a 24-hour period, and the implementation of time of year restrictions (LGL 2024). While time of year restrictions (no UXO detonations between January and April) are meant to coincide with marine mammal presence in the Project area, this mitigation measure would also limit impacts to fish species. The exact number and type of UXOs in the Project area are not yet known, but SouthCoast Wind conservatively estimates that up to five UXOs in the Lease Area and up to five along the ECCs may have to be detonated in place (LGL 2024).

For all substructure types, seabed preparation, if required, will be completed prior to transport of the foundations to the Lease Area. Seabed preparation for substructures will occur from Q1 of 2027 through Q3 of 2029. If required, UXO detonations would occur starting in Q2 of 2025 and occur periodically through Q2 of 2030 during the months from May through November.

2.2.1.4 Installation of Scour Protection

Scour protection will most likely be installed around the wind turbine and offshore substation platform foundations to prevent scouring of seabed material. The locations requiring scour protection, the type of protection selected, and the amount placed around each foundation will be based on a variety of factors, including foundation type, water flow and substrate type (hydrodynamic scour modeling), oceanographic conditions, and maintenance requirements. Descriptions of the scour protection types proposed are:

- Rock: the installation of crushed rock or boulders around a structure. Monopile foundation scour protection will most likely consist of armor rock overlaying a layer of filter rock (Figure 2-4).
- Rock bags: pre-filled bags made of meshed steel or synthetic materials containing crushed rock to be placed around a structure.
- Concrete mattresses: the installation of pre-cast blocks of concrete around a structure.
- Sandbags: pre-filled bags containing sand.
- Artificial seaweeds/reefs/frond mats: mattresses including polypropylene or similar fronds that accumulate soft sediment.
- Self-deploying umbrella systems: typically used for suction-bucket jackets. This system is pre-installed onshore and consists of metal pole outriggers with artificial seaweed frond mats attached.

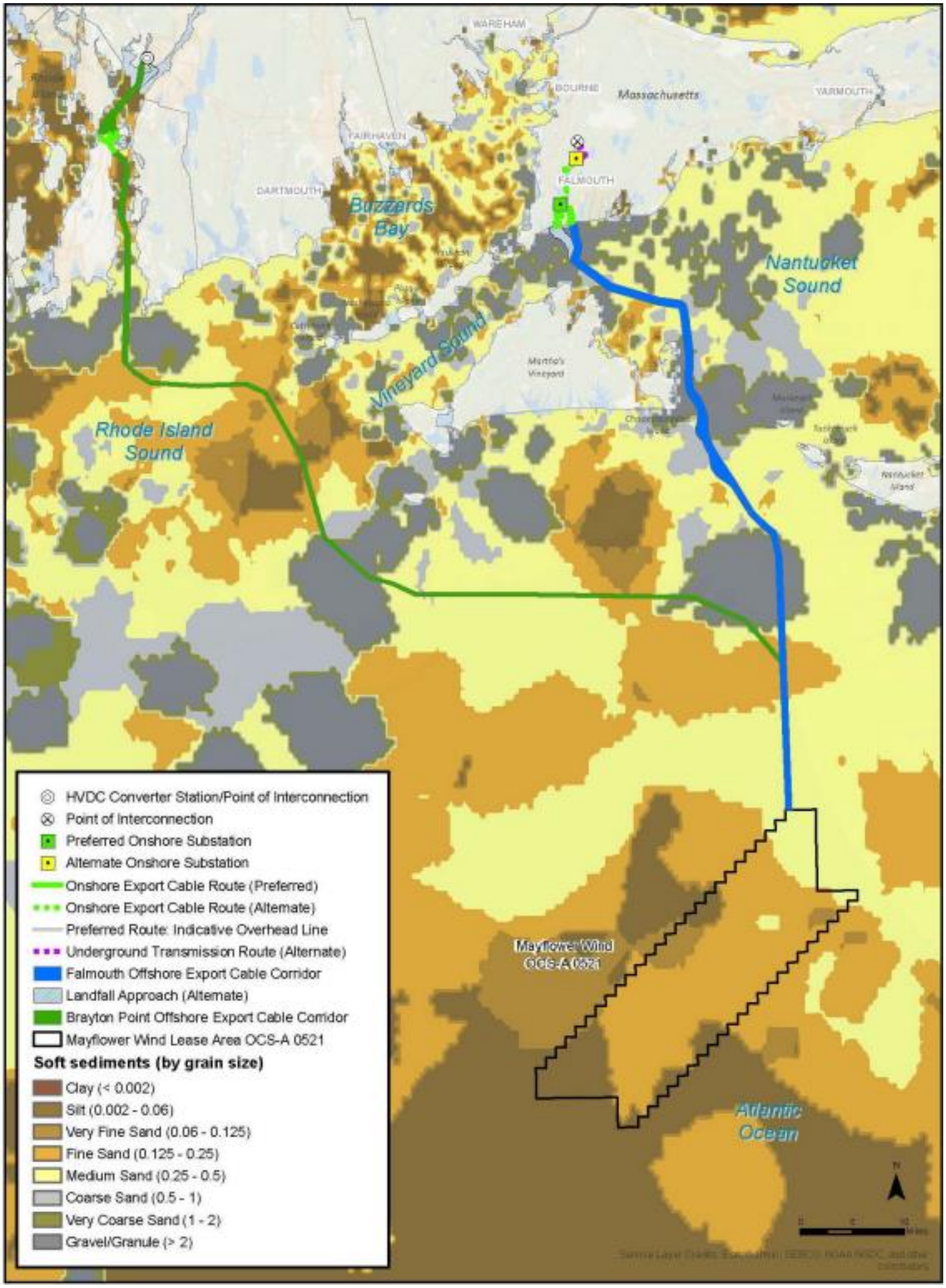
The estimated maximum extent of the scour protection area (including substructure footprint) per WTG substructure is 2.52 acres (1.02 hectares) for monopile, 2.61 acres (1.05 hectares) for piled-jacket, and 4.91 acres (1.99 hectares) for suction-bucket jacket foundations (Table 2-3). The estimated maximum scour protection volume needed per monopile foundation is 36,256 cubic yards (27,720 cubic meters) while piled-jacket and suction-bucket jacket foundations would require 37,635 cubic yards (28,774 cubic meters) and 75,583 cubic yards (57,787 cubic meters) of scour protection, respectively, depending on the design alternative chosen (COP Volume 1, Table 3-6; SouthCoast Wind 2023). For OSPs using pin-pile jacket foundations, the estimated maximum extent of the scour protection area (including substructure footprint) is 9.79 acres (3.96 hectares) per substructure with a scour protection volume of 157,193 cubic yards (120,183 cubic meters) (COP Volume 1, Table 3-7; SouthCoast Wind 2023). Scour protection installation activities will largely depend on the type and material used. In the case of rock scour protection, a rock placement vessel may be deployed. A thin layer of filter stones is typically placed before driving the piles then an armor rock layer is typically installed afterward. Frond mats and umbrella-based scour protection types may be pre-attached to the substructure and installed simultaneously. Scour protection and seabed preparation for substructures will occur from Q1 of 2027 through Q3 of 2029.

2.2.2 Interarray and Offshore/Onshore Cable Installation

SouthCoast Wind will install an interarray cabling system, a series of aluminum and/or copper-conductor core transmission cables linking each of the WTGs to the OSPs. The interarray cables would have a length of 497.1 statute miles (800 kilometers) and would each have a transmission capacity of 60 to 72.5 kilovolt, depending on the WTG alternative selected. Interarray cable diameter will range from 5 inches (130 millimeters) to 8 inches (200 millimeters) and one to nine WTGs will be part of each interarray cable string. Anticipated burial depths for interarray cables range from 3.2 feet (1.0 meter) to 8.2 feet (2.5 meters), with a target depth of 6 feet (1.8 meters). A total seabed disturbance area of 1,408 acres (570 hectares) is estimated for the installation of the entire interarray cable layout (Table 2-7; COP Volume 1, SouthCoast Wind 2023).

SouthCoast Wind would install up to two ECCs (one preferred and one variant) that would link the OSPs to a sea-to-shore transition. The Brayton Point ECC (preferred) is 97.0 to 124.0 miles (156 to 200 kilometers) long and 2,300 feet (700 meters) wide. Cables within the Brayton Point ECC would range from 97.0 to 744.0 miles (156 to 1,200 kilometers) long and would have a nominal cable voltage of 320 kilovolts. The Brayton Point export cable diameter will be up to 6.9 inches (175.0 millimeters) and anticipated burial depths range from 3.2 to 13.1 feet (1to– 4 meters), with a target depth of 6 feet (1.8

meters). The Falmouth ECC (variant) is 51.6 to 87.0 miles (83.0 to 140.0 kilometers) long and 3,280.8 feet (1,000 meters) wide. Cables within the Falmouth ECC would range from 51.6 to 434.9 miles (83 to 700 kilometers) long and would have a nominal cable voltage of 200 to 345 kilovolts (or ±525 kilovolts if HVDC). The Falmouth export cable diameter will be up to 13.8 inches (350.0 millimeters) and anticipated burial depths range from 3.2 to 13.1 feet (1 to 4 meters), with a target depth of 6 feet (1.8 meters). Cable routes will transit through a variety of sediment types ranging from clay to gravel as shown in Figure 2-12. A total seabed disturbance area of 727 acres (294 hectares) is estimated for the Brayton Point export cable while the Falmouth export cable is estimated to impact a total of 1,753 acres (709 hectares) of seafloor (Table 2-6; COP Volume 1, SouthCoast Wind 2023). The estimated disturbance area from cable installation includes the trench footprint, the area surrounding the trench where sediment suspended during installation will settle, and the footprint of any cable protection.



Source: COP Appendix N, Figure 3-2; SouthCoast Wind 2023

Figure 2-12. Offshore Project area sediment classifications

Table 2-6. Export cable estimated seabed disturbance areas

Offshore Export Cable	Area in acres (hectares) per Cable
Falmouth Export Cable (up to 5 cables)	
Seabed Preparation (per cable)	138 (56)
Cable Installation (per cable)	186 (75)
Cable Protection (per cable)	27 (11)
Total Seabed Disturbance Area (per cable)	351 (142)
Total Seabed Disturbance Area (5 cables)	1,753 (709)
Brayton Point Export Cable (up to 2 cable bundles)	
Seabed Preparation (per cable bundle)	65 (26)
Cable Installation (per cable bundle)	242 (98)
Cable Protection (per cable bundle)*	56 (23)
Total Seabed Disturbance Area (per cable bundle)	363 (147)
Total Seabed Disturbance Area (2 cable bundles)	727 (294)

*Cable protection assumes mattresses and/or rock placement will be used at cable crossings and for additional cable protection along the Brayton Point offshore export cable route if needed. Based on preliminary understanding of site conditions from desktop studies of the offshore export route, SouthCoast Wind estimates 15 percent of the route will require additional cable protection. It is assumed that a 19.7-foot (6-meter) wide rock berm will be constructed along these sections of the cable. At each of up to 16 third-party cables expected to be crossed, rock berms and/or a number of 9.8-foot (3-meter) width x 19.7-foot (6-meter) length mattresses are assumed to be used for cable separation and protection.
Source: COP Volume 1, Table 3-29; SouthCoast Wind 2023

Table 2-7. Interarray cable estimated seabed disturbance areas

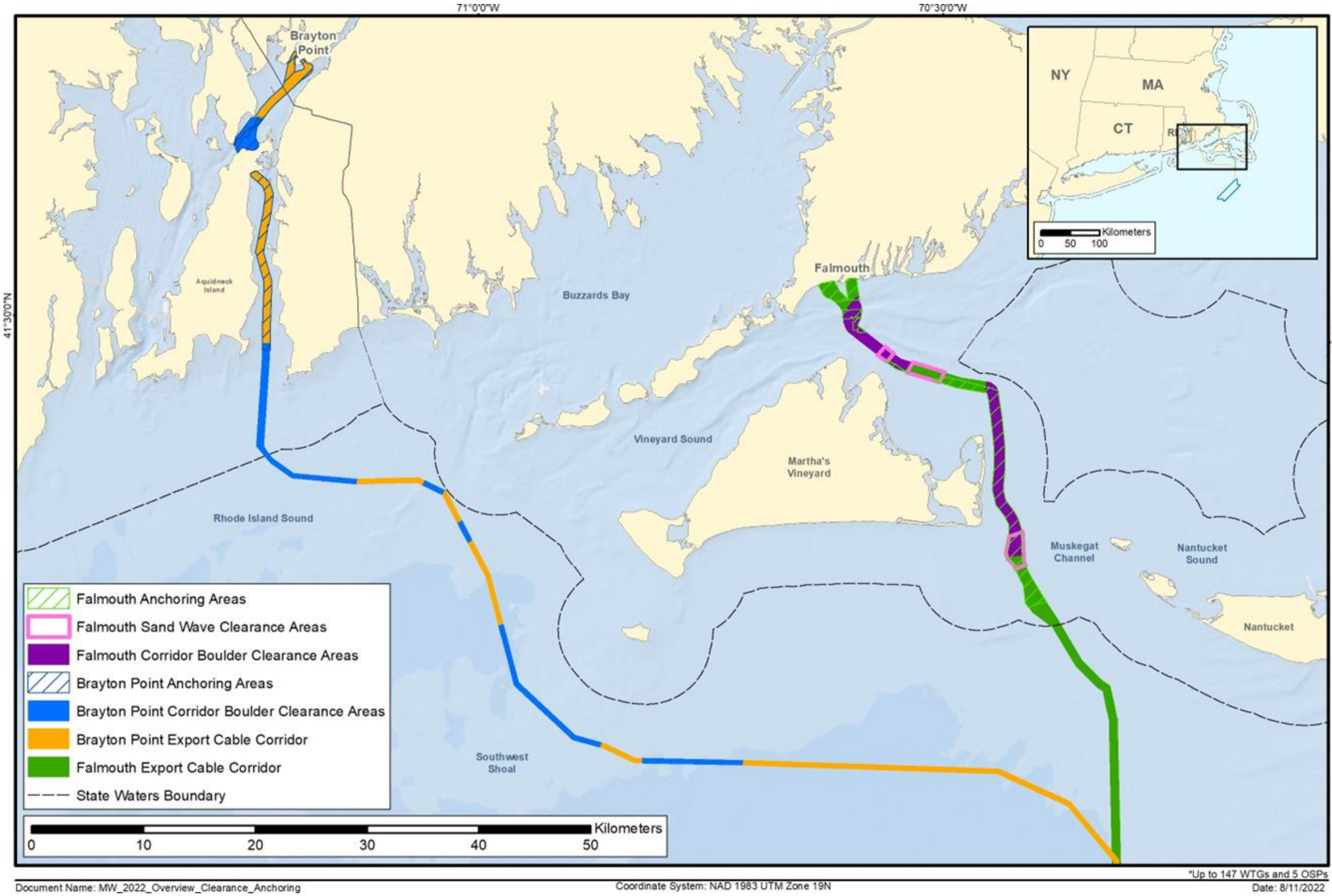
Interarray Cable Total	Area in acres (hectares)
Seabed Preparation	99 (40)
Cable Installation	1,186 (480)
Cable Protection*	122 (50)
Total Seabed Disturbance Area	1,408 (570)

*Cable protection assumes mattresses and/or rock placement will be used at cable crossings and for additional cable protection along the interarray cable layout if needed. Based on preliminary understanding of site conditions from surveys completed in 2019 and 2020, SouthCoast Wind estimates 10 percent of the interarray cable layout will require additional cable protection. It is assumed that a 19.7-foot (6-meter) wide rock berm will be constructed along these sections of the cable.
Source: COP Volume 1, Table 3-30; SouthCoast Wind 2023

As summarized in Table 2-2 and Figure 2-2, installation of the SouthCoast Wind interarray cables would occur from Q2 of 2028 to Q3 of 2030. Installation of the Brayton Point and Falmouth export cables would occur from Q4 of 2026 through Q3 of 2030.

2.2.2.1 Vessel Activity

Probable vessel classes used to transport and install the interarray and offshore export cables include carousel- or static-tank-equipped cable lay vessels, dedicated cable transport and lay vessels, cable lay barge, or a combination of these (Table 2-5). It is estimated that the Project will require approximately 15 to 35 vessels per day on average, with an expected maximum peak of 50 vessels in the Lease Area at one time, depending on activities. SouthCoast Wind will work with the export cable installation contractor to develop a comprehensive vessel anchoring plan which will include details on how vessels will be anchored and the area of substrate affected by anchoring. The total estimated seabed disturbance resulting from vessel anchoring in identified ECC anchoring areas (Figure 2-13) is 8.9 acres (3.6 hectares) for the Falmouth ECC and 2.8 acres (1.1 hectares) for the Brayton Point ECC. The area of disturbance due to anchoring assumes that an 8-point mooring spread is used with an estimated impact diameter of 16.4 feet (5 meters) per anchor (SouthCoast Wind 2023). During construction, SouthCoast Wind will receive equipment and materials to be staged and loaded onto installation vessels at one or more existing third-party port facilities. Cable lay vessels will be used to install submarine cables, pre-lay grapnel run vessels will be used for seabed clearance along cable routes, and fall pipe vessels will be used for installation of scour protection. Transport vessels would be used to rotate construction crews to and from area ports. Small support vessels would be used for construction monitoring.



Source: COP Appendix M.3, Figure 2-28; SouthCoast Wind 2023

Figure 2-13. Temporary seabed disturbance locations in the Falmouth and Brayton Point ECCs from seabed preparation activities which include vessel anchoring, boulder clearance, and sand wave clearance

A combination of moored vessel solution and a dynamic positioning (DP) vessel solution will be used for the offshore export cable installation. DP vessels can maintain positioning without anchoring and are suitable for water depths greater than 49 feet (15 meters). Nearshore or shallow areas will require moored solutions to stay within the limits of survey corridor. The maximum anchor radius from the cable installation barge will be approximately 2,625 to 3,281 feet (800 to 1,000 meters) but anchors will be positioned forward and aft of the barge so as to not extend outside the width of the ECCs. Anchor penetration depth will vary depending on the type of anchor and substrate present at the anchoring location. Maximum anchor penetration depth is estimated to be between 6 to 10 feet, with penetration depths to be finalized upon selection of the cable lay barge. It is anticipated that anchoring will occur along approximately 12 to 25 miles (20 to 40 kilometers) of the nearshore ECCs: through Mount Hope Bay and the Sakonnet River for the Brayton Point ECC, and in portions of the Falmouth ECC directly east and southeast of Martha’s Vineyard and portions nearest the landfall sites (Figure 2-13). Anchored vessels are not expected to be used for the interarray cable installation in the Lease Area (SouthCoast Wind 2023).

2.2.2.2 Seabed Preparation/Boulder Relocation/Dredging

Seabed preparation activities may be conducted in some areas prior to the installation of cables to ensure that the submarine export cable and burial equipment will not be affected by any debris or hazards, both natural and human-made, during the burial process, which may cause equipment damage and/or delays, and to ensure sufficient burial depth. Seabed preparation activities may include cable installation surveys, boulder removal, grapnel runs, sand wave dredging, UXO clearance, and seabed leveling. Seabed preparation equipment that may be used include:

- Grapnel plow for the pre-lay grapnel run;
- Orange peel grabber for localized boulder removal;
- Boulder clearance plow for boulder field clearance;
- Trailing suction hopper dredger for removal of sand wave tops;
- Water injection dredge dredger for removal of sand wave tops in shallow areas; and
- Constant flow excavator for seabed leveling and preparation.

While a boulder relocation plan is currently being developed by SouthCoast Wind, key components of the boulder relocation process are presented in this section. Boulder clearance or relocation will be minimized through micro-routing of cables within each ECC. Any boulders discovered in the pre-installation surveys that cannot be easily avoided by micro-routing could be removed with an orange peel grabber or boulder clearance plow, as needed (SouthCoast Wind 2023). An orange peel grabber will be used to locally remove and re-locate individual boulders while a boulder clearance plow is necessary for denser boulder fields. The typical maximum boulder size that can be removed by the proposed methods is 9.8 feet (3.0 meters) in diameter. The actual boulder size that can be removed will depend on specifics of the boulder, including shape, weight, embedment, and surrounding seabed conditions. Site-specific conditions will be assessed prior to any boulder removal to ensure that the boulder removal can safely proceed. Where an orange peel grabber is employed to relocate individual boulders, the coordinates and approximate size of the boulder will be recorded prior to and following relocation. Specific locations to which boulders will be re-located are still to be determined. However, it is planned that any relocated boulders will be placed within the ECC in seabed areas similar to those from which they were removed. The surface disturbance area per cable due to boulder clearance or relocation is estimated to be 34 acres in the Brayton Point ECC and 43 acres in the Falmouth ECC. Boulder field clearance in the Falmouth ECC is expected to be needed primarily in areas traversing Muskeget Channel and Nantucket Sound (Figure 2-13). Boulder field clearance is not expected in the Lease Area in preparation for interarray cable installation (SouthCoast Wind 2023).

A pre-lay grapnel run using a grapnel plow will be completed along the entire length of each cable route within each ECC and along the entire length of the interarray cable layout to remove buried hazards or seabed debris (e.g., derelict fishing gear, abandoned mooring lines, wires, etc.) along the installation route that could impact cable installation. Seabed preparation may also include leveling via constant flow excavator or dredging steep features via trailing suction hopper dredger or water injection dredge dredger to achieve the targeted burial depth and ensure seabed-operated cable burial tools can be used. Dredging is most likely in sand wave areas where typical jetting methods are insufficient to meet target cable burial depth. With the use of a trailing suction hopper dredger, a drag head moves over the seabed in sand wave areas collecting sand and silt into a hopper through suction pipes. Sand waves that are dredged would be redeposited in like-sediment areas within the ECC and no offsite disposal would be required. During water injection dredging, which is SouthCoast Wind’s preferred method, large volumes of water are injected into the sand waves fluidizing the top sediment layers which are then dispersed by a density current. The total volume of dredged material, including sand wave clearance and dredging at HDD exit pits, is estimated to be 646,077 cubic yards (493,962 cubic meters) for the Falmouth ECC. Sand wave clearance is not expected to occur in the Brayton Point ECC and the total volume of dredged material at all three landfall locations is estimated to be 22,404 cubic yards (17,124 cubic meters). No sand wave clearance is expected in the Lease Area in preparation for interarray cable installation. Sand wave clearance areas in the Falmouth ECC are expected to potentially occur within a 0.9 mile (1.4 kilometer) and 2.1 mile (3.4 kilometer) section north of Martha’s Vineyard, and a 2.1 mile (3.4 kilometer) section within the Muskeget Channel (Figure 2-13). SouthCoast Wind will bury export cables deeper in areas of sand wave activity, if applicable. The total seabed disturbance area from all seabed preparation activities is estimated to be 65 acres (26 hectares) per cable bundle in the Brayton Point ECC, 138 acres (56 hectares) per cable in the Falmouth ECC (Table 2-6), and 99 acres (40 hectares) for the entire interarray cable network (SouthCoast Wind 2023).

Positively-identified UXOs near planned activities on the seabed may be addressed by relocating the activity away from the UXO (avoidance), moving the UXO away from the activity (lift and shift), cutting the UXO open to apportion large ammunition or deactivate fused munitions, using shaped charges to reduce the net explosive yield of a UXO (low-order detonation), using shaped charges to ignite the explosive materials and allow them to burn at a slow rate rather than detonate instantaneously (deflagration), or detonating the identified UXO in place (LGL 2024). Decisions on the UXO removal method will be made in consultation with a UXO specialist and in coordination with the agencies with regulatory oversight of UXOs. For detonations that cannot be avoided due to safety considerations, a number of mitigation measures will be employed by SouthCoast Wind which include the use of noise abatement systems (e.g., bubble curtains) for noise attenuation during UXO detonations, limiting UXO detonations to no more than one in a 24-hour period, and the implementation of time of year restrictions (LGL 2024). While time of year restrictions (no UXO detonations between January and April) are meant to coincide with marine mammal presence in the Project area, this mitigation measure would also limit impacts to fish species. The exact number and type of UXOs in the Project area are not yet known, but SouthCoast Wind conservatively estimates that up to five UXOs along the ECCs may have to be detonated in place (LGL 2024).

2.2.2.3 Trenching/Cable Installation

2.2.2.3.1 Interarray and Offshore Export Cables

Following the pre-installation grapnel run and route clearance, the interarray and export cables will be brought to the appropriate section of the cable siting corridor on a deep-sea cable-laying vessel. From there, the cables will be laid onto the seabed and either installed directly or a second vessel will follow the cable-laying process and bury the cable using one of the following methods:

- Vertical injector: A vertical injector is a deep burial jetting tool used for cable installation and burial. Water propelled from jet nozzles is used to fluidize seabed material and allow lowering of the cable. This equipment is towed along the back of a vessel and acts as a trowel creating a space for the cable to be installed and subsequently buried. This vessel-mounted burial solution is intended for shallow water use and does not require seabed leveling in areas of sand waves or other mobile sediment features.
- Jetting remotely operated vehicle (ROV) or jetting sled: Jetting involves the use of pressurized water jets into the seabed, creating a trench. The equipment can be either remotely operated from the cable installation vessel or a dedicated support vessel or be towed from the vessel in a sled. As the trench is created, the submarine export cable is able to sink into the seabed up to depths of 9.8 feet (3.0 meters). The displaced sediment then resettles, naturally backfilling the trench. Jetting is considered the most efficient method of submarine cable installation. It minimizes the extent and duration of bottom disturbance for the significant length and water depths along the submarine export cable route. This is typically used in unconsolidated, softer sands and soils. It is typical that approximately 6.5 feet (2.0 meters) of seabed width is affected by the use of a jet trencher. A jetting sled is ideal for shallow water use in areas of prepared or benign seabed surfaces. A jetting ROV is typically used in deeper water in unconsolidated soft bottoms.
- Mechanical plowing: As the cable plow is dragged along the seabed, a small trench is created. The submarine export cable is simultaneously placed in the trench and displaced sediment is either mechanically returned to the trench and or backfills naturally under hydrodynamic forcing. Plowing is generally less efficient than jetting methods but may be used at any depth and can be used for hard bottoms and a wide range of soils from unconsolidated sands to stiff clays.
- Pre-cut plow: This method may be deployed when surface and sub-surface boulders are present. A basic V-shaped trench is cut ahead of cable installation, which allows boulders and soils to be lifted to the edges of the trenches, where the reconfigured plow can deposit them as backfill into the trench afterward. A pre-cut plow may be used at any depth and can be used for hard bottoms and a wide range of soils from unconsolidated sands to stiff clays.
- Mechanical cutting ROV system (trenching): Cutting (trenching) is used at any depth on seabed containing hard consolidated materials not suitable for plowing or jetting, as the trenching machine is able to cut through the material using a chain or wheel cutter fitted with picks. Once the cutter creates a trench, the submarine export cable is laid into it.

The final cable burial method(s) will be selected prior to the Facility Design Report and the Fabrication and Installation Report. The equipment selected will depend on seabed conditions, the required burial depths, as well as the results of various cable burial studies. More than one installation and burial method may be selected per route and has the potential to be used pre-installation, during installation, and/or post-installation. SouthCoast Wind’s preference is to complete array cable and export cable installation via jetting methods, wherever possible, with alternative methods that include surface lay, mechanical trenching, and mechanical plowing. Target cable burial can be directly verified during cable installation with jetting tools, which are suitable for simultaneous laying and burial of the cables. These tools may be configured with a “depressor” or similar mechanical device that directly verifies the depth of the cable as it is being buried. Additionally, cable burial depth can be assessed post-installation using magnetic or acoustic remote-sensing techniques. For all cable installation methods being considered, a surface impact width is conservatively estimated at 19.7 feet (6 meters) around each cable or cable bundle, as specifications for each cable installation method have yet to be finalized. The seabed disturbance area from cable burial along the entire length of the offshore export cable routes is estimated to be 242 acres

(98 hectares) per cable bundle in the Brayton Point ECC and 186 acres (75 hectares) per cable in the Falmouth ECC (Table 2-6) while the seabed disturbance area from cable burial along the entire interarray cable layout is estimated to be 1,186 acres (480 hectares) (SouthCoast Wind 2023).

The use of a jet plow or jetting ROV is the preferred method for cable installation due to the soft-bottom substrate (i.e., sandy, muddy) known to exist throughout the export cable corridors. Jetting technology is anticipated to be the least impactful given that it will simultaneously lay and bury cable. For nearshore portions of the Project area that overlap with the juvenile Atlantic cod HAPC (i.e., coastal waters up to a depth of 20 meters), cable installation is anticipated to occur between approximately October through January, which aligns with work windows developed in coordination with Massachusetts Division of Marine Fisheries (MA DMF) and Rhode Island Department of Environmental Management (RI DEM) to avoid impacts to fisheries resources. A detailed timeline for offshore cable installation, including areas that overlap with HAPCs, will be established once a cable installation contractor is selected and under contract for the Project.

Depending on the ultimate cable route, there may be overlap or near-overlap between ECCs from different offshore wind farms, especially in relatively congested areas (i.e., the Muskeget Channel, Sakonnet River, and Mount Hope Bay). In the case that the proposed Project cables are close enough to the others that there is potential for risk, SouthCoast Wind will coordinate with the owners of the other cables to ensure safe installation and operation. For the Falmouth ECC, target horizontal separation between each proposed Project cable is approximately 328 feet (100 meters). For the Brayton Point ECC (and the Falmouth ECC if HVDC transmission technology is used), the cables will be installed in a bundled configuration where practicable, with no horizontal separation between cables within the bundle and approximately 328 feet (100 meters) of horizontal separation between bundles. If cables are installed separately, target horizontal separation between each proposed Project cable will be approximately 164 feet (50 meters).

2.2.2.3.2 Offshore Export Cable Sea-to-Shore Transitions

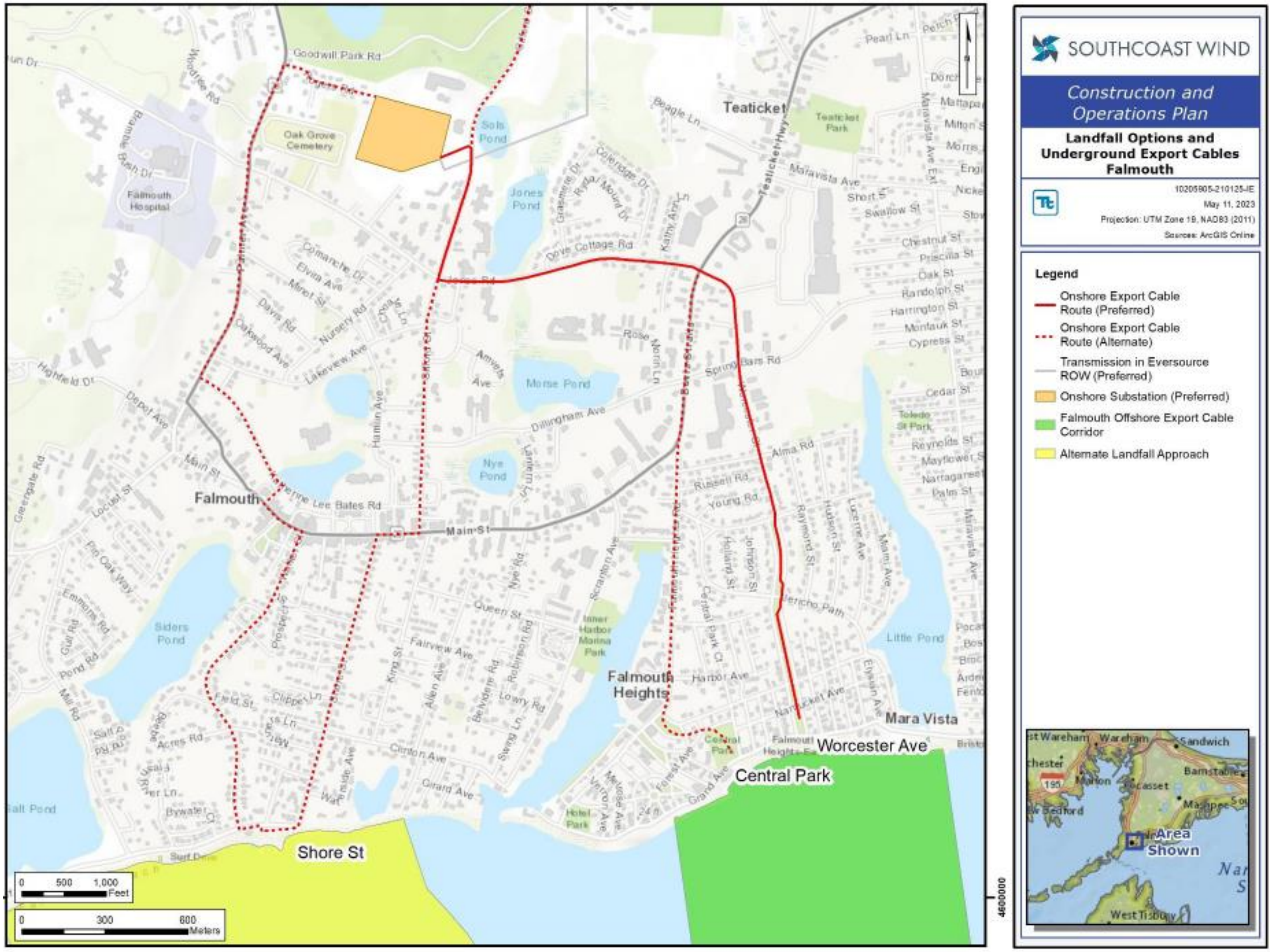
Nine potential sea-to-shore transition locations (i.e., landfall locations) are under consideration for the Falmouth ECC (three), Brayton Point ECC (two), and the onshore cable portion on Aquidneck Island (four). As depicted in Figure 2-14 and Figure 2-15, SouthCoast Wind is evaluating the following options for the Falmouth ECC and Brayton Point ECC landfalls:

- Falmouth, MA: The three locations under consideration are Worcester Avenue (preferred), Shore Street, and Central Park.
- Somerset, MA: The two locations under consideration are the western (preferred) and eastern (alternate) shorelines of Brayton Point.

HDD would be used to install export cable at the landfalls for the Brayton Point ECC and Falmouth ECC. Typically, HDD operations for an export cable landfall originate from an onshore landfall location and exit a certain distance offshore, which is determined by the water depth contour, as well as total length considerations (Figure 2-16). To support this installation, both onshore and offshore work areas are required. Once the onshore work area is set up, the HDD activities commence using a rig that drills a borehole underneath the surface. Once the drill exits onto the seafloor, the ducts in which the submarine cable would be installed are floated out to sea and then pulled back onshore within the drilled borehole. Excavated material at the HDD exit pits (seaward end of the HDDs) are planned to be side cast adjacent to the excavation areas and allowed to naturally backfill the offshore HDD work areas. This ensures that there are not two sedimentation events occurring at each pit location. For the Brayton Point ECC, there are three offshore HDD areas: the Sakonnet River, Mount Hope Bay, and Brayton Point. Within each of the three offshore HDD areas, there are four offshore HDD exit pits each with a dredged volume of 1,867 cubic yards (1,427 cubic meters) per pit for a total of 7,468 cubic yards (5,710 cubic meters) per HDD area and 22,404 cubic yards (17,124 cubic meters) for the Brayton Point ECC as a whole. Two methods of subsea excavation are under consideration: mechanical excavation and flow-based excavation. Mechanical excavation makes use of an open bucket attached to an excavator or a clamshell bucket hanging from a crane to displace material while flow-based excavation uses air and/or water flow (or suction). Water injection dredging, a type of flow-based excavation, is the proposed methodology for excavation at HDD exit pits; however, suction dredge equipment is also being considered. A suction dredger uses a vacuum to excavate a sediment slurry from the seabed and the fluidized sediment is released through a discharge pipe to a spoil area on the seafloor nearby. Contractor estimates indicate that the dredger can operate at a production rate of 180 cubic meters per hour (6,356 cubic feet per hour) with a 50 percent efficiency (i.e., 50 percent water plus 50 percent sediments). Based on the SouthCoast Wind hydrodynamic modeling report (Appendix F3, SouthCoast Wind 2023), 100 percent of the fluidized sediment will be lost to the water column as it is released from the discharge pipe (i.e., sediment will be side-cast adjacent to the excavation site).

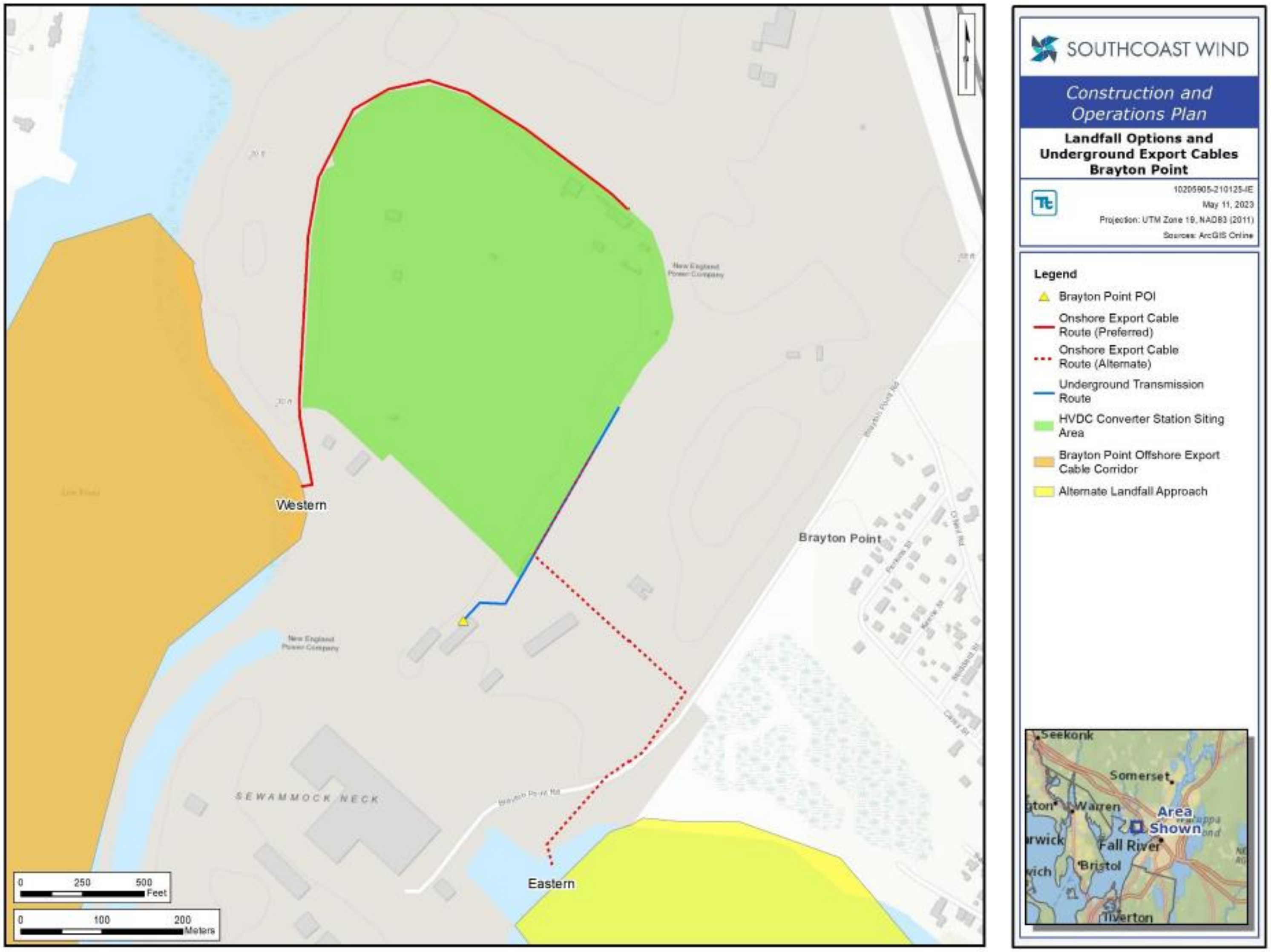
The offshore exit location would require some seafloor preparation in order to collect any drilling fluids that localize during HDD completion. SouthCoast Wind anticipates using unconfined dredging, which involves designing a pit to accumulate the drilling fluid offshore. This is a reliable method to contain the higher density drilling fluid. Seabed preparation at the HDD exit pit location may also include the installation of a temporary structure such as a cofferdam or gravity cell to facilitate cable pull-in depending on the type of subsurface material encountered. If cofferdams are required, the area of disturbance for four HDDs would be 0.40 acre (0.16 hectare) at the Falmouth exit pit and 1.20 acres (0.48 hectare) at the Brayton Point exit pit (Assumes a 65.6 foot [20 meter] width by 65.6 foot [20 meter] length exit pit or cofferdam will be constructed at each HDD exit offshore) (COP Volume 1, Tables 3-34 and 3-35; SouthCoast Wind 2023). Eelgrass beds will be avoided by HDD, and while HDD exit pit suction dredging is anticipated to disturb the seabed, it is planned to be conducted outside of eelgrass beds and only disturb 0.10 acre (0.04 hectare) of benthic area per HDD exit pit at the Falmouth sea-to-shore transition and 0.30 acre (0.12 hectare) per HDD exit pit at the Brayton Point and Aquidneck Island sea-to-shore transition locations (COP Volume 1, Tables 3-34 and 3-35; SouthCoast Wind 2023). This temporary sediment suspension is not expected to negatively impact adjacent eelgrass beds.

Within Rhode Island state waters along the Brayton Point ECC, in accordance with SouthCoast Wind’s State of Rhode Island Department of Environmental Management (RIDEM) 401 Water Quality Certification, SouthCoast Wind will provide survey data to RIDEM, at least 90 days prior to the start of construction, to demonstrate that construction activities will maintain a 400-foot separation distance from submerged aquatic vegetation (SAV). In the year prior to construction in Rhode Island state waters, surveying will occur during the peak SAV growing season (between July 1 and September 15). The survey data will include the date of the SAV survey and indicate if the cable burial location or HDD pit locations at the Aquidneck Island landfalls must be revised to maintain the 400-foot separation.



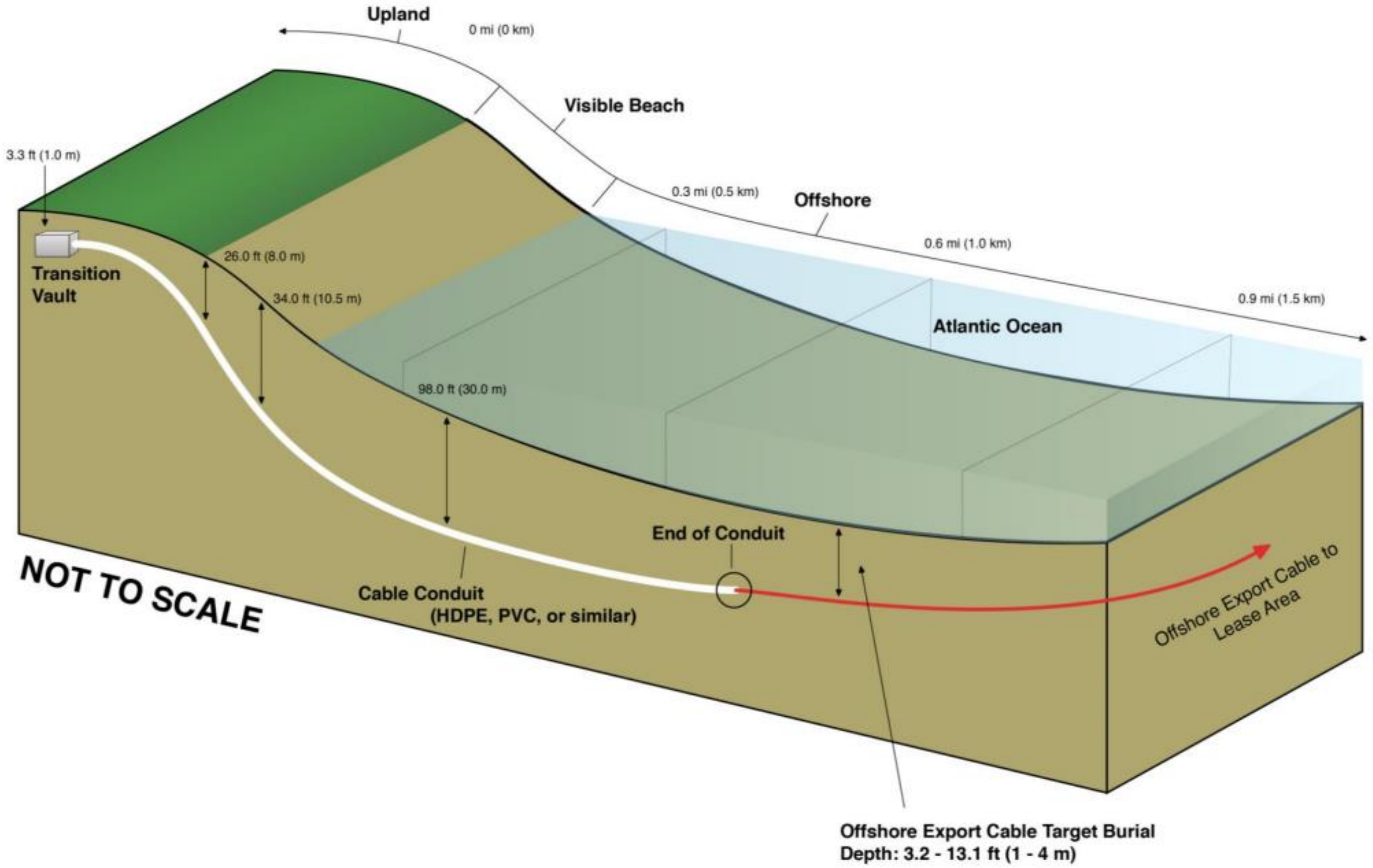
Source: COP Volume 1, Figure 3-32; SouthCoast Wind 2023

Figure 2-14. Falmouth ECC landfall and interconnection cable route



Source: COP Volume 1, Figure 3-33; SouthCoast Wind 2023

Figure 2-15. Brayton Point ECC landfall and onshore export and interconnection cable routes



Source: COP Volume 1, Figure 3-34; SouthCoast Wind 2023

Figure 2-16. Indicative sea-to-shore transition at horizontal directional drilling sites

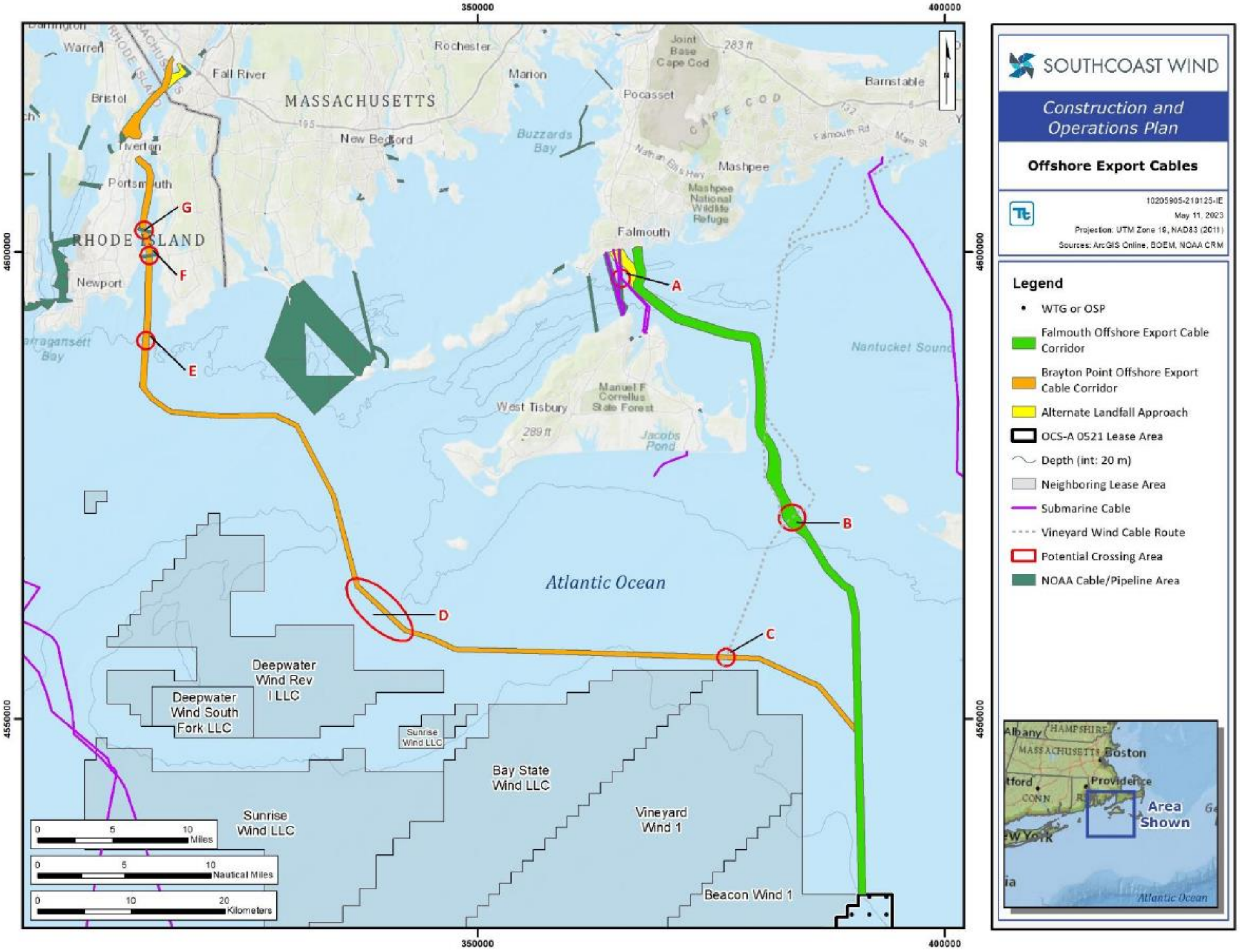
2.2.2.4 Cable Protection

Based on preliminary understanding of site conditions from desktop studies and site surveys, BOEM estimates that burial of cables to the target depth of 6 feet (1.8 meters) would not be possible and additional cable protection would be required in as much as 10 percent of the area along the interarray cables (49.7 miles [80 kilometers]), 10 percent of the Falmouth ECC (8.7 miles [14.0 kilometers]), and 15 percent of the Brayton Point ECC (18.6 miles [29.9 kilometers]). At any existing cable crossing or in areas where burial of the cable to the target depth is not feasible or sufficient burial depth is not achieved, cable protection will be installed as a secondary measure to protect the cables. The locations requiring cable protection, the type of protection selected, and the amount placed around each submarine export and interarray cable will be based on a variety of factors, including water flow and substrate type (hydrodynamic scour modeling) and potential conflicting uses (i.e., commercial fishing). Descriptions of the proposed cable protection types are as follows:

- Concrete mattress: concrete blocks, or mats, connected via rope or cable;
- Fronded mattress: mat made of polypropylene or similar fronds;
- Rock placement: the installation of crushed boulders over a cable;
- Rock berm: the creation of a sloped rock berm over the cable; and
- Half shells: typically used to protect cable ends at pull-in areas and where trenching is not possible.

Mattresses and rock placement have similar general-purpose cable protection applications and may be used where cable burial is not possible due to the presence of existing cables or pipelines (cable crossing locations) or in areas where adequate cable burial cannot be achieved. Mattress options, including concrete mattresses and fronded mattresses, are designed to promote sedimentation and mitigate scour, and can be prefabricated to suit the specific needs of a cable crossing location. Concrete mattresses can be designed to maintain a low profile, minimizing prominence above the existing seabed, while fronded mattresses may be employed in areas where seabed stabilization and scour prevention are identified as key design drivers. Fronded mattresses are designed to slow down current and allow sediment to deposit on the mattress, promoting the formation of protective, localized sand berms. Rock placement may be used to match existing seabed conditions in rocky areas as the type and size of rock material can be specified. Half shells which overlap and interlock to form close-fitting protection around cables are likely to be applied where a cable transitions from burial under the seabed to entry into a structure (e.g. at the approach to an OSP or WTG foundation). The seabed disturbance area from the use of cable protection is estimated to be 56 acres (23 hectares) per cable bundle in the Brayton Point ECC, 27 acres (11 hectares) per cable in the Falmouth ECC (Table 2-6), and 122 acres (50 hectares) for the entire interarray cable network (Table 2-7). SouthCoast Wind's preferred scour protection is rock berm. To create a rock berm, the rock placement will be installed with a flexible fall pipe which allows precise rock placement around structures. The rock size is produced according to international standards for amourstone (e.g., Standard EN 13383-1,2). It is anticipated that a 19.7-foot (6-meter) wide rock berm will be constructed along the sections of the interarray and export cables needing cable protection including rock berms and/or a number of 19.7-foot (6-meter) by 9.8-foot (3-meter) by 1.0-foot (0.3-meter) concrete mattresses for cable separation and protection at cable crossing locations (SouthCoast Wind 2023). Concrete mattresses will be orientated along the cable route, perpendicular to the crossed item, and the installation methodology will target zero overlap and zero gap between individual mattresses within a horizontal tolerance of +/- 0.33 feet (0.1 meter). It is anticipated that up to nine concrete mattresses will be required at each cable crossing location. Further details on the design of the scour protection will be completed after selection of the installation contractor.

Any required crossings of other Project cables or existing third-party cables will use mutually agreeable crossing designs consistent with typical industry practices, which typically employ concrete mattresses. SouthCoast Wind's preference is to make use of pre-lay concrete mattresses at cable crossing locations though other crossing methods such as rock placements or rock berms may also be assessed for use. Up to 10 cable crossings are estimated for the interarray cables, up to 9 crossings for the Falmouth ECC, and up to 16 crossings for the Brayton Point ECC. Each project cable will need to individually cross the existing utility in a crossing location. The footprint of secondary cable protection associated with each crossing will be approximately 20 feet (6 meters) by 656 feet (200 meters). Potential cable and pipeline crossing locations are shown in Figure 2-17 and in the Mayflower Wind – Benthic Habitat Pop-up Mapper (INSPIRE 2022). Between Martha's Vineyard and Falmouth in the Falmouth ECC, cable crossing area A has two existing cables and habitat types comprised of gravel pavement, sand, and SAV. Both south of Muskeget Channel, cable crossing area B in the Falmouth ECC and cable crossing area C in the Brayton Point ECC are predominantly soft bottom habitats made up of coarse sediment and sand. Up to seven planned cables are expected to be present at each of these cable crossing locations. Cable crossing area D south of Nomans Land is expected to have up to four planned cables. Complex habitat types, glacial moraine A and boulder fields, are found within this potential cable crossing area together with sand. Cable crossing area D encompasses a relatively large area to conservatively account for the potential export cable routes of other offshore wind projects (e.g., Revolution Wind, New England Wind) should they be installed within this area. South of Sakonnet River is cable crossing area E which may have up to two planned cables. The southern half of this potential cable crossing area is predominantly soft bottom habitat made up of sand while the northern half contains a mix of glacial moraine A, boulder fields, mixed-size gravel in muddy sand, and sand. Cable crossing areas F and G within the Sakonnet River are charted pipeline areas containing one and two existing pipelines, respectively. Mud to muddy sand is the only habitat type found in cable crossing area F while mud to muddy sand and *Crepidula* shell substrate are found in cable crossing area G.



Source: COP Volume 1, Figure 3-27; SouthCoast Wind 2023

Figure 2-17. Potential cable and pipeline crossing locations in the Falmouth and Brayton Point ECCs

2.2.3 Port Facilities

Construction and installation activities for the Proposed Action may be based out of more than one port. Currently, multiple ports are under consideration for specific vessel types. Final selection of ports to be utilized for the Project may result in a single selected port for a specific vessel type or a combination of multiple selected ports for a specific vessel type. The ports under consideration are based on feedback provided to SouthCoast Wind by U.S. and international supply chain vendors, transport and installation vendors, and the availability and/or port capability to accommodate the vessel to build the windfarm in accordance with applicable U.S. laws. Ports anticipated to be used for Project construction and decommissioning activities include New Bedford, Fall River, and Salem, Massachusetts; Davisville and Providence, Rhode Island; New London, Connecticut; Sparrows Point, Maryland; Charleston, South Carolina; Corpus Christi, Texas; Altamira, Mexico; and ports in Canada (Sheet Harbor, Sydney, Argentia). Material and equipment may be delivered from vessels originating from Europe, Asia, and via the Panama Canal. O&M vessel trips would originate primarily from the ports of New Bedford and Fall River, Massachusetts and New London, Connecticut, with occasional trips originating from ports in Davisville and Providence, Rhode Island; Salem, Massachusetts; Sparrows Point, Maryland; Charleston, South Carolina; and foreign ports, if needed. There are no port modifications proposed for this Project.

2.2.4 Other Activities, As Needed

The WTGs and OSPs would be lit and marked in accordance with Federal Aviation Administration (FAA) and U.S. Coast Guard (USCG) lighting standards and consistent with BOEM best practices. SouthCoast Wind would implement an Aircraft Detection Lighting System (ADLS) to automatically activate lights when aircrafts approach. Lighting would be placed on all structures and would be visible throughout a 360-degree arc from the surface of the water. Quick flashing yellow lighting energized at a 5-nautical-mile (9.3-kilometer) range will be included for corner towers and significant peripheral structures. Tower marking would include unique rows and columns of letters and numbers to maximize charting effectiveness. Reflective paint and lettering materials would be used to provide visibility at night and all marking will be visible above and below any servicing platforms and throughout a 360-degree arc from the surface of the water.

2.3 Operations and Maintenance

The operational parameters of the Wind Farm Area, and the ECCs that are pertinent to this assessment are described in this section and summarized in Table 2-1. Additional information about project operation and maintenance requirements is provided in the COP (SouthCoast Wind 2023). The permanent impacts for the duration of the proposed project on the environment resulting from the presence of structures, EMF and heat effects from the transmission cables, and the ongoing O&M of the Project are quantified in Section 5.

SouthCoast Wind will conduct internal and external inspections every two years of substructures using ROVs or autonomous underwater vehicles (AUVs) to detect or assess corrosion, damage to the substructure, cracks at welds, excessive marine growth, and seabed scour. Divers may be used for repairs. The WTGs will be remotely monitored from an onshore facility to minimize the need for unscheduled maintenance. Responding to an unplanned outage or equipment failure may require the use of a jack-up vessel or transportation vessel to carry, install, or repair the failure. The WTGs will be regularly inspected and maintained by service technicians delivered by service operations vessels and crew transfer vessels. The primary scheduled maintenance activities and the potential frequency of visits are presented in Table 2-8.

Table 2-8. SouthCoast Wind indicative O&M WTG tasks and schedule

O&M Task	Inspection Cycle
Planned annual maintenance	Annually
Routine maintenance and regulatory inspection including lifesaving equipment	Annually
Blade inspections (may be inspected by drone)	Every 1–3 years
Hydraulic oil change per WTG on average	Every 10 years
Gear oil change per WTG (not applicable to direct drive)	Every 6–8 years
Any routines in addition to the above	Every 5 and 10 years
Unplanned maintenance	As needed
Approximate visits for unscheduled maintenance	Annually

Source: COP Volume 1, Table 3-9; SouthCoast Wind 2023

SouthCoast Wind does not expect the substructure foundations to require maintenance over the lifetime of the project. Should unplanned maintenance of the WTGs or substructures be required, the associated vessel and activity requirements would be similar to those described for the installation of an individual WTG (i.e., vessel noise and anchoring impacts). The SouthCoast Wind O&M team will use remote monitoring systems to detect failures needing repair and will deploy maintenance activities as needed. Final O&M strategies for inspection and maintenance will be based on substructure selection.

SouthCoast Wind does not expect the interarray cables or ECCs to require planned maintenance except for manufacturer-recommended cable testing. Periodic visual inspections of the cables will be planned based on survey data and manufacturer recommendations based on the as-built drawings. Planned outages are not expected for the periodic inspections. Cable burial depth can be assessed using magnetic or acoustic remote-sensing techniques. These may be used following soil fluidization techniques such as vertical injector jetting and jet-trenching, or where it is not practical to directly verify the depth of the cable as it is buried. Burial inspection visual surveys will occur periodically and will be determined after final design and route are selected.

2.4 Project Decommissioning

In accordance with BOEM requirements (30 CFR 585.902 and 30 CFR 585.905-585.912), SouthCoast Wind will be required to remove and/or decommission all Project infrastructure and clear the seabed of all obstructions when these facilities reach the end of their 35-year designed service life. The decommissioning process for the WTGs, foundations, and OSPs is anticipated to be the reverse of installation, with Project components transported to an appropriate disposal and/or recycling facility.

All foundations/Project components will be dismantled, transported to shore, and safely recycled or discarded. Submarine export and interarray cables will be retired in place or removed in accordance with a decommissioning plan. SouthCoast Wind would need to obtain separate and subsequent approval from BOEM to retire any portion of the Project in place. Project components will be decommissioned using a similar suite of vessels, as described in Section 2.2. A separate EFH assessment will be completed for the decommissioning phase.

3. Existing Environment

To characterize habitats in the Project area, SouthCoast Wind conducted site-specific geophysical, geotechnical, and benthic surveys across the Lease Area and the submarine export cable corridors (study area) from 2019 to 2022 using multibeam echo sounder (MBES), side scan sonar (SSS), digital imagery, and sediment grab samples. Site-specific and Project-specific geophysical survey data (multibeam echo sounder and side-scan sonar) were used to support the characterization of seabed conditions. Sediment grab samples were analyzed for grain size distribution, total organic carbon, and benthic infauna and were used to ground truth the sediment types observed in digital imagery. Digital imagery was reviewed to aid in identification of key habitat types and benthic macroinvertebrates.

Additional surveys were conducted along the proposed cable corridors from the spring 2020 to spring 2022 using sediment profile imagery (SPI) and plan-view (PV) imaging supplemented by grab samples. GrabCam imaging during grab sample stations, as well as transects of SPI/PV and GrabCam imaging added to 1,319 benthic sampling stations (Table 3-1 and Table 3-2).

Table 3-1. Number of benthic stations sampled across the study area and control areas

Portion of Study Area and Control Areas	Number of Stations						
	Spring 2020	Summer 2020	Fall 2020	Spring 2021	Summer 2021	Spring 2022	Total
Lease Area	60	46	35	43	-	-	184
Brayton Point ECC – Federal Waters	12	9	5	4	92	116	238
Brayton Point ECC – RI State Waters	-	-	-	-	68	112	180
Brayton Point ECC – MA State Waters	-	-	-	-	12	15	27
Falmouth ECC – Federal Waters	11	9	5	17	2	-	44
Falmouth ECC – MA State Waters	13	29	74	121	-	-	237
Control Areas	15	15	15	10	10	10	75
Total	111	108	134	195	184	253	985

Source: Mayflower Wind – Benthic Habitat Mapping Methodology Memorandum (INSPIRE 2022).

Table 3-2. Number of benthic stations by sampling technique across surveys [a]

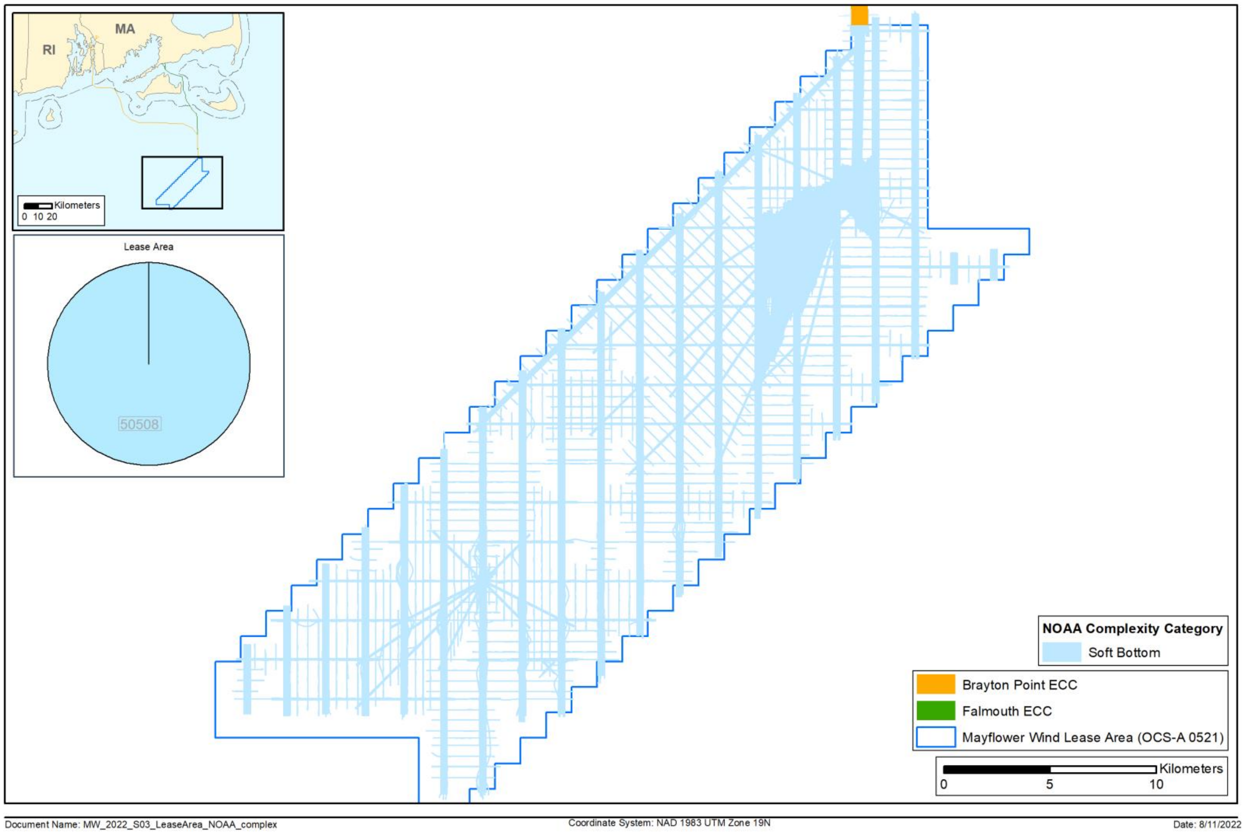
Portion of Study Area and Control Areas	Number of Stations						
	Spring 2020	Summer 2020	Fall 2020	Spring 2021	Summer 2021	Spring 2022	Total
SPI/PV	68	68	56	31	74	36	333
Grab	51	34	36	44	34	59	258
GrabCam	51	34	36	44	35	63	263
Transect SPI/PV	-	16	52	125	90	159	442
Transect GrabCam	-	-	-	3	8	12	23
Total	170	152	180	247	241	329	1,319

[a] Multiple sampling techniques were used across all stations; this table records the total number of benthic replicate “samples” (grabs or imagery) that were collected across all surveys.
Source: Mayflower Wind – Benthic Habitat Mapping Methodology Memorandum (INSPIRE 2022).

3.1 Habitat Types by Project Component

3.1.1 Lease Area

Habitat in the Lease Area is generally homogenous, with the dominant Coastal and Marine Ecological Classification Standard (CMECS) subclass determined to be Fine Unconsolidated Substrate, which includes primarily sand or finer grain sizes (< 0.08 inch [2 millimeters]) and less than 5 percent gravel (≥ 0.08 inch [2 millimeters]). Only one sample was classified as Coarse Unconsolidated Substrate, where 5 percent or more of the sediments in the sample were gravel-sized. The surficial seabed sediment is comprised of sand and muddy sand, except for a few distinct areas of more coarse sediment found in well-defined rippled scoured depressions. No boulder fields nor individual boulders have been mapped within the Lease Area based on the 2020 and 2021 HRG data. Sediments in the Lease Area have low rugosity and limited habitat variability, consisting predominantly of flat, gentle slopes with some sand ridges and ripples (SouthCoast Wind 2023, Appendix E; Guida et al. 2017). In the Lease Area, depth gradually increases from north to south at depths of 122 to 208 feet (37 to 64 meters) below mean lower low water. Figure 3-1 shows the benthic habitat types in the Lease Area categorized by habitat complexity with 50,508 acres mapped as soft-bottom habitat (SouthCoast Wind 2023, Appendix M.3).



Source: COP Appendix M.3, Figure 3-35; SouthCoast Wind 2023

Figure 3-1. Benthic habitat types with modifiers mapped in the Lease Area by NOAA complexity category and a pie chart showing habitat type composition in acres

Infaunal communities of the Lease Area consisted mainly of soft-sediment burrowing infauna, with the eastern portion consisting of clam beds and tube-building *Ampelisca* beds (SouthCoast Wind 2023). The western portion of the Lease Area also contained *Ampelisca* beds, as well as polychaete worm beds, which were classified as small, surface-burrowing fauna. Benthic epifauna were sampled by beam trawl across the RI/MA WEA with sand shrimp and sand dollars comprising 88 percent of individuals collected (Guida et al. 2017). Mobile crustaceans and mollusks were dominant in 2020 benthic samples and are commonly associated with the soft sediments of the Lease Area (SouthCoast Wind 2023). Sessile and slow-moving epifauna observed along transects in the Lease Area are characteristic of this type of habitat (e.g., sand dollars, mobile crustaceans, burrowing anemones, tube-building fauna). No SAV or macroalgae was observed in any benthic surveys within the Lease Area (SouthCoast Wind 2023, Appendix K).

There are no hard corals within the vicinity of the Lease Area according to the NOAA Deep-Sea Coral Data Portal (NOAA 2021), and only sea pens were documented in the 1960s south of the Lease Area in deeper waters (SouthCoast Wind 2023). No corals were observed within the Lease Area during 2020 benthic habitat mapping. A total of 50,508 acres (20,440 hectares) or 40 percent of the benthic habitat of the Lease Area was mapped, and 98.5 percent of that area was classified as sand sediments or finer (SouthCoast Wind 2023, Appendix M.3). Fine sediments are considered unsuitable habitat for hard corals. Artificial hardbottom in the form of known shipwrecks are not present within the Lease Area, although there is one shipwreck approximately 500 feet (152 meters) south of the southernmost corner of the Lease Area.

All waters from the surface to the ocean floor are considered to be pelagic. The entire Lease Area is in the photic zone (i.e., top 600 feet [200 meters]), which is the top layer of the pelagic environment where sunlight supports photosynthetic phytoplankton. Water depth influences surface and bottom temperatures, light penetration, sediment movement, and other physical and chemical habitat parameters that define EFH. In the Lease Area, water depths are relatively uniform, ranging from 122 to 208 feet (37 to 64 meters). Oceanic currents, temperature, conductivity, pH, dissolved oxygen, and other features of the water column influence the occurrence and abundance of marine fishes in the Lease Area. The movement of water through the Lease Area is determined by weather-driven surface currents and tidal mixing (Kaplan 2011). Currents generally flow westward across the shelf south of Nantucket and Martha’s Vineyard, although a tidally driven anticyclonic flow encircles Nantucket Shoals. Tidal mixing maintains cool water temperatures on the shoals throughout the year, whereas the rest of the region becomes stratified during the summer months (Wilkin 2006). This creates a persistent frontal zone in the northeastern edge of the Lease Area bordering Nantucket Shoals, which results in a high productivity and the use of the area by marine life foraging on prey aggregations (Scales et al. 2014).

The pelagic environment is particularly important for planktonic eggs and larvae, planktivorous or filter-feeding species/life stages, and migratory pelagic species (NMFS 2017; NEFMC 2017). The water column serves dual function as EFH: it supports the phytoplankton that sustain marine food webs, and it provides a dispersal mechanism for planktonic larvae of many managed species. Phytoplankton (e.g., diatoms, dinoflagellates) thrive where nutrients and sunlight are abundant, such as along Nantucket Shoals where abundant phytoplankton are sustained by nutrients carried to the well-lit surface waters by upwelling. Phytoplankton are consumed by zooplankton (i.e., tiny animals such as copepods and larval forms of crustaceans, bivalves, and other invertebrates) and ichthyoplankton (fish larvae). The most numerically abundant component of the pelagic fish community in the open waters of the Lease Area is the ichthyoplankton assemblage. Buoyant eggs and larvae of most marine fishes in Southern New England can remain in the plankton for weeks to months (Walsh et al. 2015). The assemblage of species represented in the ichthyoplankton varies seasonally and is strongly influenced by water temperature; patterns of ichthyoplankton assemblages have changed in recent decades, likely in response to climate change (SouthCoast Wind 2023, Appendix U; Gaichas et al. 2017; Walsh et al. 2015).

3.1.2 Offshore/Onshore Export Cable

3.1.2.1 Export Cable Route

The submarine export cable route for the Falmouth ECC extends from the northern boundary of the Lease Area through Muskeget Channel and ends at one of the two proposed landfall locations in Falmouth, Massachusetts (Worcester Avenue with alternate sites at Shore Street and Central Park). The Brayton Point ECC extends from the northern boundary of the Lease Area through the Rhode Island Sound, up the Sakonnet River, over Aquidneck Island, and into Mount Hope Bay before making landfall at one of the two proposed locations in Somerset, Massachusetts. All of the waters of the export cable routes are in the photic zone (i.e., top 600 feet [200 meters]), which is the top layer of the pelagic environment where sunlight supports photosynthetic phytoplankton. Section 3.1.1 provides a detailed description of the pelagic environment and its importance.

Similar to the Lease Area, the southern portion of the Falmouth ECC (between the Lease Area and the Muskeget Channel) consisted mainly of fine substrates / soft-bottom habitat. Samples in this southern section were classified as mainly Fine Unconsolidated Substrate, with three samples classified as Coarse Unconsolidated Substrate (≥ 5 percent gravel) or complex habitat (SouthCoast Wind 2023). The northern Falmouth ECC sediment samples were more variable, with a transition to coarser sediments as the corridor proceeds north towards landfall. Gravelly substrates dominated south of the Nantucket Sound Main Channel, while all samples within the Nantucket Sound Main Channel were classified as sand (SouthCoast Wind 2023). Complex habitat was observed in the remaining samples north of the Nantucket Main Channel, with two samples classified as Biogenic Shell Substrate (*Crepidula* reef). Some gravel pavement was noted in the SPI/PV images, and gravel/gravelly substrates were observed throughout the northern section of the Falmouth ECC.

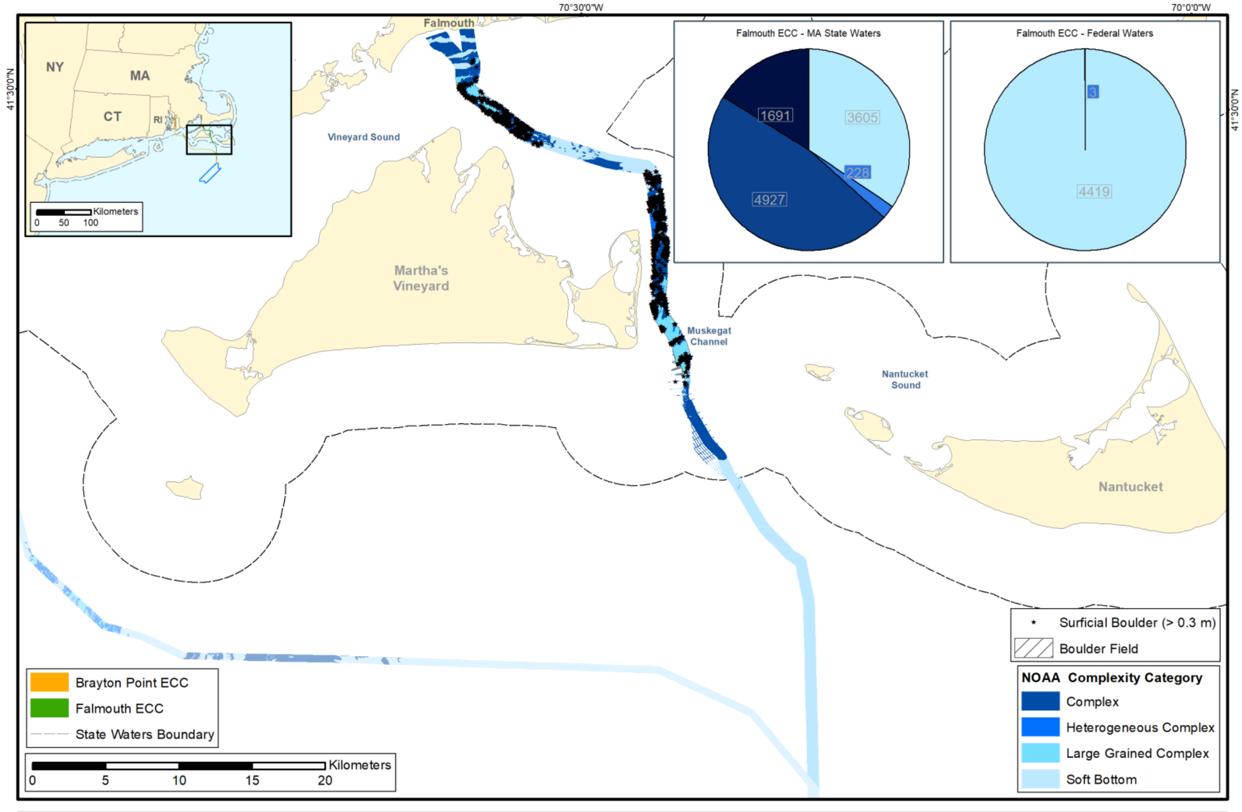
The benthic habitat in roughly the middle of the Falmouth ECC between Martha’s Vineyard and Nantucket includes Muskeget Channel, which contained mostly complex habitats consisting of coarse sediments (41%) and Glacial Moraine A (38%; INSPIRE 2022). Without a clear delineation of the Muskeget Channel width, some benthic habitat mapping polygons included in this analysis extended farther to the north and south of where the Falmouth ECC crosses the Muskeget Channel; thus, the footprint for effects within Muskeget Channel may be overestimated. Benthic data that represents Muskeget Channel included a total of 8.2 miles (13.2 kilometers) of the Falmouth ECC from where it crosses into Massachusetts state waters west of Nantucket, crossing the Muskeget Channel, and ending approximately 1.9 miles (3.1 kilometers) north of the southeastern point of Martha's Vineyard (Table 3-3).

Table 3-3. Area (acres) of different habitat components within the Muskeget Channel area of the Falmouth ECC

Habitat Types	Area (Acres)	Percentage of Area
Coarse Sediment	1,091	41.1%
Coarse Sediment - with Boulder Field(s)	22	0.8%
Glacial Moraine A	1,008	38.0%
Sand	516	19.4%
Sand - Mobile with Boulder Field(s)	19	0.7%
Sand - SAV	0.06	0.0%
Total	**2,657**	**100%**

Source: Mayflower Wind – Benthic Habitat Pop-up Mapper (INSPIRE 2022).

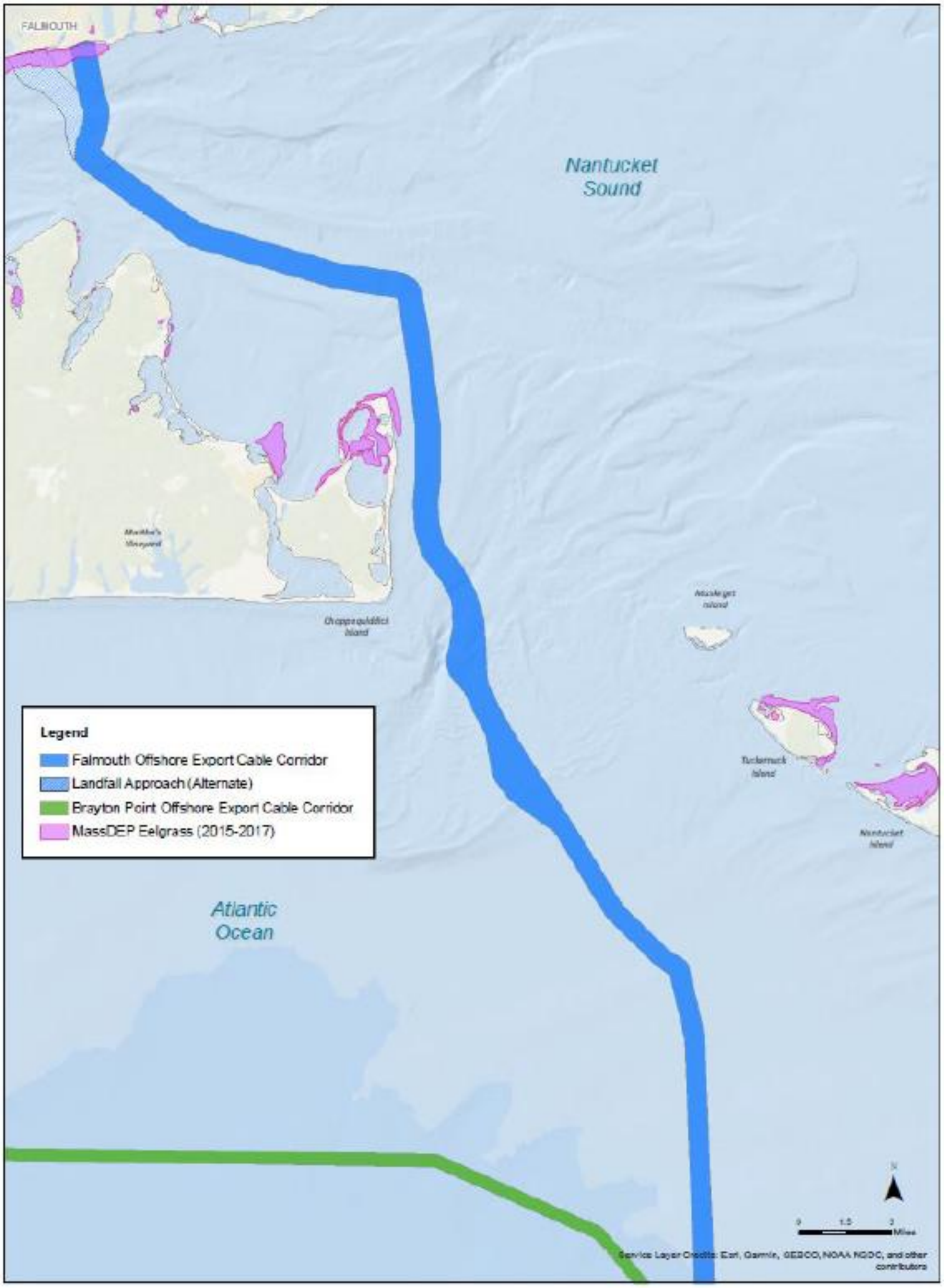
Figure 3-2 shows the mapped benthic habitat types in the Falmouth ECC categorized by habitat complexity. In federal waters, 4,419 acres of the Falmouth ECC have been classified as soft-bottom habitat with 3 acres of heterogenous complex habitat. In Massachusetts state waters, the Falmouth ECC is made up of 3,605 acres soft-bottom habitat, 228 acres heterogenous complex habitat, 4,927 acres complex habitat, and 1,691 acres large-grained complex habitat (SouthCoast Wind 2023, Appendix M.3). Figure 3-3 shows SAV that occurs near the ECC around Martha's Vineyard.



Document Name: MW_2022_S04_ECC_Falmouth_NOAA_complex
Coordinate System: NAD 1983 UTM Zone 19N
Date: 8/11/2022

Source: COP Appendix M.3, Figure 3-38; SouthCoast Wind 2023

Figure 3-2. Benthic habitat types with modifiers mapped in the Falmouth ECC (federal and state waters) by NOAA complexity category and pie charts showing habitat type composition in acres



Source: COP Appendix K, Figure 4-1; SouthCoast Wind 2023

Figure 3-3. MassDEP Mapped Eelgrass in the Falmouth ECC

Sediments sampled in the Brayton Point ECC followed similar patterns as the Falmouth ECC, with finer sediments in the southern section near the Lease Area becoming coarser as sampling proceeded north. Gravelly sand to sandy gravels, including boulders, were present in Rhode Island Sound where an area of glacial till southwest of Martha's Vineyard provides heterogenous substrate and hardbottom substrate / complex habitat. Sediments in the Sakonnet River were finer sands to silts with areas of boulders, including anthropogenic rock dumps that provide hardbottom habitat, and isolated mounds associated with *Crepidula* shell reefs (SouthCoast Wind 2023).

The Mount Hope Bay portion of the Brayton Point ECC comprises 96% sediments containing sands or finer grain sizes, as mapped along the corridor at a width of 0.4-miles (0.7-kilometers; INSPIRE 2022). Shell/*Crepidula* substrate was also a co-occurring habitat in 26% of the ECC within Mount Hope Bay, and complex habitat consisted of Glacial Moraine A (1%) and Anthropogenic dredged material deposits (3%; Table 3-4). The Sakonnet River portion of the Brayton Point ECC comprises 93% sediments of sand or finer grain size (INSPIRE 2022). *Crepidula* shell substrate was a co-occurring habitat in 18% of the ECC within the estuarine segment and complex habitat consisting of Mixed-Size Gravel in Muddy Sand to Sand made up 7% (Table 3-5). There are also four acres of sensitive SAV habitat of Mud to Muddy Sand – with SAV approximately 656 feet (200 meters) from the landfall on Aquidneck Avenue.

Table 3-4. Area (acres) of different habitat components within the Mount Hope Bay portion of the Brayton Point ECC

Habitat Types	Area (Acres)	Percentage of Area
Anthropogenic (dredged material deposit)	75	3.0%
Anthropogenic (rock rubble)	0	0.0%
Bedrock	2	0.1%
Coarse Sediment - with Boulder Field(s)	0	0.0%
Glacial Moraine A	19	0.7%
Mud to Muddy Sand	1,700	67.6%
Mud to Muddy Sand - (Likely) Crepidula Substrate with Boulder Field(s)	56	2.2%
Mud to Muddy Sand - Crepidula Substrate with Boulder Field(s)	4	0.2%
Mud to Muddy Sand - Shell / Crepidula Substrate	609	24.2%
Mud to Muddy Sand - with Boulder Field(s)	7	0.3%
Sand	42	1.7%
Total	**2,516**	**100%**

Source: Mayflower Wind – Benthic Habitat Pop-up Mapper (INSPIRE 2022).

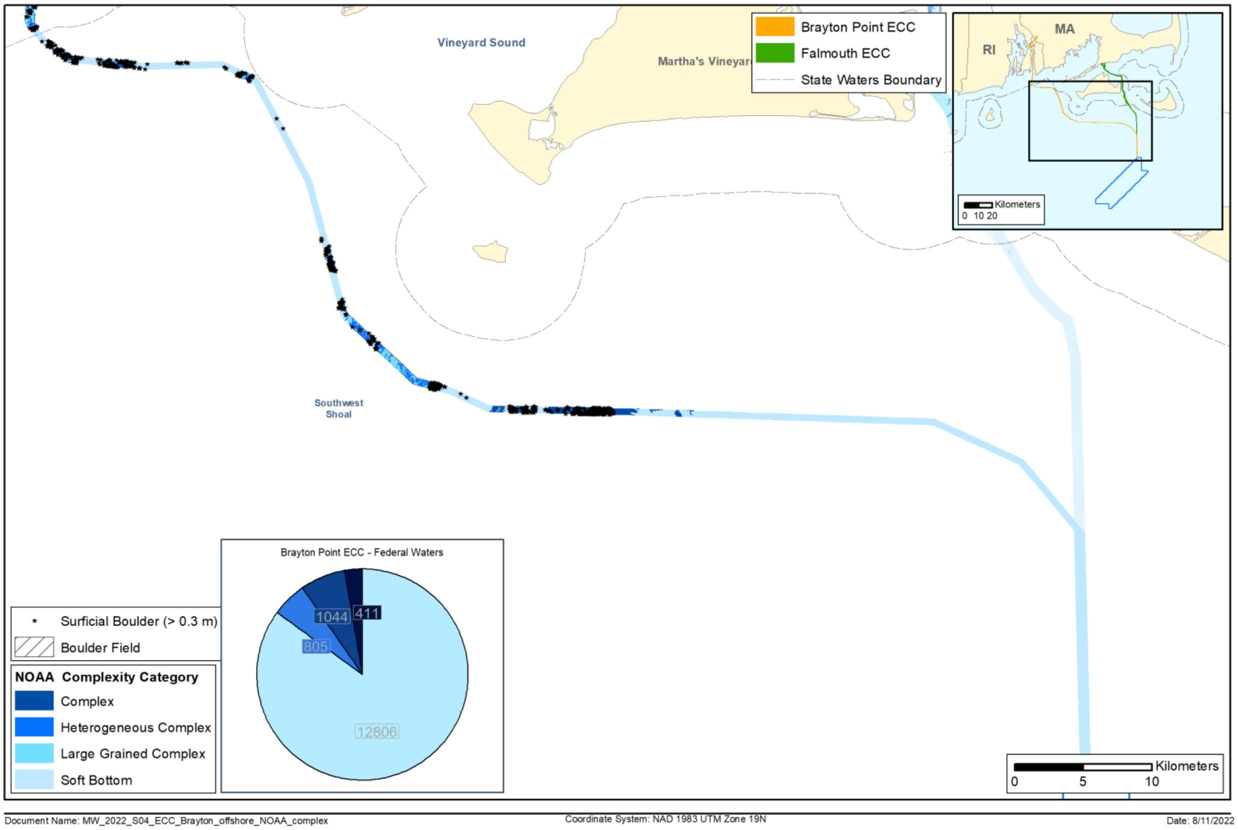
Table 3-5. Area (acres) of different habitat components within the Sakonnet River portion of the Brayton Point ECC

Habitat Types	Area (Acres)	Percentage of Area
Anthropogenic (Rock Rubble)	4	0.1%
Anthropogenic (Rock Rubble/Trawl Marks)	3	0.1%
Mixed-Size Gravel in Muddy Sand to Sand	233	7.0%
Mud to Muddy Sand	1,632	48.9%
Mud to Muddy Sand - (Likely) Crepidula Substrate	37	1.1%
Mud to Muddy Sand - Crepidula Substrate	606	18.1%
Mud to Muddy Sand - Mobile	29	0.9%
Mud to Muddy Sand - with SAV	4	0.1%

Habitat Types	Area (Acres)	Percentage of Area
Sand	791	23.7%
Sand - with Boulder Field(s)	1	0%
Total	**3,340**	**100%**

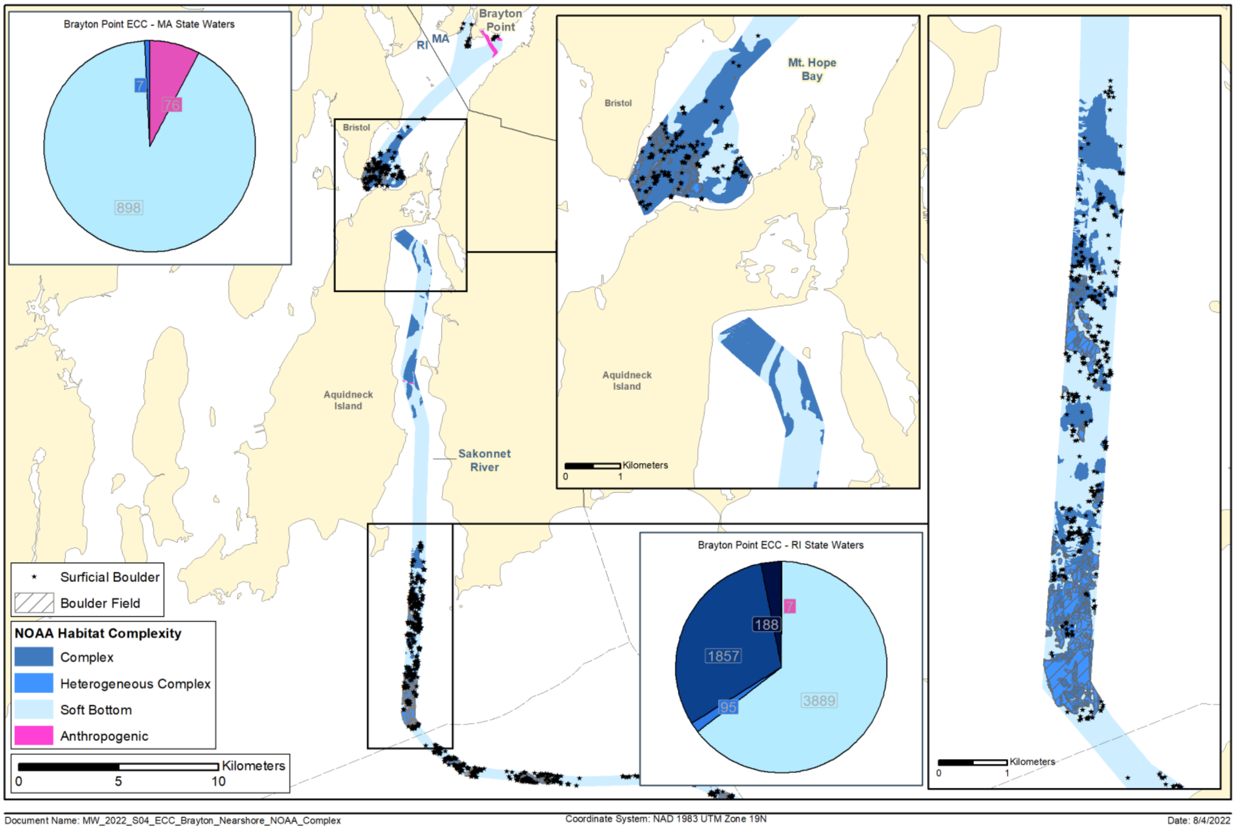
Source: Mayflower Wind – Benthic Habitat Pop-up Mapper (INSPIRE 2022).

Figure 3-4 and Figure 3-5 show the mapped benthic habitat types in the Brayton Point ECC categorized by habitat complexity. In federal waters, 12,806 acres of the Brayton Point ECC have been classified as soft-bottom habitat with 805 acres of heterogenous complex habitat, 1,044 acres complex habitat, and 411 acres of large grained complex habitat. In Rhode Island state waters, the Brayton Point ECC is made up of 3,889 acres soft-bottom habitat, 95 acres heterogenous complex habitat, 1,857 acres complex habitat, 188 acres large-grained complex habitat, and 7 acres anthropogenic material deposits. In Massachusetts state waters, the Brayton Point ECC consists of 898 acres soft-bottom habitat, 7 acres heterogenous complex habitat, and 76 acres anthropogenic material deposits (SouthCoast Wind 2023, Appendix M.3).



Source: COP Appendix M.3, Figure 3-36; SouthCoast Wind 2023

Figure 3-4. Benthic habitat types with modifiers mapped in the Brayton ECC (federal waters) by NOAA complexity category and a pie chart showing habitat type composition in acres



Source: COP Appendix M.3, Figure 3-37; SouthCoast Wind 2023

Figure 3-5. Benthic habitat types with modifiers mapped in the Brayton ECC (state waters) by NOAA complexity category and pie charts showing habitat type composition in acres

Macroalgae were noted as present at seven benthic sampling stations along the central portion of the Falmouth ECC. Along the Brayton Point ECC, eelgrass was identified in Rhode Island state waters to the east and west of the ECC as it enters the Sakonnet River. However, both of these small beds are located more than 1 mile (1.6 kilometers) away from the ECC and are unlikely to be affected by Project activities.

Epifauna found in the southern portion of the Falmouth ECC and in the Lease Area were predominantly surface-dwelling organisms (e.g., sand dollars, crabs, gastropods). Soft sediment fauna was the dominant CMECS biotic component subclass observed in the southern portion of the Falmouth ECC and Lease Area, characterized by tube-building and surface burrowing fauna. The northern Falmouth ECC had a heterogenous array of species including soft-sediment bryozoans and mobile burrowing crustaceans (SouthCoast Wind 2023). Soft sediment fauna was the dominant CMECS biotic component subclass observed along the entire Brayton Point ECC, which was characterized by clam beds, larger tube-building, mobile crustaceans, and surface-burrowing fauna, with much more diversity in the southern portion of the Brayton Point ECC.

The sensitive northern star coral was observed within the Brayton Point ECC in federal waters, associated with Glacial Moraine A and Sand, with Boulder Field habitats at the Southwest Shoal. In the Rhode Island Sound, northern star coral was found corresponding with Glacial Moraine A and Mixed-Size Gravel in Muddy Sand to Sand habitats. Northern star coral was observed within the Falmouth ECC only in Massachusetts state waters, corresponding with Glacial Moraine A and Gravel Pavement habitats north of Martha’s Vineyard and the nearshore portion of the Falmouth ECC landing area (SouthCoast Wind 2023, Appendix M.3).

Another taxon of concern is the non-native tunicate *Didemnum* spp., which was only observed at the Falmouth ECC in Massachusetts state waters at 35 percent of benthic stations. *Didemnum* spp. was also observed within 57 percent of gravel pavement habitats, with the most widespread and prevalent occurrence in Gravel Pavement habitat north of Martha's Vineyard and near the Falmouth ECC landing area (SouthCoast Wind 2023, Appendix M.3). *Didemnum* spp. was also observed in Glacial Moraine A, Coarse Sediment – *Crepidula* Substrate, and Coarse Sediment habitat types in the Massachusetts state waters portion of the Falmouth ECC.

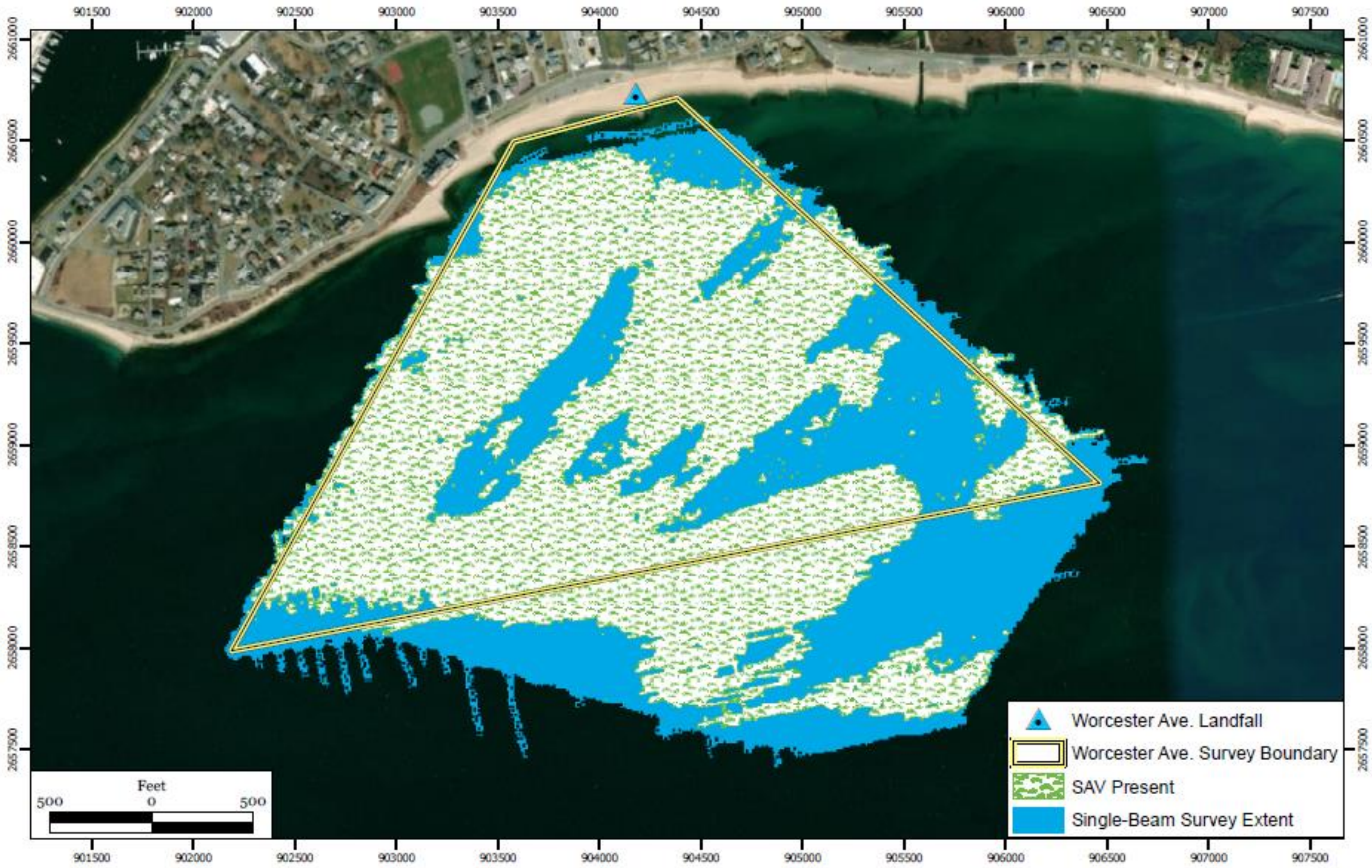
3.1.2.2 Landing Area

The proposed location of the Brayton Point export cable landfall is at the industrialized Brayton Point in Somerset, Massachusetts with intermediate landfall across Aquidneck Island in Portsmouth, Rhode Island. The Falmouth export cable landfall options are coastal beach habitats, but HDD is proposed for both ECCs which will avoid impacts on sensitive coastal terrestrial habitats (Figure 3-6 to Figure 3-8). Eelgrass surveys of the Falmouth ECC landing areas conducted in August 2020 consisted of a combination of single beam echo sounding, side scan sonar, and towed underwater video. At the Falmouth landing point, HDD will allow the export cable to go underneath and avoid SAV habitats of extensive eelgrass beds. The HDD punch-out location of the Falmouth ECC is planned to be approximately 328 feet (100 meters) south and offshore of the mapped SAV and macroalgae at the proposed Worcester Avenue landfall location, and approximately 525 feet (160 meters) south and offshore of the mapped SAV and macroalgae at the alternative Shore Street landfall location (Figure 3-8). Mobile sand with ripples was mapped as the benthic habitat for approximately 1,640 feet (500 meters) offshore of the furthest extent of eelgrass beds at the Worcester Avenue and Shore Street landfall locations.

Four HDD exit pits are anticipated in each landfall location with habitat disturbance occurring as a result of exit pit drilling, cofferdam installation, and support vessel activity (SouthCoast Wind 2023, Appendix M.3). For the Brayton Point ECC, the HDD activities south of Aquidneck Island (Boyds Lane and Park Avenue), are anticipated to occur over 0.46 acres of soft-bottom habitat. At landfall options North of Aquidneck Island, HDD activities are anticipated to occur over 0.31 and 0.16 acres of complex *Crepidula* substrate at the RIDEM/Aquidneck Land Trust and Mount Hope Bridge landfall options, while a mix of complex *Crepidula* substrate and soft-bottom habitat is expected in up to 0.33 acres at the Roger Williams University landfall option (SouthCoast Wind 2023, Appendix M.3). At the Brayton Point landfall site, HDD activities are expected to occur over 0.27 acres of dredged anthropogenic material deposit at the Taunton River landing option and over 0.24 acres of soft-bottom habitat at the Lee River landing option. For the Falmouth ECC, HDD activities are anticipated to occur in up to 0.4 acres of soft-bottom habitat at all landfall options (Central Park, Shore St., Worcester Ave.) (SouthCoast Wind 2023, Appendix M.3).

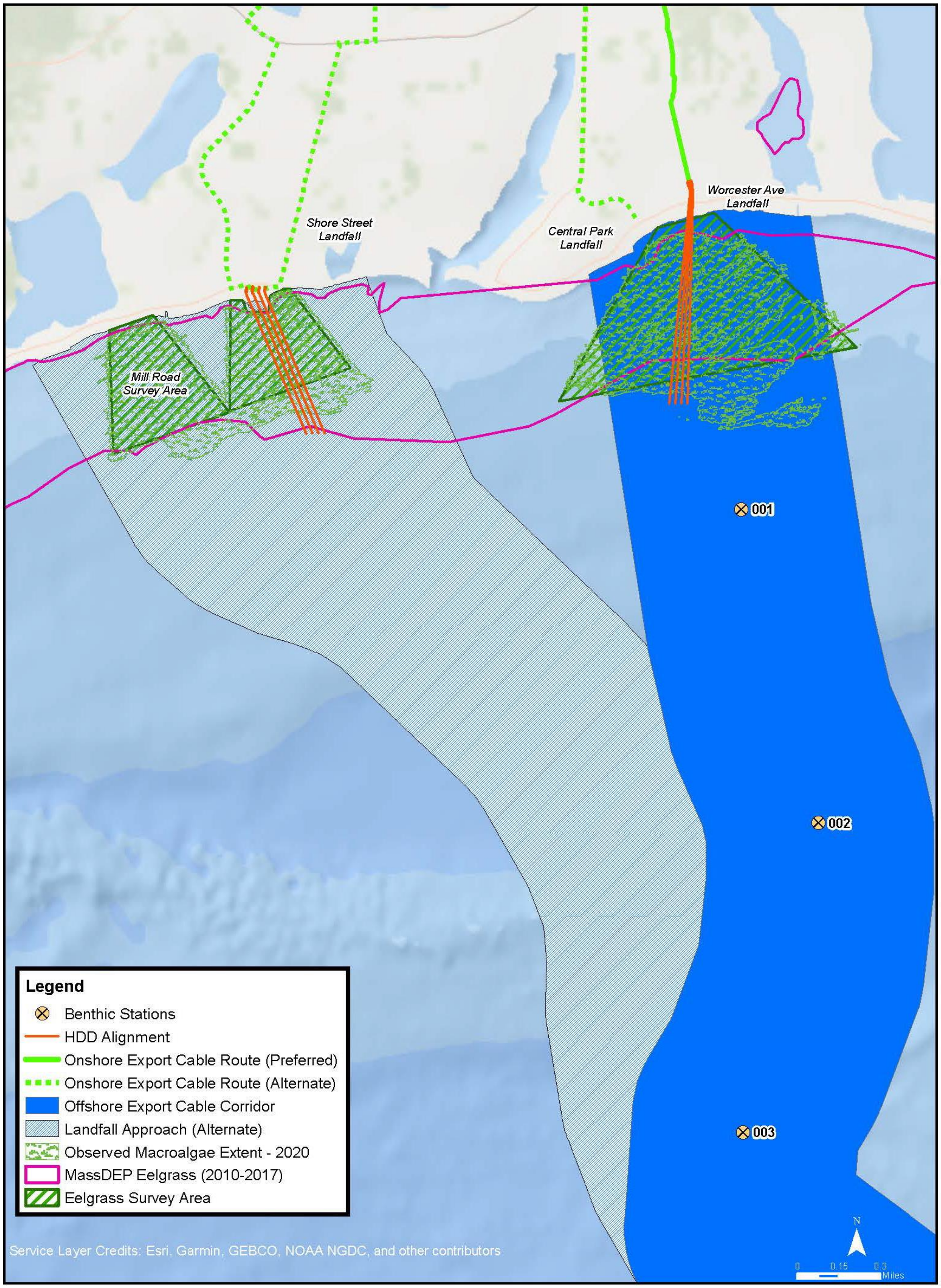
Source: COP Appendix K, Figure 6; SouthCoast Wind 2023

Figure 3-6. SAV distribution at Mill Road and Shore Street alternative landfall approaches



Source: COP Appendix K, Figure 7; SouthCoast Wind 2023

Figure 3-7. SAV distribution at Worcester Avenue landfall approach



Source: COP Appendix K, Figure 5-1; SouthCoast Wind 2023

Figure 3-8. Mapped eelgrass from 2020 survey and HDD path for the Falmouth Landfall locations

3.1.2.3 Interior Coastal

The onshore and interior coastal positions of the Brayton Point and Falmouth export cable routes are located within developed landscapes in both Rhode Island and Massachusetts, primarily along or within existing roadway corridors. The Brayton Point onshore submarine export cable will go up the Sakonnet River and connect to the electric grid on the industrialized Brayton Point, or under Alternative C will avoid the Sakonnet River and associated EFH and have onshore cable components along roadways of Aquidneck Island to the east or Little Compton, Rhode Island to the west.

The Falmouth onshore cable component is mostly developed, but residential, and will also run primarily along existing roadway corridors and not disturb much native habitats. Natural Heritage Database inquiries were submitted Massachusetts Division of Marine Fisheries (MA DMF), and results indicated that within the onshore cable corridor (1-mile buffer) only four species have Massachusetts state endangered status. These species include the Roseate Tern, Upland Sandpiper, Walsh's Anthophora Bee, and the Papillose Nut-Sedge.

3.1.3 Port Modifications and O&M Facility

There are no port modifications or expansions anticipated for this Project. For O&M, SouthCoast Wind's preference is to use a Massachusetts-based port.

3.1.4 Habitat Areas by Project Component Tables

The Project area provides general types of EFH that support managed species and their prey which include rocky habitats with bedrock, glacial moraine A, boulder fields, gravel, and coarse sediment; shellfish reefs and beds made up of *Crepidula* substrate; soft-bottom habitats of mud or sand; submerged aquatic vegetation (SAV); and Habitat Area of Particular Concern (HAPC) for juvenile Atlantic cod and summer flounder (Table 3-6 and Table 3-7). Table 3-6 provides a summary of the areas of mapped benthic habitat types found in the Lease Area and both federal and state portions of the Falmouth and Brayton Point ECCs based on SouthCoast Wind's benthic assessment surveys (SouthCoast Wind 2023, Appendix M.3). In Table 3-7, these mapped habitat types are cross-walked to functional habitat classifications which include rocky, soft bottom mud, soft bottom sand, SAV, tidal marsh, shellfish reefs and beds, shell accumulations, other biogenic, pelagic, estuarine, habitat for sensitive life stages, and HAPCs with total acreages reported for the Lease Area, export cable route, and landing area. Interior coastal areas are not included in the Project scope and no port modifications or O&M facility expansions are anticipated.

Table 3-6. Area (acres) of different habitat types within Project components

Habitat Types	Lease Area	Falmouth ECC Route - Federal	Falmouth ECC Route – MA State Waters	Brayton Point ECC Route - Federal	Brayton Point ECC Route – RI State Waters
Glacial Moraine A	-	-	1,691	411	185
Bedrock	-	-	-	-	3
Gravel Pavement	-	-	1,818	-	-
Mixed-Size Gravel	-	-	-	18	510
Boulder Fields Present	-	2.6	544	945	184
Coarse Sediment	-	-	2,325	1,026	0.1
Mud to Muddy Sand	49,731	15	444	4,015	3,851
Sand	777	4,406	4,174	9,596	1,478

Habitat Types	Lease Area	Falmouth ECC Route - Federal	Falmouth ECC Route – MA State Waters	Brayton Point ECC Route - Federal	Brayton Point ECC Route – RI State Waters
SAV	-	-	295	-	-
Crepidula Substrate	-	-	1,531	-	1,342
Anthropogenic	-	-	-	-	7
HAPC	-	151	10,895	-	6,210

Source: COP Appendix M.3, SouthCoast Wind 2023 and NOAA Fisheries EFH Mapper (NMFS 2022)

Table 3-7. Habitat areas by project components

Habitat Classification		Project Component Area (acres)					
Habitat Types	**SouthCoast Wind Mapped Benthic Habitat Types (COP Volume 1, Appendix M.3; SouthCoast Wind 2023)**	**Lease Area**	**Offshore/ Onshore Export Cable: Export cable route**	**Offshore/ Onshore Export Cable: Landing area**	**Offshore/ Onshore Export Cable: Interior coastal**	**Port modifications**	**O&M facility**
Rocky	Bedrock Glacial Moraine A Gravel Pavement Mixed-Size Gravel in Muddy Sand to Sand Coarse Sediment Coarse Sediment - with Boulder Field(s) Coarse Sediment - *Crepidula* Substrate and Boulder Field(s) Coarse Sediment - Mobile Coarse Sediment - Mobile with Boulder Field(s) Sand - with Boulder Field(s) Sand - Mobile with Boulder Field(s) Mud to Muddy Sand - *Crepidula* Substrate with Boulder Field(s) Mud to Muddy Sand - (Likely) *Crepidula* Substrate with Boulder Field(s)	-	8,354.084	-	-	-	-
Soft bottom mud	Mud to Muddy Sand Mud to Muddy Sand - Mobile	49,731	7,391	Up to 0.46[e]	-	-	-
Soft bottom sand	Sand; Sand - Mobile	777	18,225	Up to 0.40[e]	-	-	-
Submerged Aquatic Vegetation (SAV)	Sand – SAV Sand - Potential SAV Mud to Muddy Sand - with SAV	-	298.6	-	-	-	-
Tidal Marsh	-	-	-	-	-	-	-
Shellfish reefs and beds	Gravel Pavement - Crepidula Substrate Coarse Sediment - *Crepidula* Substrate Coarse Sediment - (Likely) *Crepidula* Substrate Sand - Shell / *Crepidula* Substrate Mud to Muddy Sand - Shell / *Crepidula* Substrate Mud to Muddy Sand - *Crepidula* Substrate Mud to Muddy Sand - (Likely) *Crepidula* Substrate	-	2,603	Up to 0.31[e]	-	-	-

Habitat Classification		Project Component Area (acres)					
Habitat Types	**SouthCoast Wind Mapped Benthic Habitat Types (COP Volume 1, Appendix M.3; SouthCoast Wind 2023)**	**Lease Area**	**Offshore/ Onshore Export Cable: Export cable route**	**Offshore/ Onshore Export Cable: Landing area**	**Offshore/ Onshore Export Cable: Interior coastal**	**Port modifications**	**O&M facility**
Shell accumulations	-	-	-	-	-	-	-
Other biogenic	-	-	-	-	-	-	-
Pelagic	-	127,388 [a]	37,948 [b]	-	-	-	-
Estuarine	-	-	6,044 [b]	-	-	-	-
Habitat for sensitive life stages	-	-	11,255.684 [c]	Up to 0.31 [e]	-	-	-
Habitat Areas of Particular Concern (HAPC)	-	-	17,256 [d]	Up to 1.17 [e]	-	-	-

Note: Interior coastal areas are not included in the Project scope and no port modifications or O&M facility expansions are anticipated.

[a] Total Lease Area size located in pelagic waters

[b] Estimate value based on INSPIRE Benthic Habitat Pop-up Mapper (INSPIRE 2022) benthic habitat mapping polygons

[c] Total of Rocky, SAV, and shellfish reefs and beds habitat types

[d] Calculated using NOAA Fisheries EFH Mapper (NMFS 2022) and Project component GIS layers

[e] Extent of habitat types that may be disturbed at potential landfall locations (Appendix M.3, SouthCoast Wind 2023)

Source: COP Volume 1, Appendix M.3 Tables 3-2, 3-4, 3-6, 3-8, 3-10, 3-12, and 4-1 (SouthCoast Wind 2023); INSPIRE Benthic Habitat Pop-up Mapper (INSPIRE 2022); NOAA Fisheries EFH Mapper (NMFS 2022)

4. Designated EFH

The Project area includes EFH designations developed by the New England Fishery Management Council (NEFMC), the Mid-Atlantic Fishery Management Council (MAFMC), and NMFS. The management councils and NMFS designate EFH for species in association with a mapped grid of 10-by-10-minute squares covering all marine habitat along the U.S. coast. The quadrangles are used by the NEFMC and the MAFMC to delineate specific areas for the purpose of EFH designations. Species and life stages with EFH in the Project area were identified with the NMFS EFH Mapper (NMFS 2022). Descriptions and habitat designations for EFH-designated species and life stages were primarily developed from NMFS EFH source documents, the Final Omnibus Essential Fish Habitat Amendment 2 (NEFMC 2017), and the Final Amendment 10 to the 2006 Consolidated Atlantic Highly Migratory Species FMP (NMFS 2017).

Using the NOAA EFH mapper and EFH designations for species life stages, 46 species of finfish and invertebrates were found to have a designated EFH for various life stages within the Lease Area, ECCs, and approach/landfall component areas (SouthCoast Wind 2023, Appendix N). Resources are managed under various FMPs. NEFMC FMPs include Northeast Multispecies; Sea Scallop; Monkfish; Atlantic Herring; Skates, Small-Mesh Multispecies; and Spiny Dogfish. MAFMC FMPs include Summer Flounder, Scup, Black Sea Bass; Mackerel, Squid, Butterfish; Surfclam and Ocean Quahog; Bluefish; and Spiny Dogfish. NMFS FMPs include the Atlantic Highly Migratory Species.

Designated EFH occurrence in the Project area by taxonomic grouping, individual species, life stage, and EFH species group is summarized in Table 4-1 and Table 4-2. Taxonomic groupings include Gadids, flatfish, other finfish, highly migratory species, invertebrates, skates, and sharks. Life stages include eggs, larvae, juvenile, and adult (Table 4-1) and neonate / young of year, juvenile, and adult (Table 4-2). EFH species group refers to species-specific life stage habitat associations which include Sessile Benthic/Epibenthic – Soft Bottom, Mobile Benthic/Epibenthic – Soft Bottom, Sessile Benthic/Epibenthic – Complex, Mobile Benthic/Epibenthic – Complex, and Pelagic. The Sessile Benthic/Epibenthic – Soft Bottom EFH species group includes slow-moving benthic/epibenthic species and/or life stages that associate with soft bottom habitat, while the Mobile Benthic/Epibenthic – Soft Bottom group includes the mobile juvenile and adult life stages of demersal fish species that associate primarily with or routinely use soft bottom habitat. The Sessile Benthic/Epibenthic – Complex EFH species group includes sessile and slow-moving species and/or life stages that associate primarily with large-grained complex and complex benthic habitat, while the Mobile Benthic/Epibenthic – Complex group includes highly mobile species and/or life stages that associate primarily with large-grained complex and complex benthic habitat. The last EFH species group, Pelagic, includes species and life stages that are found primarily in the water column and at mid-depth or near the surface. These species-habitat association groupings are further used in Section 5 to describe the adverse effects on EFH and EFH species. Occurrences of species in the Project area categorized as NOAA Trust Resources are presented in Section 7.

Prey organisms of the 46 fish and invertebrate species with EFH designations within the Project area are categorized into benthic, epibenthic, and pelagic groups for this assessment. As prey consumed by managed fish and invertebrate species are a component of the EFH, the potential adverse effects on prey species from impact-producting factors (IPFs) are also analyzed in Section 5. Benthic prey species include infaunal invertebrates such as polychaete worms, flatworms, nematodes, and burrowing crustaceans, while epibenthic prey include bottom-dwelling crustaceans, echinoderms, mollusks, and fish. Gadids, flatfish, skates, and other bottom-foraging fish species consume prey in both the benthic and epibenthic categories. Pelagic prey species include forage fish, squid, and pelagic crustaceans. Sharks and highly migratory fish species, such as tuna, consume prey belonging to this group. Another component of the pelagic prey group are planktonic organisms, such as phytoplankton, zooplankton, and fish larvae, consumed by various life stages of EFH fish and invertebrate species.

Table 4-1. EFH-designated fish and invertebrate species in the Project area

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Gadids										
Atlantic cod (*Gadus morhua*)				**General habitat description**: Prefers muddy, gravelly, or rocky substrates. In state waters, cod can be found year-round but peak in winter and spring both nearshore and offshore. Cod typically move south and into deeper water in the winter and spring, and spawn nearshore in the winter months (Collette and Klein-MacPhee 2002). **Eggs/Larvae**: Pelagic waters around the perimeter of the Gulf of Maine, Georges Bank, and in the Mid-Atlantic region, as well as the high-salinity zones of bays and estuaries. Cod larvae are most abundant throughout their range during the spring (Fahay et al. 1999). **Juvenile:** Benthic habitats of complex sediments of pebble, gravel, and boulder in the Gulf of Maine, Georges Bank, and the eastern portion of the continental shelf off southern New England. Generally found in water temperatures below 20° C and depths from 25-75 meters (NEFMC 2017). **Adults**: Demersal/Structure Oriented. Subtidal benthic habitats in the Gulf of Maine, south of Cape Cod, and Georges Bank between 30 and 160 meters, as well as high-salinity zones in bays and estuaries (Fahay et al. 1999).						
Eggs	●	●	●	●	●	●	●	●	●	Pelagic
Larvae	●	●	●	●	●	●	●	●	●	Pelagic
Juvenile	●	●	●	●	●	●	●	●	●	Mobile Benthic/Epibenthic – Complex
Adult	●	●	--	--	●	●	--	--	--	Mobile Benthic/Epibenthic – Complex
Haddock (*Melanogrammus aeglefinus*)				**General habitat description**: Haddock eggs and larvae inhabit pelagic waters and demersal life stages (juveniles and adults) observed from Cape Charles, VA to Labrador. Abundant throughout the Gulf of Maine and offshore banks; greatest concentration on Georges Bank (Cargnelli et al. 1999a). **Eggs/Larvae:** Generally pelagic surface waters of Georges Bank to Nantucket Shoals. Maximum depth approximately 150 meters. Majority found at depths of 30-90 meters (NEFMC 2017). **Juveniles**: Small juveniles found near the surface (10-40 meters), more or less stationary in the open sea. Descent to bottom (35-100 meters) occurs at age 3-5 months. Nursery area between Nantucket Shoals & Hudson Canyon (Cargnelli et al. 1999a). **Adults**: Benthic habitats of pebble and smooth sand areas within rocky patches on Georges Bank and Nantucket Shoals (NEFMC 2017).						

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Eggs	●	●	--	--	●	--	--	--	--	Pelagic
Larvae	●	●	--	--	●	--	--	--	--	Pelagic
Juvenile	●	--	--	--	--	--	--	--	--	Mobile Benthic/Epibenthic – Complex
Adult	●	--	--	--	--	--	--	--	--	Mobile Benthic/Epibenthic – Complex
Pollock (*Pollachius virens*)				**General habitat description**: Pollock inhabit pelagic habitats on the Scotian Shelf, Georges Bank, the Great South Channel, and the Gulf of Maine (Cargnelli et al. 1999b). **Eggs/Larvae**: Pelagic inshore and offshore habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic, including Great South Bay (NEFMC 2017). **Juveniles**: Pelagic inshore and offshore habitats from Cape Ann, MA to Nova Scotia. Abundant inshore during summer/fall; seek deeper water in winter (Cargnelli et al. 1999b).						
Eggs	●	--	--	--	●	--	--	--	--	Pelagic
Larvae	●	●	--	--	●	--	--	--	--	Pelagic
Juvenile	●	--	--	--	●	●	●	●	●	Mobile Benthic/Epibenthic – Soft Bottom / Complex
Adult	--	--	--	--	--	--	--	--	--	

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Red hake (*Urophycis chuss*)				**General habitat description**: This groundfish species 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. **Eggs/Larvae**: Pelagic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic to Cape Hatteras, and selected bays and estuaries (Steimle et al. 1999a). **Juveniles/ Adults**: Demersal life stages inhabit sandy or muddy substrates. Juveniles are found in intertidal and subtidal areas to depth of 80 meters. Benthic habitats providing shelter are essential for juveniles, including mud substrates with depressional features, substrates providing biogenic complexity, and artificial reefs. Older juveniles are commonly associated with shelter or structure and often inside live bivalves (Steimle et al. 1999a). Adult red hake have been collected inshore near Martha's Vineyard. In the summer-fall, adult red hake are found in waters from ~ 10 m deep across the continental shelf to around 300 m; especially abundant off southern New England (Steimle et al. 1999a).						
Eggs	●	●	--	--	●	●	●	●	●	Pelagic
Larvae	●	●	--	--	●	●	●	●	●	Pelagic
Juvenile	●	●	--	--	●	●	●	●	●	Mobile Benthic/Epibenthic – Soft Bottom
Adult	●	●	--	--	●	●	●	●	●	Mobile Benthic/Epibenthic – Soft Bottom
Silver hake (*Merluccius bilinearis*)				**General habitat description**: This groundfish species prefers deep water environments and are concentrated in deep basins in the Gulf of Maine and along the continental slope in winter and spring. Associate with all bottom types, from gravel to fine silt and clay, but mainly with silts and clay (Scott 1982). **Eggs/Larvae**: Pelagic habitats from the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the Mid-Atlantic south to Cape Hatteras (NEFMC 2017). **Juveniles/ Adults**: Juveniles inhabit sand waves, flat sand with amphipod tubes, and shells, and in biogenic depressions. Juvenile EFH includes pelagic and benthic habitats (e.g., sandy substrates) in selected coastal bays and estuaries and on the continental shelf as far south as Cape May, New Jersey. Juveniles inhabit depths greater than 10 meters in coastal waters in the Mid-Atlantic and between 40 and 400 meters in the Gulf of Maine, Georges Bank, and middle continental shelf in the Mid-Atlantic. Adults are observed in water temperatures below 71.6°F (22°C) and at depths between 20 and 270 meters in benthic habitats of all substrate types. Adults occur in the Gulf of Maine, on Georges Bank, and on the continental shelf off southern New England, and the Mid-Atlantic south to Cape Hatteras (NEFMC 2017).						

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Eggs	●	●	--	--	●	●	●	●	●	Pelagic
Larvae	●	●	--	--	●	●	●	●	●	Pelagic
Juvenile	●	●	--	--	--	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom / Complex
Adult	●	●	--	--	●	●	●	●	--	Mobile Benthic/Epibenthic – Soft Bottom / Complex
Offshore hake (*Merluccius albidus*)				**Larvae**: Pelagic waters along the outer continental shelf of Georges Bank and southern New England. Found at water depths up to 1,250 meters, but primarily collected at 70-130 meters (NEFMC 2017).						
Eggs	--	--	--	--	--	--	--	--	--	
Larvae	●	●	--	--	--	--	--	--	--	Pelagic
Juvenile	--	--	--	--	--	--	--	--	--	
Adult	--	--	--	--	--	--	--	--	--	
White hake (*Urophycis tenuis*)				**General habitat description**: This groundfish species prefers deep water environments and is predominantly found along the edge of the OCS between Cape Hatteras and Cape Cod, becoming more prevalent on the coastal shelf and inshore waters moving northward into the Gulf of Maine (Chang et al. 1999a). **Larvae**: Pelagic habitats in southern New England, and on Georges Bank. Early stage white hake larvae have been collected on the continental slope, but also across the shelf-slope front and use nearshore habitats for juvenile nurseries (NEFMC 2017). **Juveniles**: Young juveniles are pelagic and migrate from offshore spawning grounds to estuarine nursery areas. Some juveniles may descend to as yet unknown habitats on the shelf. Older juveniles are demersal and inhabit offshore waters at a wide range of temperatures (4-19℃) and depths (5-325 meters) but are most abundant at 4-9℃ in spring and 7-16℃ in autumn at depths < 225 meters. Eelgrass is an important habitat for demersal juveniles (Chang et al. 1999a). **Adults**: Sub-tidal benthic habitats in the Gulf of Maine, including depths greater than 25 meters and in bays and estuaries as well as in 400-900 meters on the outer continental shelf and slope. Adults occur in fine-grained, muddy substrates and in mixed soft sediment and rocky habitats (NEFMC 2017).						

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Eggs	--	--	--	--	--	--	--	--	--	
Larvae	--	●	--	--	●	--	--	--	--	Pelagic
Juvenile	●	●	--	--	●	--	--	--	--	Pelagic; Mobile Benthic/Epibenthic – Soft Bottom
Adult	●	--	--	--	--	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom
Flatfish										
Summer flounder (*Paralichthys dentatus*)				**General habitat description**: This demersal fish species ranges from Maine to South Carolina but is predominantly concentrated south of Cape Cod. Present in Mid-Atlantic waters during summer and fall at depths between 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. 1999). EFH includes macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations. **Eggs/Larvae**: Pelagic waters over the continental shelf from the Gulf of Maine to Cape Hatteras. Eggs are abundant from Cape Cod to Cape Hatteras, with the highest frequency of occurrence and greatest abundances of eggs in the northwest Atlantic occurs in October and November. Further, from 1980 to 1986 the heaviest concentrations of eggs within 45 km of shore were found from New York to Massachusetts (Packer et al. 1999). Larvae are most abundant 12 to 50 miles from shore at depths from 30 to 230 feet (9.1-70.1 meters; Packer et al. 1999). **Juveniles/Adults**: Demersal waters over the shelf from the Gulf of Maine to Cape Hatteras. Juveniles are most abundant from May to September but are present year-round. Juveniles use estuarine habitats as nursery areas, including salt marsh creeks, seagrass beds, mudflats, and open bay areas with temperatures greater than 37.4°F and salinities from 10 to 30 parts per thousand (ppt). Adults inhabit shallow coastal and estuarine waters during warmer months, ranging in depths from 1 to 82 feet, with an extensive range of salinities. In winter, adults move offshore on the OCS at depths of 500 feet (Packer et al. 1999).						
Eggs	●	●	●	●	●	●	●	●	●	Pelagic
Larvae	●	●	●	●	●	●	●	●	●	Pelagic
Juvenile	●	●	●	●	●	●	●	●	●	Mobile Benthic/Epibenthic – Soft Bottom / Complex

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Adult	●	●	●	●	●	●	●	●	●	Mobile Benthic/Epibenthic – Soft Bottom / Complex
Windowpane flounder (*Scophthalmus aquosus*)				**General habitat description**: This groundfish species is typically associated with non-complex benthic habitats from the Gulf of Saint Lawrence to Florida (Collette and Klein-MacPhee 2002). Windowpane flounder adults are found throughout Narragansett Bay in all seasons with no apparent seasonal shifts. In Massachusetts, windowpane flounder are generally found south of Cape Cod in the summer (Chang et al. 1999b). Spawning occurs from April to December along areas of the northwest Atlantic (Chang et al. 1999b). **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 (Chang et al. 1999b). **Juveniles/Adults**: Intertidal and subtidal benthic habitats in estuarine, coastal marine, and continental shelf waters from the Gulf of Maine to northern Florida (juveniles) and Cape Hatteras (adults), including mixed and high-salinity zones in selected bays and estuaries. EFH for these demersal lifestages includes mud and sand substrates and extends from the intertidal zone to a maximum depth of 60 meters for juveniles and 70 meters for adults. Juveniles prefer sand over mud (Chang et al. 1999b).						
Eggs	●	●	--	--	●	●	●	●	●	Pelagic
Larvae	●	●	--	--	●	●	●	●	●	Pelagic
Juvenile	●	●	●	●	●	●	●	●	●	Mobile Benthic/Epibenthic – Soft Bottom
Adult	●	●	●	●	●	●	●	●	●	Mobile Benthic/Epibenthic – Soft Bottom
Winter flounder (*Pseudopleuronectes americanus*)				**General habitat description**: This groundfish species inhabits coastal waters from the Strait of Belle Isle, Newfoundland to Georgia (Collette and Klein-MacPhee 2002). Winter flounder are common in the inshore waters of Massachusetts and Rhode Island. Prefers muddy, sandy, cobbled, gravely, or boulder substrates (Pereira et al. 1999). Spawns over sandy bottom in shallow habitats. **Eggs/Larvae**: Eggs found over mud, muddy sand, sand, gravel, macroalgae, and SAV. Pelagic 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 (Pereira et al. 1999). **Juveniles/Adults**: Estuarine, coastal, and continental shelf benthic habitats, as well as the mixed and high-salinity zones in bays and estuaries (NEFMC 2017). EFH extends from the intertidal zone to depth of 60 meters for juveniles and 70 meters for adults. Juveniles are found inshore on muddy and sandy sediments in and adjacent to eelgrass and macroalgae, in bottom debris, and in marsh creeks. Adult EFH occurs on muddy and sandy substrates, and on hard bottom on offshore banks (Pereira et al. 1999).						

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Eggs	--	●	●	●	●	●	●	●	●	Sessile Benthic/Epibenthic – Soft Bottom
Larvae	●	●	●	●	●	●	●	●	●	Pelagic; Mobile Benthic/Epibenthic – Soft Bottom
Juvenile	●	●	●	●	●	●	●	●	●	Mobile Benthic/Epibenthic – Soft Bottom
Adult	●	●	●	●	●	●	●	●	●	Mobile Benthic/Epibenthic – Soft Bottom
Witch flounder (*Glyptocephalus cynoglossus*)				**General habitat description**: This groundfish species ranges from the Gulf of Maine to Cape Hatteras, North Carolina and tends 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 (Cargnelli et al. 1999c). **Eggs/Larvae**: Pelagic habitats on the continental shelf throughout the northeast. 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 (Cargnelli et al. 1999c). **Juveniles/Adults**: Demersal sub-tidal benthic habitats between 35 and 400 meters in the Gulf of Maine and as deep as 1,500 meters on the OCS and slope, with mud and muddy sand substrates (Cargnelli et al. 1999c).						
Eggs	●	--	--	--	●	--	--	--	--	Pelagic
Larvae	●	●	--	--	●	--	--	--	--	Pelagic
Juvenile	●	--	--	--	--	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom
Adult	●	●	--	--	--	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Yellowtail flounder (*Limanda ferruginea*)				**General habitat description**: This groundfish species ranges 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 (Johnson et al. 1999). **Eggs/Larvae**: For these pelagic lifestages, EFH is sub-tidal benthic habitats between 35 and 400 meters depth in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region (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 (larvae) (Johnson et al. 1999). **Juveniles/Adults**: These demersal lifestages are found in 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 selected bays and estuaries. EFH for juveniles occurs on sand and muddy sand between 20 and 80 meters. EFH for adults occurs on sand and sand with mud, shell hash, gravel, and rocks at depths between 25 and 90 meters.						
Eggs	●	●	--	--	●	--	--	--	--	Pelagic
Larvae	●	●	--	--	●	--	--	--	--	Pelagic
Juvenile	●	●	--	--	●	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom
Adult	●	●	--	--	●	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom
American plaice (*Hippoglossoides platessoides*)				**Larvae**: Pelagic areas of Georges Bank and Nantucket Shoals to Montauk, NY. Highest abundance along 60 meters contour of Georges Bank (Johnson 2004).						
Eggs	--	--	--	--	--	--	--	--	--	
Larvae	●	--	--	--	--	--	--	--	--	Pelagic
Juvenile	--	--	--	--	--	--	--	--	--	
Adult	--	--	--	--	--	--	--	--	--	

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Other Finfish										
Atlantic herring (*Clupea harengus*)				**General habitat description**: Schooling, pelagic, coastal species that ranges from northern Labrador to Cape Hatteras, North Carolina. Migrates extensively north and south of their range (Reid et al. 1999). **Eggs/Larvae**: Pelagic waters in the Gulf of Maine, Georges Bank, the upper Mid-Atlantic Bight, and listed bays and estuaries (NEFMC 2017). Generally found at sea surface temperatures below 16°C, at depths between 50 and 90 meters, and in salinities around 32 ppt. Larvae are observed between August and April, with peaks in September through November (Reid et al. 1999). **Juveniles/Adults**: Pelagic waters and bottom habitats in the Gulf of Maine, Georges Bank, southern New England, and the Mid-Atlantic south to Cape Hatteras. Juveniles occur in water temperatures below 10°C, at depths between 15 and 135 meters, and in salinities ranging from 26 to 32 ppt. Adults are occur in water temperatures below 10°C, at depths between 20 and 130 meters, and in salinities above 28 ppt.						
Eggs	●	●	--	--	--	--	--	--	--	Sessile Benthic/Epibenthic – Complex
Larvae	●	●	--	--	●	●	●	●	●	Pelagic
Juvenile	●	●	●	●	●	●	●	●	●	Pelagic
Adult	●	●	--	--	●	●	●	●	●	Pelagic
Atlantic wolffish (*Anarhichas lupus*)				**Eggs/Larvae**: Cape Cod to Georges Bank, in 40-240 meters. Eggs are deposited in rocky substrates and larvae stay and develop on benthic substrates **Juveniles/Adults**: Similar location of Cape Cod to Georges Bank, in 40-240 meters. They prefer rocky substrates of large stones and rocks for nesting and shelter, with softer sediments nearby for feeding (NEFMC 2017).						
Eggs	--	●	●	●	●	--	--	--	--	Sessile Benthic/Epibenthic – Complex
Larvae	--	●	●	●	●	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom / Complex
Juvenile	--	●	●	●	●	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom / Complex

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Adult	--	●	●	●	●	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom / Complex
Monkfish (*Lophius americanus*)				**General habitat description**: More abundant in deeper waters up to 500 meters in the spring (Steimle 1999b). Abundant on Georges Bank. Prefer hard sand, pebbly bottom, gravel, and broken shells (Collette and Klein-MacPhee 2002). **Eggs/Larvae**: Pelagic waters in the Gulf of Maine, Georges Bank, southern New England, and the Mid-Atlantic south to Cape Hatteras. Eggs occur at sea surface temperatures below 18°C and in water depths from 15 to 1,000 meters; whereas larvae occur at water temperatures of 15°C and in water depths from 25 to 1,000 meters. Eggs are most often observed from March through September, and larvae are most often observed from March through September (Steimle et al. 1999b). **Juveniles/Adults**: Demersal lifestages that inhabit bottom habitats with substrates of a sand-shell mix, algae-covered rocks, hard sand, pebbly gravel, or mud along the OCS in the Mid-Atlantic. Juveniles occur at water temperatures below 13°C, at depths from 25 to 200 meters, and at salinities from 29.9 to 36.7 ppt. Adults occur at water temperatures below 15°C, at depths from 25 to 200 meters, and at salinities from 29.9 to 36.7 ppt (Steimle et al. 1999b).						
Eggs	●	●	--	--	●	--	--	--	--	Pelagic
Larvae	●	●	--	--	●	--	--	--	--	Pelagic
Juvenile	●	--	--	--	●	--	--	--	--	Mobile Benthic/Epibenthic – Complex
Adult	●	--	--	--	●	--	--	--	--	Mobile Benthic/Epibenthic – Complex
Ocean pout (*Macrozoarces americanus*)				**General habitat description**: Present in southern New England from late summer to winter. Prefers habitats that contain sandy mud, sticky sand, broken bottom, or on pebbles and gravel (Collette and Klein-MacPhee 2002). Spawn in protected habitats, such as rock crevices and man-made artifacts (Steimle et al. 1999c). **Eggs**: Hard-bottom habitats in the Gulf of Maine, Georges Bank, and in the Mid-Atlantic Bight, as well as high-salinity zones in estuaries. Eggs are typically found in water depths less than 100 meters (Steimle et al. 1999c). **Juveniles/Adults**: EFH for juveniles is intertidal and sub-tidal benthic habitats in the Gulf of Maine and on the continental shelf north of Cape May, New Jersey, on the southern portion of Georges Bank, and in the high-salinity zones of bays and estuaries north of Cape Cod. Adult EFH is sub-tidal benthic habitats in the Gulf of Maine, on Georges Bank, in coastal and continental shelf waters north of Cape May, New Jersey, and in the high-salinity zones of bays and estuaries north of Cape Cod. Adult habitat includes mud and sand, particularly in association with structure forming habitat types like shell, gravel, or boulder (Steimle et al. 1999c).						

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Eggs	●	●	--	--	●	●	●	●	--	Sessile Benthic/Epibenthic – Complex
Larvae	--	--	--	--	--	--	--	--	--	
Juvenile	●	●	--	--	●	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom
Adult	●	●	--	--	●	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom
Atlantic butterfish (*Peprilus triacanthus*)				**General habitat description**: Pelagic, surface-dwelling fish that ranges from the Gulf of St. Lawrence to Florida. Occur 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. Preference for sandy benthic habitat. Spawning occurs on the continental shelf and nearshore areas (Cross et al. 1999). **Eggs/Larvae**: Pelagic habitats in inshore estuaries and embayments. EFH for eggs is bottom depths of 1,500 meters or less at temperatures of 6.5 to 21.5°C. EFH for larvae is bottom depths between 41 and 350 meters at temperatures of 8.5 to 21.5 °C (Cross et al. 1999). **Juveniles/Adults**: Pelagic habitats in inshore estuaries and embayments, inshore waters, and on the inner and outer continental shelf. EFH for juveniles is bottom depths between 10 and 280 meters at temperatures between 6.5 and 27 °C and salinities above 5 ppt. EFH for adults is bottom depths between 10 and 250 meters at temperatures are between 4.5 and 27.5°C and salinities above 5 ppt.						
Eggs	●	●	--	--	●	●	●	●	●	Pelagic
Larvae	●	●	--	--	●	●	●	●	●	Pelagic
Juvenile	●	●	●	●	●	●	●	●	●	Pelagic; Mobile Benthic/Epibenthic – Soft Bottom
Adult	●	●	●	●	●	●	●	●	●	Pelagic; Mobile Benthic/Epibenthic – Soft Bottom

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Atlantic mackerel (*Scomber scombrus*)				**General habitat description**: Ranges from the Gulf of St. Lawrence to Cape Lookout, North Carolina (MAFMC 2011). Spawning occurs 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 8°C (Studholme et al. 1999). **Eggs/Larvae**: Pelagic habitats in inshore estuaries and embayments and inshore and offshore waters of the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras. EFH for eggs is depths of < 100 meters and temperatures of 6.5-12.5°C. EFH for larvae is depths of 21-100 meters and temperatures of 5.5-11.5°C (Studholme et al. 1999). **Juveniles/Adults**: Pelagic habitats in inshore estuaries and embayments in the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina. EFH for juveniles is depths of 10-110 meters and temperatures of 5-20°C. EFH for adults is depths of < 170 meters and temperatures of 5-20°C. Spawning occurs at temperatures above 7°C, with a peak from 9-14°C) (Studholme et al. 1999).						
Eggs	●	●	--	--	●	●	●	●	●	Pelagic
Larvae	●	●	--	--	●	●	●	●	●	Pelagic
Juvenile	●	●	●	●	●	●	●	●	●	Pelagic
Adult	●	--	--	--	--	●	●	●	●	Pelagic
Black sea bass (*Centropristis striata*)				**General habitat description**: Demersal species that occurs in the western Atlantic, ranging from southern Nova Scotia to Florida, within a depth range from the tide line down to 128 meters. Prefers structured habitats such as reefs, shipwrecks, and lobster pots along the continental shelf (Steimle et al. 1999d). Spawning begins in the spring in the southern part of their range (North Carolina and Virginia) and progresses north into southern New England waters from summer through fall (Steimle et al. 1999d). **Juveniles/Adults**: EFH for juveniles is coastal waters with temperatures > 6.1°C and salinities greater than 18 ppt. Juveniles are associated with rough bottom, shellfish and eelgrass beds, man-made structures in sandy shelly areas; offshore clam beds and shell patches may also be used during the wintering. Adults are also structure orientated, with sand and shell usually the substrate preference. Adults require temperatures > 6.1°C (Steimle et al. 1999d).						
Eggs	--	--	--	--	--	--	--	--	--	
Larvae	--	--	--	--	--	--	--	--	--	

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Juvenile	●	●	●	●	●	●	●	●	●	Mobile Benthic/Epibenthic – Complex
Adult	●	●	●	●	●	●	●	●	●	Mobile Benthic/Epibenthic – Complex
Bluefish (*Pomatomus saltatrix*)				**General habitat description**: Bluefish range from Nova Scotia to Bermuda and seasonally migrate to the Mid-Atlantic Bight during the spring, returning to deeper offshore water of southeastern Florida in November (Sheperd and Packer 2006). **Juveniles/Adults**: EFH for juveniles is pelagic, nearshore areas and estuaries with temperatures of 19-24°C and salinities of 23-36 ppt. EFH for adults is oceanic, nearshore, and continental shelf waters with temperatures above 14-16°C and salinities above 25 ppt (Sheperd and Packer 2006). The species migrates extensively. There are two predominant spawning areas on the east coast: one located offshore from southern Florida to North Carolina in spring and the located in Mid-Atlantic Bight in summer (Wilk 1982).						
Eggs	--	--	--	--	--	--	--	--	--	
Larvae	--	--	--	--	--	--	--	--	--	
Juvenile	--	--	--	--	●	●	●	●	●	Pelagic
Adult	●	●	--	--	●	●	●	●	●	Pelagic
Scup (*Stenotomus chrysops*)				**General habitat description**: This demersal finfish ranges from the Gulf of Maine to North Carolina. Known to congregate in nearshore areas of New England from early April to December, at depths of 82-128 meters (Collette and Klein-MacPhee 2002). Preference for smooth to rocky bottom habitats. Spawning occurs nearshore, shallow waters over sandy bottom between May and August (Steimle et al. 1999e). **Eggs/Larvae**: Eggs and larvae inhabit estuaries from southern New England to coastal Virginia in temperatures of 12.7-22.8°C and salinities above 15 ppt. Eggs and larvae are abundant from May through August (Steimle et al. 1999e). **Juveniles/Adults**: Offshore EFH is the demersal waters over the continental shelf from the Gulf of Maine to Cape Hatteras, North Carolina. During spring and summer, juveniles inhabit estuaries and bays between Virginia and Massachusetts in association with various sands, mud, mussel, and eelgrass bed type substrates, in water temperatures above 7°C, and in salinities above 15 ppt. Wintering adults (November through April) are usually offshore, south of New York to North Carolina, in waters above 7°C (Steimle et al. 1999e).						
Eggs	--	--	--	--	--	●	●	●	●	Pelagic

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Larvae	--	--	--	--	--	●	●	●	●	Pelagic
Juvenile	●	●	●	●	●	●	●	●	●	Mobile Benthic/Epibenthic – Soft Bottom / Complex
Adult	●	●	●	●	●	●	●	●	●	Mobile Benthic/Epibenthic – Soft Bottom / Complex
Highly Migratory Species										
Albacore tuna (*Thunnus alalunga*)				**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. 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 (Collette and Klein-MacPhee 2002). **Juveniles/Adults**: Offshore pelagic habitats are seaward of the continental shelf break to the extent of the U.S. Exclusive Economic Zone (EEZ) boundary on Georges Bank and Cape Cod. Adults are generally found farther offshore than juveniles (NEFMC 2017).						
Eggs	--	--	--	--	--	--	--	--	--	
Larvae	--	--	--	--	--	--	--	--	--	
Juvenile	●	●	●	●	●	●	--	--	--	Pelagic
Adult	●	●	●	●	●	--	--	--	--	Pelagic
Bluefin tuna (*Thunnus thynnus*)				**General habitat description**: Bluefin tuna range from Labrador south to the Gulf of Mexico 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). **Juveniles**: Coastal and pelagic habitats extend from the Gulf of Maine to the Mid-Atlantic Bight, continuing south to Cape Hatteras. EFH follows the continental shelf from the outer extent of the U.S. EEZ on Georges Bank to Cape Lookout. EFH for juveniles is temperatures of 4-26 °C and depths of < 20 meters (NMFS 2017). **Adults**: Offshore and coastal pelagic habitats from the Gulf of Maine to the outer extent of the U.S. EEZ (NMFS 2017).						

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Eggs	--	--	--	--	--	--	--	--	--	
Larvae	--	--	--	--	--	--	--	--	--	
Juvenile	●	●	●	●	●	●	--	--	--	Pelagic
Adult	●	●	●	●	●	--	--	--	--	Pelagic
Skipjack tuna (*Katsuwonus pelamis*)				**General habitat description**: Global, pelagic species that has a range from Newfoundland to Brazil. Spawns in warm waters near the equator from spring to fall, with peak spawning in summer (Collette and Klein-MacPhee 2002). Designated EFH for spawning is restricted to the Gulf of Mexico and Atlantic waters off the coast of Florida (NMFS 2017). **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 inhabit waters deeper than 20 meters (NMFS 2017). **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 (NMFS 2017).						
Eggs	--	--	--	--	--	--	--	--	--	
Larvae	--	--	--	--	--	--	--	--	--	
Juvenile	●	●	--	--	--	--	--	--	--	Pelagic
Adult	●	●	●	●	●	●	--	--	--	Pelagic

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Yellowfin tuna (*Thunnus albacares*)				**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 (NMFS 2017). **Juveniles/Adults**: Offshore pelagic habitats are seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank and Cape Cod (NMFS 2017).						
Eggs	--	--	--	--	--	--	--	--	--	
Larvae	--	--	--	--	--	--	--	--	--	
Juvenile	●	●	●	●	●	●	●	●	--	Pelagic
Adult	●	--	--	--	●	--	--	--	--	Pelagic
Invertebrates										
Atlantic sea scallop (*Placopecten magellanicus*)				**General habitat description**: Occurs along the continental shelf at depths of 18-110 meters in seabed areas with coarse substrates consisting of gravel, shells, and rocks. Spawns in September, relying on the currents for egg and larval advection. Scallops often occur in aggregations called beds which may be sporadic or essentially permanent, depending on how suitable the habitat conditions are and whether oceanographic features (fronts, currents) keep larval stages near to the spawning population (Hart and Chute 2004). **Eggs/Larvae**: Eggs occur in benthic habitats both inshore and on the continental shelf. Demersal eggs remain on the seafloor until they develop into the first free-swimming larval stage (Hart and Chute 2004). Larvae inhabit benthic and 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, including shells, pebbles, gravel, and macroalgae and other benthic organisms. Spat that settle on shifting sand do not survive. Maximum larval survival occurs at temperatures of 1.2-15°C and salinities > 25 ppt (Hart and Chute 2004). **Juveniles/Adults**: Demersal benthic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic in depths of 18-110 meters for adults and older juveniles. Younger juveniles leave the original substrate on which they settle and attach to shells, gravel, and small rocks. EFH for older juveniles and adults is sand and gravel substrates in depths of 18-110 meters. Growth of adult scallops is optimal at temperatures of 10-15°C) and they prefer high-salinity seawater (Hart and Chute 2004).						

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Eggs	●	●	--	--	●	--	--	--	--	Sessile Benthic/Epibenthic – Complex
Larvae	●	●	--	--	●	--	--	--	--	Pelagic; Sessile Benthic/Epibenthic – Complex
Juvenile	●	●	--	--	●	--	--	--	--	Sessile Benthic/Epibenthic – Complex
Adult	●	●	--	--	●	--	--	--	--	Sessile Benthic/Epibenthic – Complex
Atlantic surf clam (*Spisula solidissima*)				**General habitat description**: Inhabits areas along the continental shelf from southern portions of the Gulf of St. Lawrence to Cape Hatteras. Prefers sandy habitats and spawns in summer and fall (Cargnelli et al. 1999d). **Juveniles/Adults**: Inhabits benthic substrate to a depth of 1 meter below the water/sediment interface. Most abundant from the beach zone to a depth of 61 meters (Cargnelli et al. 1999e).						
Eggs	--	--	--	--	--	--	--	--	--	
Larvae	--	--	--	--	--	--	--	--	--	
Juvenile	●	●	●	●	--	--	--	--	--	Sessile Benthic/Epibenthic – Soft Bottom
Adult	●	●	●	●	●	--	--	--	--	Sessile Benthic/Epibenthic – Soft Bottom
Ocean quahog (*Arctica islandica*)				**General habitat description**: Distributed along the shelf from Newfoundland to Cape Hatteras. Peak abundance occurs offshore from Nantucket to the Delmarva Peninsula. Prefers medium to fine sandy bottom with mud and silt. Spawning occurs from spring to fall (Cargnelli et al. 1999e). **Juveniles/Adults**: Inhabits benthic substrate to a depth of 0.9 meters below the water/sediment interface. Occurs at depths of 9-244 meters. Rarely occurs where bottom water temperatures exceed 15.5°C (Cargnelli et al. 1999e).						

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Eggs	--	--	--	--	--	--	--	--	--	
Larvae	--	--	--	--	--	--	--	--	--	
Juvenile	●	●	--	--	●	--	--	--	--	Sessile Benthic/Epibenthic – Soft Bottom
Adult	●	●	--	--	●	--	--	--	--	Sessile Benthic/Epibenthic – Soft Bottom
Northern shortfin squid (*Illex illecebrosus*)				**Adults**: EFH for adult northern shortfin squid is defined as pelagic habitat on the continental shelf and slope from Georges Bank to South Carolina and in inshore waters of the Gulf of Maine and southern New England. Adult northern shortfin squid primarily forage for fish, euphausiids, and smaller squids (MAFMC 2011).						
Eggs	--	--	--	--	--	--	--	--	--	
Larvae	--	--	--	--	--	--	--	--	--	
Juvenile	--	--	--	--	--	--	--	--	--	
Adult	--	●	●	●	●	--	--	--	--	Pelagic
Longfin inshore squid (*Doryteuthis pealeii*)				**General habitat description**: Pelagic, schooling species that is abundant from Georges Bank to Cape Hatteras. Typically occurs at temperatures of > 9°C. Squid migrate offshore in late fall to overwinter along the edge of the shelf. Most spawning occurs in May, although there are two broods, an early spring and late summer (Cargnelli et al. 1999f). **Eggs**: Demersal eggs masses ("mops") are deposited inshore and offshore over benthic habitats from Georges Bank to Cape Hatteras at temperatures of 10-23°C, salinities of 30-32 ppt, and depths of < 50 meters. Egg mops are attached to rocks, boulders, and aquatic vegetation and on sand or mud bottom (Cargnelli et al. 1999f). **Juveniles/Adults**: Pelagic habitats in inshore and offshore continental shelf waters from Georges Bank to South Carolina and in embayments. EFH for juveniles is depths of 6-160 meters, temperatures of 8.5-24.5ºC, and salinities of 28.5-36.5 ppt. EFH for adults is depths of 6-200 meters, temperatures of 8.5-14°C, and salinities of 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 (Cargnelli et al. 1999f).						

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Eggs	●	●	●	●	●	●	--	--	--	Sessile Benthic/Epibenthic – Complex
Larvae	--	--	--	--	--	--	--	--	--	
Juvenile	●	●	●	●	●	●	●	●	●	Pelagic
Adult	●	●	●	●	●	●	●	●	●	Pelagic

Notes: ECC = Export Cable Corridor; • = present; -- = not present
Sessile Benthic/Epibenthic – Soft Bottom = includes slow-moving benthic/epibenthic species and/or life stages that associate with soft bottom habitat
Mobile Benthic/Epibenthic – Soft Bottom = includes the mobile juvenile and adult life stages of demersal fish species that associate primarily with or routinely use soft bottom habitat
Sessile Benthic/Epibenthic – Complex = includes sessile and slow-moving species and/or life stages that associate primarily with large-grained complex and complex benthic habitat
Mobile Benthic/Epibenthic – Complex = includes highly mobile species and/or life stages that associate primarily with large-grained complex and complex benthic habitat
Pelagic = includes species and life stages that are found primarily in the water column and at mid-depth or near the surface

Table 4-2. EFH-designated elasmobranchs in the Project Area

<table>
<tr><th>Species and Life Stage</th><th>Lease Area</th><th>Falmouth ECC</th><th>Worcester Avenue/ Central Park Landfalls</th><th>Shore Street Landfall</th><th>Brayton Point Offshore ECC</th><th>Sakonnet River ECC</th><th>Mount Hope Bay ECC</th><th>Aquidneck Island Landfalls</th><th>Brayton Point Landfalls</th><th>EFH Species Group</th></tr>
<tr><td colspan="11">Skates</td></tr>
<tr><td colspan="4">Little skate (<i>Leucoraja erinacea</i>)</td><td colspan="7">General habitat description: Demersal species that ranges from Nova Scotia to Cape Hatteras, North Carolina and is highly concentrated in the Mid-Atlantic Bight and on Georges Bank. Occurs year-round on Georges Bank and tolerates a wide range of temperatures (Packer et al. 2003a). Prefers sandy or pebbly bottom but is also common on mud and ledges (Collette and Klein-MacPhee 2002).
Juveniles/Adults: EFH for juveniles and adults includes 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. Juvenile EFH extends to a maximum depth of 80 meters and adult EFH extends to a maximum depth of 100 meters. EFH also includes high-salinity zones in selected bays and estuaries. EFH occurs on sand and gravel substrates, but also mud (Packer et al. 2003a).</td></tr>
<tr><td>Neonate/YOY</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td></td></tr>
<tr><td>Juvenile</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>Mobile Benthic/Epibenthic – Soft Bottom / Complex</td></tr>
<tr><td>Adult</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>Mobile Benthic/Epibenthic – Soft Bottom / Complex</td></tr>
<tr><td colspan="4">Winter skate (<i>Leucoraja ocellata</i>)</td><td colspan="7">General habitat description: Demersal species that ranges 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. 2003b).
Juveniles/Adults: Sub-tidal benthic habitats in coastal waters from eastern Maine to Delaware Bay and on the continental shelf in southern New England, the Mid-Atlantic region, and Georges Bank. EFH extends from the shoreline to a maximum depth of 90 meters for juveniles and 80 meters for adults. EFH includes high-salinity zones of selected bays and estuaries over sand and gravel substrates, but also mud (Packer et al. 2003b).</td></tr>
<tr><td>Neonate/YOY</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td></td></tr>
<tr><td>Juvenile</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>Mobile Benthic/Epibenthic – Soft Bottom / Complex</td></tr>
<tr><td>Adult</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>Mobile Benthic/Epibenthic – Soft Bottom / Complex</td></tr>
</table>

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Barndoor skate (*Dipturus laevis*)				**Juvenile/Adults:** Bottom habitats with mud, gravel, and sandy substrates in eastern Georges Bank, southern New England and the Mid-Atlantic Bight. Found from the shore to 750 meters, but most abundant in depths less than 150 meters (NEFMC 2017).						
Neonate/YOY	--	--	--	--	--	--	--	--	--	
Juvenile	●	--	--	--	--	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom / Complex
Adult	●	--	--	--	--	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom / Complex
Sharks										
Blue shark (*Prionace glauca*)				**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. Prefers deep, clear waters with temperatures of 10-20°C (Castro 1983). **Neonates:** EFH is in the Atlantic in areas offshore of Cape Cod through New Jersey, seaward of the 30-meter bathymetric line and excluding inshore waters. EFH follows the continental shelf south of Georges Bank to the outer extent of the U.S. EEZ in the Gulf of Maine (NMFS 2017). **Juveniles/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 (NMFS 2017).						
Neonate/YOY	●	●	--	--	●	--	--	--	--	Pelagic
Juvenile	●	●	--	--	●	--	--	--	--	Pelagic
Adult	●	●	--	--	●	--	--	--	--	Pelagic
Basking Shark (*Cetorhinus maximus*)				**Neonates, Juveniles, and Adults:** Insufficient data are available to differentiate EFH between size classes, so EFH designations for all life stages have been combined. Aggregations tend to be associated with thermal fronts where areas of high prey density can be found, from the Gulf of Maine near the Great South Channel, approximately 75 kilometer southeast of Cape Cod and 75 kilometer south of Martha's Vineyard (NEFMC 2017).						
Neonate/YOY	●	●	--	--	●	--	--	--	--	Pelagic

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Juvenile	●	●	--	--	●	--	--	--	--	Pelagic
Adult	●	●	--	--	●	--	--	--	--	Pelagic
Common thresher shark (*Alopias vulpinus*)				**General habitat description**: The common thresher shark occurs in both coastal and oceanic and cool and warm waters and ranges from the south Atlantic to the Gulf of Maine. Females give birth to young once a year in the spring (Castro 1983). **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 of 18.2-20.9°C and at depths of 4.6-13.7 meters (NMFS 2017).						
Neonate/YOY	●	●	●	●	●	--	--	--	--	Pelagic
Juvenile	●	●	●	●	●	--	--	--	--	Pelagic
Adult	●	●	●	●	●	--	--	--	--	Pelagic
Dusky shark (*Carcharhinus obscurus*)				**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. Gives birth in the Chesapeake Bay in Maryland in June and July (NMFS 2017). **Neonates**: EFH includes areas along the Atlantic east coast of Florida to the mid-coast of Georgia, and South Carolina to southern Cape Cod (NMFS 2017). **Juveniles and Adults:** EFH designation for juvenile and adult life stages have been combined and are considered the same. EFH includes localized areas in the central Gulf of Mexico, southern Texas, the Florida Panhandle, mid-west coast of Florida, and Florida Keys. EFH also includes the Atlantic east coast of Florida and South Carolina to southern Cape Cod (NMFS 2017).						
Neonate/YOY	●	●	--	--	●	--	--	--	--	Pelagic
Juvenile	●	●	--	--	●	--	--	--	--	Pelagic

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Adult	●	●	--	--	●	--	--	--	--	Pelagic
Sand tiger shark (*Carcharias taurus*)				**General habitat description**: Sand tiger sharks occur off the coast of the northwest Atlantic and have been known to make transoceanic migrations and in North America. They are rarely encountered north of the Mid-Atlantic Bight. Nurseries for sand tiger sharks are most likely offshore, although little is known about the pupping grounds (NMFS 2017). **Neonates and Juveniles:** EFH for both neonate and juvenile life stages occurs along the Atlantic east coast from northern Florida to Cape Cod and includes the Plymouth, Kingston, Duxbury Bay system, Sandy Hook, and Narragansett Bays as well as coastal sounds, lower Chesapeake Bay, Delaware Bay, and Raleigh Bay. Nursery habitat for sand tiger shark is temperatures of 19-25°C, salinities of 23-30 ppt, and depths of 2.8-7 meters in sand and mud areas (NMFS 2017).						
Neonate/YOY	●	●	●	●	●	●	●	●	●	Mobile Benthic/Epibenthic – Soft Bottom / Complex
Juvenile	●	●	●	●	●	●	●	●	●	Mobile Benthic/Epibenthic – Soft Bottom / Complex
Adult	--	--	--	--	--	--	--	--	--	
Sandbar shark (*Carcharhinus plumbeus*)				**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 at depths of 20-55 meters. Nursery areas consist of shallow coastal waters from Cape Canaveral, Florida, to Martha's Vineyard, Massachusetts (NMFS 2017). **Juveniles**: Designated EFH for juveniles is in localized areas of the Atlantic coast of Florida, South Carolina, and southern North Carolina, and from Cape Lookout to southern New England. Juveniles will remain in or near the nursery grounds until late fall, later forming schools and migrating to deeper waters. Juvenile sandbar sharks return to nursery grounds during warmer months and repeat this migratory pattern until they are approximately 7 to 10 years of age and begin a wider migration into the adult life stage (NMFS 2017). **Adults:** EFH designations for adults occur within localized areas off Alabama and coastal areas from the Florida Panhandle to the Florida Keys in the Gulf of Mexico. Adults occur along the Atlantic coast from the shore to a depth of 280 meters in southern Nantucket, Massachusetts, to the Florida Keys (NMFS 2017). They migrate seasonally along the western Atlantic coast, moving north with warming water temperatures during the summer and south as temperatures begin to decrease during the fall (Collette and Klein-MacPhee 2002).						

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Neonate/YOY	--	--	--	--	--	--	--	--	--	
Juvenile	●	●	--	--	●	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom
Adult	●	●	--	--	●	--	--	--	--	Mobile Benthic/Epibenthic – Soft Bottom
Shortfin mako shark (*Isurus oxyrinchus*)				**General habitat description**: The shortfin mako shark is a pelagic, oceanic species that inhabits warm and warm-temperate waters throughout all oceans (NMFS 2017). **Neonates, Juveniles, and Adults:** Pelagic waters in the Atlantic from southern New England through Cape Lookout, and specific areas off Maine, South Carolina, and Florida (NMFS 2017).						
Neonate/YOY	●	●	--	--	●	--	--	--	--	Pelagic
Juvenile	●	●	--	--	●	--	--	--	--	Pelagic
Adult	●	●	--	--	●	--	--	--	--	Pelagic
Tiger shark (*Galeocerdo cuvier*)				**General habitat description**: The tiger shark ranges 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. Inhabits warm waters in both deep oceanic and shallow coastal regions. They occur in the western North Atlantic, but rarely occur north of the Mid-Atlantic Bight (Castro 1983). **Juvenile/Adults:** EFH extends from offshore pelagic habitats associated with the continental shelf break at the seaward extent of the U.S. EEZ boundary to the Florida Keys and is found in the central Gulf of Mexico and off Texas and Louisiana, and from Mississippi through the Florida Keys. EFH in the Atlantic Ocean extends from offshore pelagic habitats associated with the continental shelf break (NMFS 2017).						
Neonate/YOY	--	--	--	--	--	--	--	--	--	
Juvenile	●	●	--	--	--	--	--	--	--	Pelagic

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Adult	●	●	--	--	--	--	--	--	--	Pelagic
Porbeagle Shark (*Lamna nasus*)				**General habitat description:** Common in deep, cold waters of the North Atlantic, with separate stocks in the northwestern and northeastern Atlantic with little crossover (NMFS 2017). **Neonates, Juveniles, and Adults:** Insufficient information are available to separate EFH by life stage. EFH in the Atlantic Ocean includes offshore and coastal waters of the Gulf of Maine (not including Cape Cod Bay and Massachusetts Bay).						
Neonate/YOY	●	--	--	--	--	--	--	--	--	Pelagic
Juvenile	●	--	--	--	--	--	--	--	--	Pelagic
Adult	●	--	--	--	--	--	--	--	--	Pelagic
White shark (*Carcharadon carcharias*)				**General habitat description**: The white shark ranges within all temperate and tropical belts of oceans, including the Mediterranean Sea, where it occurs in coastal and offshore waters and has a very sporadic presence. Sightings of the white shark in the Mid-Atlantic Bight occur from April to December. The white shark prefers open ocean habitat (NMFS 2017). **Neonates**: EFH includes inshore waters out to 65.2 miles (104.9 kilometers) from Cape Cod, Massachusetts, to an area offshore of Ocean City, New Jersey (NMFS 2017). **Juveniles and Adults:** EFH includes inshore waters to habitats 65.2 miles (104.9 kilometers) from shore in water temperatures of 9-28°C, but most commonly observed in water temperatures of 14-23°C, from Cape Ann, Massachusetts, including parts of the Gulf of Maine, to Long Island, New York, and from Jacksonville to Cape Canaveral, Florida (NMFS 2017).						
Neonate/YOY	●	●	●	●	●	●	●	●	--	Pelagic
Juvenile	●	●	●	●	●	--	--	--	--	Pelagic
Adult	●	●	●	●	●	--	--	--	--	Pelagic

Species and Life Stage	Lease Area	Falmouth ECC	Worcester Avenue/ Central Park Landfalls	Shore Street Landfall	Brayton Point Offshore ECC	Sakonnet River ECC	Mount Hope Bay ECC	Aquidneck Island Landfalls	Brayton Point Landfalls	EFH Species Group
Spiny dogfish (*Squalus acanthias*)				**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). Spawning occurs offshore during the winter. Based on seasonal temperatures, spiny dogfish migrate up to 994.2 miles (1,600 kilometers) along the east coast and have been observed along the New Jersey coast in March (Bigelow and Schroeder 1953). **Adults:** Adults occur in deeper waters inshore and offshore from the shallows to depths of 900 meters, in water temperatures of 6-8°C, and seldom over 15°C (Collette and Klein-MacPhee 2002).						
Neonate/YOY	--	--	--	--	--	--	--	--	--	
Juvenile	●	--	--	--	--	--	--	--	--	Pelagic
Adult	●	●	--	--	●	--	--	--	--	Pelagic
Smoothhound shark complex (*Mustelus canis; M. norrisi; M. sinusmexicanus*)				**General habitat description**: The smooth dogfish is a common coastal species found from Massachusetts to northern Argentina. They are primarily demersal and inhabit coastal shelves and inshore waters to a maximum depth of 200 meters. Smooth dogfish is a migratory species that responds to water temperature and congregates between southern North Carolina and the Chesapeake Bay in the winter (NMFS 2017). **Neonates, Juveniles, and Adults:** EFH for smooth dogfish includes coastal areas from Cape Cod Bay, Massachusetts, to South Carolina, inclusive of inshore bays and estuaries (e.g., Delaware Bay, Long Island Sound). EFH also includes continental shelf habitats between southern New Jersey and Cape Hatteras, North Carolina (NMFS 2017).						
Neonate/YOY	●	●	●	●	●	●	--	--	--	Pelagic
Juvenile	●	●	●	●	●	●	--	--	--	Pelagic
Adult	●	●	●	●	●	●	--	--	--	Pelagic

Notes: ECC = Export Cable Corridor; YOY = Young of Year; • = present; -- = not present
Sessile Benthic/Epibenthic – Soft Bottom = includes slow-moving benthic/epibenthic species and/or life stages that associate with soft bottom habitat
Mobile Benthic/Epibenthic – Soft Bottom = includes the mobile juvenile and adult life stages of demersal fish species that associate primarily with or routinely use soft bottom habitat
Sessile Benthic/Epibenthic – Complex = includes sessile and slow-moving species and/or life stages that associate primarily with large-grained complex and complex benthic habitat
Mobile Benthic/Epibenthic – Complex = includes highly mobile species and/or life stages that associate primarily with large-grained complex and complex benthic habitat
Pelagic = includes species and life stages that are found primarily in the water column and at mid-depth or near the surface

Certain life stages of fish species, sessile and slow-moving invertebrates, and attached vegetation can be more susceptible to the effects of construction and operations of WTGs, OSPs, and ECCs due to a close association to the substrate or demersal habitat. The following list includes species with vulnerable life stages and habitat:

- Winter flounder eggs and larvae, which are demersal and are found in estuaries of Massachusetts and Rhode Island 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;
- Atlantic wolffish egg masses, which are hidden under boulders and cobbles;
- Atlantic herring eggs, which adhere to the bottom and form extensive egg beds;
- Longfin inshore squid demersal larvae and egg capsule clusters attached to rocks/small boulders or aquatic vegetation;
- Atlantic cod spawning (Fall to Winter);
- 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; and
- SAV, especially beds dominated by *Zostera marina*.

4.1 Habitat Areas of Particular Concern

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 2019). 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 2019).

4.1.1 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 2019). These areas have been identified as important for shelter, predation, nursery habitat, and, potentially, reproduction (MAFMC 1998). SAV and macroalgae have been shown to attract common summer flounder prey for both adults and juveniles (Packer et al. 1999).

No SAV or macroalgae habitats were observed in the benthic surveys within the Lease Area or Brayton Point ECC (Appendix K, SouthCoast Wind 2023). Macroalgae was observed at seven nearshore benthic sampling stations along the Falmouth ECC, and eelgrass was identified at the Falmouth landing areas in Massachusetts state waters. Direct disturbance of this area would be avoided by the use of HDD.

4.1.2 Juvenile Atlantic Cod HAPC

HAPC for juvenile Atlantic cod is defined as occurring between the mean high-water line and a depth of 66 feet (20 meters) 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 is not present within the boundaries of the Lease Area, but would be crossed by both the Brayton Point ECC and Falmouth ECC as the cable routes approach landfall.

The entirety of Mount Hope Bay is considered juvenile Atlantic cod HAPC (NMFS 2022). The segment of the Brayton Point ECC that crosses Mount Hope Bay is made up of 89 acres (36 hectares) or 3.5 percent of rocky habitats directly associated with this HAPC, over 90 percent Mud to Muddy Sand with 24 percent of Mud to Muddy Sand co-occurring with *Crepidula* shell substrate, and no SAV beds (INSPIRE 2022). Approximately 93 percent of the Sakonnet River portion of the Brayton Point ECC is made up of sediments of sand or finer grain size. Rocky habitats make up seven acres (2.8 hectares) or 0.2 percent while Mixed-Size Gravel in Muddy Sand to Sand make up 233 acres (94 hectares) or seven percent (INSPIRE 2022). *Crepidula* shell substrate is a co-occurring habitat in 18 percent of the ECC within the estuarine segment. Complex habitats, in the form of rock, coarse sediment, and *Crepidula* substrates, together with sandy habitats make up the components of the juvenile Atlantic cod HAPC in the Sakonnet River within the 20-meter depth contour. In Falmouth ECC, rocky habitats, SAV, and sandy habitats that comprise the juvenile Atlantic cod HAPC are also present within the 20-meter depth contour as the ECC approaches landfall (INSPIRE 2022).

4.1.3 Southern New England HAPC

On July 30, 2022, the NEFMC approved a new HAPC designation to address concerns over potential adverse impacts from offshore wind development on sensitive hard-bottom habitats and cod spawning activity. With evidence of cod spawning having been observed in an area known as Cox Ledge on the northwest corner of the Massachusetts and Rhode Island wind energy areas (Van Hoeck et al. 2023), the HAPC framework adjustment for southern New England was proposed for complex habitats and Atlantic cod spawning habitats which could potentially overlap with offshore wind project areas (NEFMC 2023). Adjustments to the Southern New England HAPC included designating cod spawning grounds on and surrounding Cox Ledge as a HAPC, designating the spawning grounds on and around Cox Ledge and any future cod spawning grounds identified in southern New England as HAPCs, designating all areas in southern New England with complex habitats as a HAPC, and designating the area overlapping offshore wind lease sites in Southern New England as a HAPC (NEFMC 2023). The spatial extent of the HAPC overlapping wind energy lease sites is based on the footprint of the lease areas, buffered by approximately 6.2 miles (10 kilometers) on all sides, combined with the footprint of the Cox Ledge spawning ground.

The Southern New England HAPC would comprise all large-grained complex and complex benthic habitats wherever present within the area bounded by a 6.2-mile (10-kilometer) buffer around the RI/MA and MA WEAs (Plante 2022). This would include:

- Hard bottom substrates, defined by the CMECS as Substrate Class Rock Substrate and by the four Substrate Groups: Gravels, Gravel Mixes, Gravelly, and Shell.
- Hard bottom substrates with epifauna or macroalgae cover.
- Vegetated habitats (e.g., SAV and tidal wetlands).

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). 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 NEFMC finalized the designation of the Southern New England HAPC on February 2, 2024, and the HAPC adjustments became effective on March 6, 2024 (NOAA 2024).

5. Adverse Effects

This section provides an analysis of the effects of the Proposed Action on designated EFH for managed species and life stages in the Project area defined in Section 2.1. As stated, the Project area is composed of the range of impact footprints resulting from the Wind Farm Area, OSPs, and ECCs. These footprints are defined by the geographic extent of measurable short-term, long-term, and permanent effects from project construction and operation. Potential effects on EFH are evaluated in this section by (1) determining if designated EFH occurs in one or more project footprints, and (2) determining if impact mechanisms are likely to impair the suitability of the affected habitat for the species and life stage in question. Adverse effects on EFH may include direct or indirect physical, chemical, or biological alterations of waters or substrates used by EFH species during their life cycle, impacts on pelagic and benthic prey organisms and their habitats, and other ecosystem components. Adverse effects may be short-term, long-term, or permanent, site-specific, or habitat-wide, and can result from the individual, cumulative, or synergistic consequences of actions (50 CFR § 600.910). If a project component is likely to result in a short-term, long-term, or permanent impairment of designated EFH for a managed species and life stage, this would constitute an adverse effect on EFH.

5.1 Construction and Operation Activities

Project construction would generate short-term and long-term direct and indirect effects on EFH through vessel activity, pile driving, seabed preparation, and installation of scour protection. Effects would include noise, crushing and burial, entrainment, and elevated suspended sediments and sediment deposition. These effects would occur intermittently and at varying locations in the Project area over the construction period. Therefore, 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 in the following sections.

5.1.1 Installation of WTG/OSP Structures and Foundations

5.1.1.1 Vessel Activity

During installation of the 147 WTGs and up to 5 OSP structures and associated foundations, it is estimated that 15 to 35 construction vessels per day on average would be necessary for the construction of the Project, with a maximum peak of 50 vessels in the Lease Area (SouthCoast Wind 2023). Vessel activity would occur intermittently during the construction period beginning with installation of the OSPs in Q2 of 2026 and continuing through the completion of WTG installation in Q4 of 2031 (Figure 2-2).

5.1.1.1.1 Habitat Disturbance

Certain construction vessels such as jack-up vessels or hotel vessels would require the use of stabilization spuds and anchors during WTG and OSP installation, which would disturb benthic EFH and EFH species that rely on that habitat. These activities would take place within the 127,388-acre Wind Farm Area. Vessels that use anchors (rather than spud cans) to hold position generally have a greater potential to disturb the seabed and result in crushing or burial impacts and habitat loss or conversion. Aside from monopile installation activities, vessels within the Wind Farm Area would primarily use dynamic positioning systems to hold position and would not result in such impacts. SouthCoast Wind has estimated that a total of 74.5 acres of soft-bottom habitat would be disturbed by anchoring of vessels during construction of the Proposed Action, including the installation of the WTGs and OSPs (SouthCoast Wind 2023).

Anchor placement and retrieval, anchor chain sweep, and spud placement could cause habitat loss or conversion by disturbing or crushing habitat in the immediate area where anchors, chains, and spuds meet the seafloor, resulting in short-term to long-term direct impacts on EFH for sessile benthic/epibenthic species. EFH in soft bottom habitats would likely recover in the short-term through natural sediment transport processes and recolonization by habitat-forming organisms from adjacent habitats. Based on recovery rates observed at the nearby Block Island Wind Farm (HDR 2020), soft bottom habitat is expected to recover within 1.5 to 2 years following cessation of disturbance.

Anchoring activities could also result in the crushing and burial of sessile or slow-moving benthic/epibenthic EFH species and/or life stages, resulting in direct, permanent (lethal), localized impacts on these species. Benthic/epibenthic communities in soft bottom habitat would be recoverable in the short-term. Anchor placement and retrieval, anchor chain sweep, and spud placement could cause mobile benthic and pelagic EFH species, as well as benthic and pelagic prey species, to avoid the area of impact, resulting in direct, short-term, localized impacts on these species. Sessile or slow-moving prey species could be crushed or buried as a result of anchoring activities, resulting in indirect short-term effects on pelagic and mobile benthic EFH species and/or life stages that feed on those species. Anchoring activities could also result in the direct mortality of immobile, longfin squid egg mops and damage and/or disturb nests guarded by ocean pout. To minimize anchoring impacts and reduce impacts on EFH and EFH species, SouthCoast Wind has committed to an Applicant Mitigation Measure (AMM) to avoid anchoring on sensitive habitat during construction activities (Section 6.1).

5.1.1.1.1.1 Direct Effects on EFH and EFH Species

- Short-term loss/conversion of EFH (AMM for avoidance of sensitive habitat when anchoring):
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Mobile Benthic/Epibenthic – Soft Bottom
  - Pelagic
  - Prey Species – Benthic/Epibenthic
  - Prey Species – Pelagic
- Permanent, localized crushing and burial of EFH species:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Prey Species –Benthic/Epibenthic
- Short-term avoidance of anchoring activities by EFH species:
  - Mobile Epibenthic/Benthic – Soft Bottom
  - Pelagic
  - Prey Species – Benthic/Epibenthic
  - Prey Species – Pelagic

5.1.1.1.1.2 Indirect Effects on EFH and EFH Species

- Short-term loss of benthic prey items:
  - Mobile Benthic/Epibenthic – Soft Bottom

5.1.1.1.2 Sediment Suspension/Redeposition

Some Project vessel activities, such as those associated with anchoring (e.g., anchor placement and retrieval, chain sweep, and/or spud placement), would result in sediment suspension, a concomitant increase in turbidity in the water column, and sedimentation. 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 on EFH resulting from a decrease in habitat quality for benthic species and life stages, with small sessile or slow-moving benthic EFH species and life stages experiencing greater impacts from deposition than larger, mobile species or life stages.

Egg and larval life stages are sensitive to suspended sediment and can experience sublethal or lethal effects from as little as 0.4 inch (10 millimeters) of sediment deposition (Kjelland et al. 2015; Michel et al. 2013; Wilber and Clarke 2001). Certain species (e.g., winter flounder) are particularly sensitive to sediment deposition and can experience mortality at burial depths less than 0.1 inch (3 millimeters) (Michel et al. 2013). Modeling of sediment deposition associated with the Proposed Action has been limited to cable emplacement and HDD activities, which estimated that the sediment deposition thickness from cable emplacement would generally fall below 0.2 inch (5 millimeters) within 79 feet (24 meters) of the trench centerline (SouthCoast Wind 2023, Appendix F1). Modeling of dredging effects at the HDD exit pit is expected to have similar limited effects, with deposits exceeding 0.2-inch (5-millimeters thickness found at respective maximum distances of 85 feet and 105 feet (26 meters and 32 meters). This indicates that anchoring, which would disturb sediment over a shorter distance than cable emplacement, would generate sediment deposition levels of 0.1 inch (3 millimeters) only in immediate proximity to the anchoring footprint. Benthic habitats exposed to measurable burial depths from anchoring would be rendered temporarily unsuitable for EFH species with benthic or epibenthic eggs and larvae in the Lease Area.

Adult and juvenile fishes exposed to elevated suspended sediment levels may temporarily cease feeding, abandon cover, and/or experience short-term physiological stress. Modeling of suspended sediments associated with the Proposed Action has been limited to cable emplacement activities, which estimated that maximum plume distances were typically between 620 and 1,654 feet (189 and 504 meters) from the trench centerline and dissipated to levels below 1 milligram per liter for any of the simulated scenarios within 4 hours of the disturbance. This indicates that anchoring, which would disturb sediment over a shorter distance than cable emplacement, would generate elevated turbidity levels only in immediate proximity to the anchoring footprint and only for a short duration. However, short-term exposure to elevated suspended sediment levels, such as those anticipated from anchoring, are not expected to have adverse effects on filter-feeding bivalves (USACE 2020; Wilber and Clarke 2001; Yang et al. 2017).

5.1.1.1.2.1 Direct Effects on EFH and EFH Species

- Short-term decrease in quality of EFH resulting from suspended sediments and increased turbidity:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Mobile Benthic/Epibenthic – Soft Bottom
    - Pelagic
- Short-term, local impacts resulting from sedimentation:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Prey Species – Benthic

5.1.1.1.2.2 Indirect Effects on EFH and EFH Species

- Short-term loss of foraging opportunities:
    - Mobile Epibenthic/Benthic – Soft Bottom
    - Pelagic
- Short-term decrease in quality of EFH in areas adjacent to Project activities:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Mobile Benthic/Epibenthic – Soft Bottom
    - Prey Species – Benthic

5.1.1.1.3 Vessel Noise

Vessel noise may have several effects on fish and invertebrates, including interfering with feeding and breeding, altering 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), masking important environmental auditory cues (Codarin et al. 2009; Radford et al. 2014), and inducing 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 about 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 generated by vessels has been observed to cause avoidance behavior in hearing specialist fish species (e.g., Atlantic herring [*Clupea harengus*] and Atlantic cod [*Gadus morhua*]) and is likely to cause similar behavior in other hearing specialist species (Vabø et al. 2002; 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). Noise from vessel activity could potentially have an impact on Atlantic cod reproduction by reducing the efficiency of low-frequency vocalizations used to locate potential mates and signal fertility (Stanley et al. 2017). Analysis of vessel noise related to the Cape Wind Energy Project observed that underwater noise generated by construction vessels at 10 feet (3 meters) was loud enough to cause an avoidance response in fish, but not loud enough to do physical harm (MMS 2008). Pelagic species and life stages and prey species that inhabit the upper water column (e.g., Atlantic butterfish, Atlantic herring, Atlantic mackerel, bluefish, and some highly migratory pelagic species) are the most likely to be affected by vessel noise, although the behavioral avoidance impacts would be short-term. However, benthic species and life stages inhabiting inshore, shallow waters could also be affected. Demersal and benthic invertebrates are generally less sensitive to underwater noise compared to fish and are not expected to be affected by vessel-related noise. Project-related vessel noise would be intermittent and of short duration, so the overall impacts on fish are expected to be negligible. 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.

5.1.1.1.3.1 Direct Effects on EFH and EFH Species

- Short-term, local avoidance responses to vessel noise:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Mobile Benthic/Epibenthic – Soft Bottom

  - Sessile Benthic/Epibenthic – Complex
  - Mobile Benthic/Epibenthic – Complex
  - Pelagic
  - Prey Species – Benthic/Epibenthic
  - Prey Species – Pelagic

5.1.1.1.4 Potential Introduction of Exotic/*Invasive Species*

Non-native (i.e., exotic) species can be accidentally released in the discharge of ballast water and bilge water during vessel activities. Although not all non-native species may survive introduction into a new ecosystem or cause adverse ecological effects, increasing vessel traffic throughout the construction duration of the project would increase the risk of accidental releases of species that may become invasive. Vessels are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR 151.2025) and USEPA NPDES Vessel General Permit standards, 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. Invasive species also have the potential to use foundations as stepping stones to expand their geographic range (Adams et al. 2014). 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.

5.1.1.1.4.1 Direct Effects on EFH and EFH Species

- Extremely low likelihood, but potentially long-term and wide-spread impacts on any or all EFH and EFH species:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Mobile Benthic/Epibenthic – Soft Bottom
  - Sessile Benthic/Epibenthic – Complex
  - Mobile Benthic/Epibenthic – Complex
  - Pelagic
  - Prey Species – Benthic/Epibenthic
  - Prey Species – Pelagic

5.1.1.1.4.2 Indirect Effects on EFH and EFH Species

- Extremely low likelihood of competition with invasive species, loss of foraging opportunities:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Mobile Benthic/Epibenthic – Soft Bottom
  - Sessile Benthic/Epibenthic – Complex
  - Mobile Benthic/Epibenthic – Complex
  - Pelagic

  - Prey Species – Benthic/Epibenthic
  - Prey Species – Pelagic

5.1.1.2 Pile Driving and Jacket Installation

Impact pile driving would be required during the installation of up to 147 WTGs and up to five OSP foundations but limited to a total of 149 monopile or piled jacket foundation positions. Installation of a single WTG or OSP monopile foundation is estimated to require approximately 4 hours of piling. It is anticipated that a maximum of one monopile foundation can be driven into the seabed per day assuming 24-hour pile-driving operation. Installation of a single WTG pin-piled jacket substructure is estimated to require approximately 8 hours of pile driving (2 hours of pile driving per pin pile foundation, four piles per jacket substructure), with up to one substructure installed per day assuming 24-hour pile-driving operations. For all three OSP piled jacket options (modular, integrated, and HVDC-converter), installation of a single pin pile is anticipated to take up to 2 hours of pile driving with a maximum of eight pin piles that could be driven into the seabed per day, assuming 24-hour pile-driving operations. Suction-bucket jacket foundations may be used as substructures for up to 85 WTG/OSP positions in the southern portion of the Lease Area associated with Project 2. As summarized in Table 2-2, installation of the WTG foundations would occur from Q2 through Q4 in 2028, 2029, and 2030 for piled jacket and monopiles and Q2 of 2030 to Q3 of 2031 for suction bucket jackets. Installation of the OSPs would occur from Q2 of 2026 through Q4 of 2030.

5.1.1.2.1 Underwater Sound

Pile driving would generate noise exceeding established thresholds for mortality, permanent or temporary injury, and behavioral effects in fish and invertebrates. Underwater noise would temporarily render the affected habitats unsuitable for EFH species and could temporarily impact prey availability for EFH species. The extent of these stressors would be limited to ensonified areas within the Lease Area and would depend on the noise sensitivity of EFH species, as described below. 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). As installation activities for suction-bucket jackets are considered the least noise-emitting among foundation types considered for the Project (ICF 2021), the assessment of acoustic impacts provided in the following section emphasizes direct acoustic effects on EFH-designated species and their life stages from pile driving activity associated with monopile and piled-jacket foundation installation.

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. 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 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 cause 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). 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). Solé et al. (2018, 2022) exposed various species of cephalopod larvae to underwater noise comparable to impact pile driving and observed similar statocyst injuries that were likely to negatively affect survival. Solé et al. (2022) found that exposure to impact pile driving noise above 170 dB re 1 µPa^2 caused observable damage to statocysts in cuttlefish larvae, and that those effects could be attributed to the sound pressure, (versus particle motion) component of noise. That damage resulted in an apparent reduction in survival and reduced response to predator stimuli in the developing larvae. Solé et al. (2018) observed similar statocyst damage in two species of squid exposed to maximum peak noise levels of 175 dB re 1 µPa. While Kusel et al. (2021) did not explicitly model exposure distances to these thresholds, their findings suggest that project-related impact pile driving could cause injury-level effects on cephalopods at distances several thousand feet or more from a foundation site.

The current underwater noise thresholds consider 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, thresholds for particle motion exposure are not currently available because of the difficulty of measuring fish sensitivity to this component of sound (Popper et al. 2014; Popper and Hawkins 2018).

Table 5-1. Acoustic metrics and thresholds for fish currently used by NMFS and BOEM for impulsive pile driving

Fish Group	Onset of Physical Injury		Behavioral Disturbance
	L_{pk}	$L_{E,\ 24\text{-hour}}$	L_p
Fish equal to or greater than 2 grams [a,b]	206	187	150
Fish less than 2 grams [a,b]	206	183	150
1- Fish without swim bladder [c]	213	216	150
2- Fish with swim bladder not involved in hearing [c]	207	203	150
3- Fish with swim bladder involved in hearing [c]	207	203	150

L_E = weighted cumulative sound exposure level in decibels referenced to 1 microPascal squared second; also written SEL_{cum}
L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
L_p = root mean squared sound pressure level in decibels referenced to 1 microPascal squared; also written SPL_{rms} or L_{rms}

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] NMFS recommended criteria adopted from Andersson et al. (2007); Mueller-Blenkle et al. (2010); Purser and Radford (2011); Wysocki et al. (2007).
[c] BOEM recommended criteria from Popper et al. (2014)
Source: Limpert et al. (2024); FHWG (2008); Popper et al. (2014).

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 (1) organisms without swim bladders; (2) fish with swim bladders not involved in hearing; and (3) fish with swim bladders involved in hearing. 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, fish eggs and larvae	Flatfish, monkfish, sharks, rays, some tunas, cephalopods	Species are less susceptible to barotrauma. Detect particle motion but not sound pressure, but some barotrauma may result from exposure to sound pressure.
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

Acoustic propagation modeling of the impact pile-driving activities for the Proposed Action was undertaken by JASCO Applied Sciences (Limpert et al. 2024) to determine distances to the established fish injury and disturbance thresholds and provided as Appendix A to the *Petition for Incidental Take Regulations* for the Project (LGL 2024), which constitutes the results presented herein (Table 5-3). The acoustic model considered tapered monopiles that are 52 feet (16 meters) in diameter at the expected waterline and jacket foundations with 15-foot (4.5-meter)-diameter jacket pin piles. Sound fields from 52 feet (16 meter) monopiles and 15-foot (4.5-meter) jacket pin piles were modeled at two representative locations in the Lease Area using a 6,600 kilojoule impact hammer and a 3,300 kilojoule impact hammer, respectively. The modeling also applied a 10-dB-per-hammer-strike noise attenuation, which is considered achievable with currently available technologies (Bellman 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.

Table 5-3. Acoustic radial distances ($R_{95\%}$ in kilometers) for fish during pile driving under various scenarios at the higher impact of two modeled locations for both seasons, with 10-decibel noise attenuation from a noise-abatement system

Faunal Group	Unit	Threshold Level	Location 1			Location 2		
			16 m Monopile Scenario, NNN 6600 (b) hammer	4.5 m Pre-piled Jacket Scenario, MHU 3500S (b) hammer	4.5 m Post-piled Jacket Scenario, MHU 3500S (b) hammer	16 m Monopile Scenario, NNN 6600 (b) hammer	4.5 m Pre-piled Jacket Scenario, MHU 3500S (b) hammer	4.5 m Post-piled Jacket Scenario, MHU 3500S (b) hammer
Acoustic Radial Distances to Thresholds ($R_{95\%}$ in kilometers) during Winter								
Behavioral (all fish) [b]	L_p	150 dB	17.22	10.79	13.02	12.35	9.11	11.07
Single Strike Injury (all fish) [a]	L_{pk}	206 dB	0.15	0.05	0.06	0.11	0.05	0.06
Injury over 24hr (fish ≥ 2 grams) [a]	L_E	187 dB	9.68	6.83	8.21	7.69	5.36	6.30
Injury over 24hr (fish < 2 grams) [a]	L_E	183 dB	13.19	9.63	11.78	10.10	7.48	8.74
Acoustic Radial Distances to Thresholds ($R_{95\%}$ in kilometers) during Summer								
Behavioral (all fish) [b]	L_p	150 dB	13.86	9.28	10.99	9.69	7.34	8.34
Single Strike Injury (all fish) [a]	L_{pk}	206 dB	0.14	0.05	0.06	0.11	0.05	0.06
Injury over 24hr (fish ≥ 2 grams) [a]	L_E	187 dB	8.50	6.31	7.34	6.51	4.77	5.48
Injury over 24hr (fish < 2 grams) [a]	L_E	183 dB	10.99	8.50	9.63	8.26	6.26	7.17

Cumulative sound exposure level values were calculated for a 24-hour period. Values shown were at the middle (b) hammer energy.
L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
L_E = weighted cumulative sound exposure level in decibels referenced to 1 microPascal squared second; also written SEL_{cum}
L_p = root mean squared sound pressure level in decibels referenced to 1 microPascal squared; also written SPL_{rms} or L_{rms}
Sources:
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
Source: Summarized from Tables 50 – 55 in Limpert et al. (2024)

Single-strike peak sound pressure (SPL_{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 based on sound exposure level (SEL_{cum}) consider total estimated daily exposure, meaning a fish would have to remain within that threshold distance over the entire daily period of installation to experience injury. The exposure distances for behavioral effects (SPL_{RMS}) can be met without prolonged exposure, 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. Modeling results (Table 5-3) indicate that acoustic radial distances were generally smaller in Location 2 and in the summer. Results modeled in the winter at Location 1 show that noise levels exceeding the injury threshold from a single strike is limited to 0.09 miles (0.15 kilometers) from the monopile, 0.03 miles (0.05 kilometers) from pre-piled jacket pin piles, and 0.04 miles (0.06 kilometers) from post-piled jacket pin piles. For fish greater than 2 grams, injury from prolonged cumulative exposure (24 hours), assuming 10 dB of attenuation is applied, extends as far as 6 miles (9.68 kilometers) during monopile driving, 4.2 miles (6.83 kilometers) for pre-piled jacket pin pile driving, and 5.1 miles (8.21 kilometers) for post-piled jacket pin pile driving. For fish less than 2 grams, cumulative exposure in the winter is expected at distances between 8.2 miles (13.19 kilometers) for monopile driving, 5.9 miles (9.63 kilometers) for pre-piled jacket pin pile driving, and 7.32 miles (11.78 kilometers) for post-piled jacket pin pile driving. Results modeled in Location 1 indicate that behavioral effects on fish could occur between 5.8 and 10.7 miles (9.3 and 17.2 kilometers) depending on the season and equipment (monopile vs. jacket pin pile), with monopile installation in the winter having the greatest acoustic range. 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). Biological cues used by soniferous fishes for communication may also be masked potentially disrupting foraging and breeding (Mooney et al. 2020) while pile driving is ongoing. 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. Additionally, brief disturbance may not necessarily disrupt Atlantic cod spawning. For example, Morgan et al. (1997) observed the dispersal of a spawning aggregation of Atlantic cod by the passage of a single bottom trawl for a brief period (approximately 1 hour), after which the aggregation returned to the affected area and resumed spawning. In another study, McQueen et al. (2022) observed that exposure to seismic airgun noise did not cause displacement of Atlantic cod from their spawning grounds. They speculated that strong site affinity could explain the lack of a significant behavioral response to an otherwise intensive stressor. These contrasting findings suggest that short-term periods of disturbance may not necessarily result in adverse effects on Atlantic cod spawning. Similarly, recent research suggests that longfin squid spawning may be not adversely affected by pile-driving noise. In laboratory experiments where longfin squid were exposed to recordings of pile-driving noise from the installation of the Block Island Wind Farm, longfin squid did not demonstrate significant changes in reproductive behaviors (Stanley et al. 2023). The results from this study suggest that noise exposure is potentially more disruptive to squid feeding behavior and anti-predator responses than to spawning activity.

Behavioral disturbance to fish and invertebrates from pile driving noise is considered temporary for the duration of the activity. To mitigate impacts to the extent practicable, the Project will use a noise attenuation system that achieves at least 10 dB reduction in sound levels, and will employ soft starts during impact piling, allowing a gradual increase of hammer blow energy, thus allowing mobile marine life to leave the area. Time of year restrictions may also be employed to limit construction noise exposure to soniferous species, such as Atlantic cod, and to avoid disrupting spawning aggregations that may form within the Project area (Nantucket Shoals).

Underwater noise generated by impact pile driving 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. Noise from pile driving would cause short-term stress and behavioral changes to some EFH-designated species. 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. Impact pile driving would produce acoustic impacts that would adversely affect EFH for fish and invertebrates (Table 5-3) and distance from the pile. EFH species could exhibit physiological and behavioral impacts depending on intensity and duration of the acoustic impact, distance from the sound source, and hearing sensitivity. The noise levels would temporarily make the habitat less suitable and cause individuals to vacate the area of Project activities. Pile driving is anticipated to cause adverse impacts on EFH for both pelagic and demersal life stages; however, this impact will be short-term and EFH is expected to return to pre-pile driving conditions. Affected areas would likely be recolonized by finfish in the short-term following completion of pile-driving activity. Early sessile life stages of finfish and invertebrates, 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).

5.1.1.2.1.1 Direct Effects on EFH and EFH Species

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

5.1.1.2.2 Habitat Conversion

The installation of 147 52.5-foot (16-meter)-diameter monopile foundations for the WTGs and two monopile OSP foundations of the same size would render approximately 376 acres of benthic habitat unavailable to EFH species for the entire 30-year life of the Project through decommissioning when the foundations are removed. For piled-jacket foundations, the equivalent estimated benthic habitat disturbance area is 403 acres. SouthCoast Wind is considering suction-bucket jackets for up to 85 WTG/OSP positions in the southern portion of the Lease Area associated with Project 2. If suction-bucket jackets are used, maximum benthic habitat disturbance would be 598 acres associated with 85 WTG/OSP suction-bucket jackets and 64 WTG/OSP piled-jacket foundations. The installation of these vertical structures in the Lease Area, where the average water depth is approximately 164 feet (50 meters) (SouthCoast Wind 2023), would introduce approximately 93 acres of new hard surfaces to the water column extending from the seabed to the water surface. The resulting underwater vertical structure from any foundation type installed would alter the characteristics of pelagic habitats used by many EFH species and their prey and foraging resources. Over time, these new hard surfaces will become colonized by sessile organisms, creating complex habitats that effectively serve as artificial reef. In addition to reef effects, the WTGs may 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 5.1.3.2.

The artificial reef effect created by offshore structures, such as WTGs, is well documented and can have an attractive effect on many marine species (Wilber et al. 2022; Degraer et al. 2020; Hutchison et al. 2020a; Langhamer 2012; Peterson and Malm 2006; Ruebens et al. 2013; Wilhelmsson et al. 2006). OSP foundations may utilize an increased numbers of legs for support, leading to more surface area for settling benthic organisms. Some WTG options such as pin-pile and suction-bucket jacket foundations (Figure 2-5 and Figure 2-6) and OSP design options B and C (Figure 2-9 and Figure 2-10) could have up to 24 cross beams between foundation legs that provide more overhead structure for sheltering fishes and more foraging opportunities for predatory species. This can lead to localized increases in fish abundance and changes in community structure. In a meta-analysis of studies on windfarm reef effects, Methratta and Dardick (2019) observed an almost universal increase in the abundance of epibenthic and demersal fish species. However, effects on pelagic fish species are less clear (Floeter et al. 2017; Methratta and Dardick 2019). On balance, the reef effect of offshore windfarms is likely to produce a neutral to beneficial effect on epibenthic and demersal EFH. However, these beneficial effects could be offset if the colonizable habitats provided by offshore wind energy structures aggregate predators and prey, increasing predation risk, or provide steppingstones for non-native species invasions (De Mesel et al. 2015; Raoux et al. 2017). Artificial structures may provide opportunities for range expansion by invasive species in conjunction with range shifts due to climate change (Degraer et al. 2020; Langhamer 2012; Schulze et al 2020), which would constitute a synergistic cumulative effect.

The invasive tunicate *Didemnum vexillum* has been expanding its presence in New England waters. Benthic monitoring at the Block Island Wind Farm has shown that this species is part of a diverse faunal community on morainal deposits and is an early colonizer along the edges of anchor scars left in mixed sandy gravel with cobbles and boulders (Guarinello and Carey 2020). Four years after construction at the Block Island Wind Farm, *D. vexillum* was common on WTG structures (HDR 2020). Studies have shown that activities that cause fragmentation of *D. vexillum* colonies can facilitate its distribution (Lengyel et al. 2009; Morris and Carman 2012). It is important to minimize or eliminate activities that return fragmented colonies of *D. vexillum* to the water column, to reduce the spread of this invasive species (Morris and Carman 2012). The effects of foundation installation within hard bottom habitat where *D. vexillum* is present could fragment the invasive colonies. Also, the addition of new hard substrate from scour protection and foundations may provide suitable habitat and a potential for this invasive species to expand its geographic range.

Hutchison et al. (2020a) and Wilber et al. (2022) documented fish responses to reef effects at the Block Island Wind Farm. They observed a notable increase in the abundance of black sea bass, an EFH species, in proximity to the WTG foundations. This species is known to associate with complex benthic habitat and artificial reef structures and is clearly benefiting from the habitat and foraging opportunities created by the artificial reef effect. Several other fish species have also been observed in abundance, including EFH species like Atlantic cod, scup, bluefish, monkfish, winter flounder, and dogfish (Hutchison et al. 2020a; Wilber et al. 2022). Atlantic striped bass and tautog, highly valued commercial and recreational fish species, have also been observed in abundance around the structures (Hutchison et al. 2020a; Wilber et al. 2022). Similar changes in fish community structure would likely occur in the Lease Area as the reef effect matures. Degraer et al. (2020) indicate that the finfish community around artificial structures differs significantly from the surrounding natural habitat, as would be expected with the introduction of novel hard surfaces available for colonization by habitat forming organisms.

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 are 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. 2019). The trophic resources used by suspension feeders could include pelagic eggs or larvae of EFH species, as well as prey resources for ichthyoplankton. 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 previously, the colonization of the WTG and OSP foundations 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. 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. 2020a). Around the foundations, colonizing organisms on the surface of the piles would likely enhance food availability and food web complexity through an accumulation of organic matter (Degraer et al. 2020; Mavraki et al. 2020b). Increased fish abundance can also alter predator prey relationships. For example, Russel et al. (2014) observed that seals appear to concentrate foraging activity around WTG foundations, presumably to exploit the higher abundance and concentration of prey organisms associated with reef effects. While localized effects are possible, ecosystem modeling studies of a European windfarm did not detect a significant difference in key food web indicators before and after construction (Raoux et al. 2017). Even though the biomass of certain taxa increased in proximity to the wind farm, trophic group structure was functionally similar between the before and after scenarios. Thus, large-scale food web shifts are not expected due to the installation of WTGs and conversion of pelagic habitat to hard surface.

The new habitats created by the WTG and OSP foundations could have a variety of indirect effects on fish and other aquatic species occurring in the vicinity. For example, pelagically-oriented juvenile and adult fish may be attracted to the complex habitats formed on the vertical structures in search of cover and foraging opportunities. Surface and pelagically-oriented eggs and larvae would be exposed to filter-feeding invertebrates in open water habitats where they did not previously exist. Fish concentrations around the monopile habitats may attract marine mammals and commercial and recreational fishers.

During suction-bucket jacket substructure installation, soft-bottom benthic and epibenthic EFH species that occur within the 65.6-foot (20-meter) diameter of each of the four foundation suction buckets could be exposed to lethal crushing, burial, or entrainment effects as the suction buckets are embedded into the seafloor to a penetration depth of up to 65.6 feet (20 meters). Soft-bottom benthic habitats within the area of each suction bucket would be rendered unavailable to EFH species that utilize this habitat type as it is converted to hard-bottom by the bucket substructure.

The net effect of WTG and OSP foundations would be adverse for benthic EFH associated with soft-bottom habitat, and likely to be neutral to beneficial for epibenthic, demersal, and pelagic EFH depending on species-specific responses, with the recognition that beneficial effects could be negated should these structures inadvertently promote the establishment of invasive species on the mid-Atlantic OCS.

5.1.1.2.2.1 Direct Effects on EFH and EFH Species

- Long-term, adverse effects on EFH and EFH species resulting from decrease in preferred habitat:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Mobile Benthic/Epibenthic – Soft Bottom
    - Prey Species – Benthic/Epibenthic

- Long-term, beneficial effects on EFH and EFH species resulting from increase in preferred habitat:
    - Sessile Benthic/Epibenthic – Complex
    - Mobile Benthic/Epibenthic – Complex
    - Pelagic
    - Prey Species – Pelagic
- Permanent, localized crushing and burial of EFH species:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Mobile Benthic/Epibenthic – Soft Bottom
    - Prey Species – Benthic/Epibenthic

5.1.1.2.2.2 Indirect Effects on EFH and EFH Species

- Long-term, adverse effects on 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
    - Mobile Benthic/Epibenthic – Complex
    - Prey Species – Benthic/Epibenthic
    - Prey Species – Pelagic

5.1.1.2.3 Sediment Suspension/Redeposition

The installation of up to 85 suction-bucket jacket foundations in the southern portion of the Lease Area as part of Project 2 may result in sediment suspension, increased turbidity in the water column, and sediment redeposition. Because the suction bucket will be lowered to the seabed in a controlled manner, sediment plumes resulting from contact with the seafloor are only expected to occur in the immediate area of the suction bucket and at minimal heights from the seabed. There is minimal information available on turbidity and sediment deposition levels that are associated with the deployment and installation of suction bucket foundations. As suction bucket foundations require less benthic disturbance compared to other offshore wind foundation types (ICF 2021), it was assumed that suspended sediment plumes produced during the installation of suction-bucket jacket foundations would be similar to, or less than, those associated with site preparation activities such as dredging for sand bedform clearing. Near bottom sediment plumes caused by suction hopper dredgers have been found to extend approximately 2,300 to 2,400 feet (701 to 731 meters) down-current from the dredge (NMFS 2020 citing ACOE 1983) but can extend as far as 3,937 feet (1,200 meters) (NMFS 2020 citing Wilbur and Clarke 2001). Near-field total suspended sediment (TSS) concentrations can range from 80 to 475 milligrams per liter but decrease exponentially with increasing time and distance from the active dredge due to settling and dispersion, quickly reaching ambient concentrations with majority of re-suspended sediments resettling close to the dredge within one hour (NMFS 2020 citing Anchor Environmental 2003). Based on this information, the localized sediment plume generated by suction bucket installations may extend up to 1,200 meters along the seabed at suspended sediment concentrations of 475 milligrams per liter or less, with higher concentrations possible immediately adjacent to the suction bucket. The plume is expected to dissipate rapidly, such that sediment disturbance is not expected to cause cumulative or long-lasting impacts on water quality.

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 resulting from a decrease in habitat quality for benthic species and life stages, with small sessile or slow-moving benthic EFH species and life stages experiencing greater impacts from deposition than larger, mobile species or life stages that are able to avoid areas of reduced water quality.

Egg and larval life stages are sensitive to suspended sediment and can experience sublethal or lethal effects from as little as 0.4 inches (10 millimeters) of sediment deposition (Kjelland et al. 2015; Michel et al. 2013; Wilber and Clarke 2001). Egg and larval stages of certain fish species (e.g., winter flounder) are particularly sensitive to sediment deposition and can experience mortality at burial depths less than 0.1 inch (3 millimeters) (Michel et al. 2013). Further, sediment deposition depths between 0.4 and 1.2 inches (10 and 30 millimeters) could result in sublethal to lethal effects on benthic life stages of sessile bivalves. Benthic habitats exposed to measurable burial depths during suction-bucket jacket foundation installation would be rendered temporarily unsuitable for EFH species with sessile, benthic or epibenthic eggs and larvae in the Lease Area. Installation of suction-bucket jacket foundations would generate measurable sediment deposition levels only in the immediate area of seabed contact and only until suspended sediment has redeposited on the seafloor, such that impacts of sediment deposition on EFH and EFH species would be short-term and localized.

Adult and juvenile fishes exposed to elevated suspended sediment levels may temporarily experience sublethal effects (e.g., ceased feeding, abandoning cover, short-term physiological stress) and behavioral avoidance effects. Short-term exposure to TSS concentrations exceeding 1,000 milligrams per liter has been associated with sublethal and behavioral avoidance effects on adult marine and estuarine fishes, while concentrations of less than 500 milligrams per liter are more commonly associated with behavioral avoidance (Michel et al. 2013; Wilber and Clarke 2001). Adult bivalves may experience sublethal effects of suspended sediments at TSS concentrations of 1,000 mg/L or higher (Wilber and Clarke 2001). As described above, the TSS concentrations associated with site preparation activities (475 milligrams per liter or less) would suggest that suspended sediment associated with the deployment of a suction bucket foundation is unlikely to cause sublethal effects but may cause behavioral avoidance within the sediment plume produced during suction bucket installation. Elevated turbidity levels would occur for a short duration, such that impacts of suspended sediment on juvenile and adult fishes with EFH in the vicinity of the Proposed Action would be short-term and localized.

5.1.1.2.3.1 Direct Effects on EFH and EFH Species

- Short-term, localized decrease in quality of EFH resulting from increased turbidity from suspended sediment:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Mobile Benthic/Epibenthic – Soft Bottom
  - Pelagic
- Short-term, localized impacts resulting from redeposition of suspended sediment:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Prey Species – Benthic/Epibenthic

5.1.1.2.3.2 Indirect Effects on EFH and EFH Species

- Short-term, localized loss of foraging opportunities resulting from turbidity and redeposition of suspended sediment:
  - Mobile Benthic/Epibenthic – Soft Bottom

5.1.1.2.4 Entrainment

Entrainment and subsequent mortality of planktonic organisms may occur during the installation of up to 85 suction-bucket jacket WTG foundations in the southern portion of the Lease Area as part of Project 2. Using ichthyoplankton and zooplankton density data from plankton surveys conducted by the NOAA NEFSC Ecosystem Monitoring (EcoMon) survey program (NOAA NEFSC 2019) within 3.10 miles (5 kilometers) of the SouthCoast Wind suction-bucket jacket installation area, a total per foundation seawater displacement volume of 27,200 cubic meters (6,800 m^3 per bucket x 4 buckets per foundation), and a 16-month construction schedule for suction-bucket jacket installations between the start of Q2 2030 (April 2030) to the start of Q3 2031(July 2031) (Figure 2-2), monthly plankton entrainment estimates resulting from this Project activity were calculated (Appendix B). Excluding unidentified fish (Pisces), the ichthyoplankton taxa with the highest estimated monthly larval entrainment were the Atlantic mackerel (944,475; June), sand lance (394,397; January), hake (259,068; August), and gulf stream flounder (248,608; September). Summer flounder and Atlantic cod were estimated to have relatively low monthly larval entrainment in the suction-bucket jacket installation area with a peak of 16,614 (October) and 3,920 (February) individuals, respectively. Total estimated entrainment (number of individuals) by taxa from start to completion of suction-bucket jacket foundation installation was highest for Atlantic mackerel (954,383) followed by sand lance (869,447), gulf stream flounder (507,854), and hake (488,465). While entrainment estimates were generated from the best available data, these estimates do not reflect the current species composition in the study area, seasonality, population dynamics, and natural variability due to the limitations of the data set used and given that no project-specific studies have been conducted to characterize the local composition of plankton species in the vicinity of the suction bucket installation area and the susceptibility of these species to the impacts of entrainment. As the installation of suction-bucket jacket foundations is a one-time localized action, entrainment impacts are considered short-term and limited to the immediate vicinity of the installation activity. More detail on the suction-bucket jacket installation entrainment assessment is provided in Appendix B.

Many fish species in the region exhibit broadcast spawning or other high fecundity reproductive strategies that produce thousands to millions of eggs per fish (e.g., Kelly and Stevenson 1985; Kjesbu 1989; Morse 1980; Papaconstantinou and Vassilopoulou 1986; Pitt 1971). Given these high fecundity rates, entrainment mortality at the scale estimated here is not expected to result in population-level effects on EFH species. It is important to note that the entrainment analysis excluded fish eggs, such that the estimates presented are less than the potential entrainment of all life stages. However, given the high natural mortality of the egg stage for most fish species and the relatively small volume of water being withdrawn, entrainment mortality of eggs is expected to be small relative to natural egg mortality. Entrainment mortality would also remove some small organisms that are consumed by planktivorous species, potentially resulting in a loss in foraging opportunity for sessile EFH species (e.g., filter-feeding invertebrates). However, mobile and pelagic species are not expected to experience losses in foraging opportunities because they can move to feed in areas outside the suction bucket foundation footprint.

5.1.1.2.4.1 Direct Effects on EFH and EFH Species

- Short-term, localized, negligible entrainment effects on early life stages of EFH species:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Pelagic

  - Prey Species – Benthic/Epibenthic
  - Prey Species – Pelagic

5.1.1.2.4.2 Indirect Effects on EFH and EFH Species

- Short-term loss of food sources for planktivorous species, including filter-feeding invertebrates:
  - Sessile Benthic/Epibenthic – Soft Bottom

5.1.1.3 Seabed Preparation (Including UXO Removal)/Boulder Relocation

Seabed preparation may be required prior to the installation of WTG and OSP foundations in certain areas depending on seabed condition and the foundation type. Seabed preparation activities may include removal of surface or subsurface debris and in-situ UXO/Munitions and Explosives of Concern disposal. Currently, no specific benthic impact calculations (i.e., acres disturbed) exist for seabed debris removal prior to WTG and OSP foundation installation. Boulder removal and/or clearance will occur where boulders are present and cannot be avoided with micro-siting. For the Lease Area, boulder field removal is not expected. Seabed preparation in the Lease Area would occur from Q1 of 2027 to Q3 of 2029 (Figure 2-2), as required.

5.1.1.3.1 Habitat Loss/Conversion

The entire Lease Area, including potential converter OSP locations, is classified as soft bottom, and SouthCoast Wind does not plan to micro-site foundations. For as long as the foundations remain in place, the area affected by seabed preparation would be rendered unavailable for EFH species associated with complex, heterogenous complex, and soft bottom benthic habitats during one or more life stages. Seabed preparation would therefore result in a long-term, localized, adverse effect on EFH lasting through the lifespan of the proposed Project.

Benthic or epibenthic eggs that occur within the Project area could be exposed to lethal crushing, burial, or entrainment effects. This includes eggs and larvae of 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.

EFH species with benthic or epibenthic adults that occur within the Project area could be exposed to lethal crushing, burial, or entrainment effects. Most adults of EFH species in the area are likely to exhibit behavioral avoidance responses and would not be subject to lethal crushing, burial, or 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) and subject to impacts from seabed preparation for WTG and OSP 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.

5.1.1.3.1.1 Direct Effects on EFH and EFH Species

- Long-term, localized, adverse effects on EFH and EFH species/life stages resulting from decrease in preferred habitat for:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Mobile Benthic/Epibenthic – Soft Bottom
    - Sessile Benthic/Epibenthic – Complex
    - Prey Species – Benthic/Epibenthic

5.1.1.3.2 Sediment Suspension/Redeposition

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

Low-order (deflagration) or high-order (detonation) in-situ disposal of UXO/discarded military munitions (DMM) has the potential to affect benthic resources via direct disturbance and sediment suspension/redeposition. SouthCoast Wind is commissioning an evaluation of UXO/DMM in the Offshore Project area and will provide this information to BOEM when the study is completed. Impacts of UXO/DMM disposal are expected to be short term and direct, with the potential to cause injury or mortality to benthic species within the direct vicinity of the disposal activities.

Changes to the Project design and additional impacts that were not considered in the EFH assessment could occur in the unlikely event that UXO/DMM are discovered in the project footprint. These changes could include the primary strategy of the micrositing of monopile foundations and cable routes to avoid UXO/DMM hazards, and/or the removal and relocation of UXO/DMM 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 permanent 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 on complex benthic habitat in specific circumstances. The removal and relocation of UXO/DMM would result in similar 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/DMM relocation.

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

Unexploded Ordnance (UXO removal) for Mayflower Wind Farm Construction (Hannay and Zykov 2022).

5.1.1.3.2.1 Direct Effects on EFH and EFH Species

- Short-term, localized, adverse effects on EFH and EFH species/life stages resulting from sediment suspension and deposition would affect the following groups:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Mobile Benthic/Epibenthic – Soft Bottom
    - Prey Species – Benthic/Epibenthic

5.1.1.3.3 Underwater Sound (UXO/DMM Disposal)

If high-order detonation is necessary to remove certain UXO/DMM, the underwater explosion(s) would generate high pressure levels that could kill, injure, or disturb fish and invertebrates. Species could exhibit physiological impacts depending on size of the UXO/DMM, distance from the sound source, and hearing sensitivity. The noise levels would temporarily make the habitat less suitable and cause individuals to vacate the area of Project activities. UXO/DMM disposal during site preparation activities, if necessary, is anticipated to cause adverse impacts on EFH for both pelagic and benthic life stages; however, this impact would be short-term and EFH exposed to acoustic impacts from UXO/DMM disposal is expected to return to pre-demolition conditions following cessation of the disposal activities. SouthCoast Wind is commissioning an evaluation of UXO/DMM in the Offshore Project area and will provide this information to BOEM when the study is completed.

Injury to fish from exposures to blast pressure waves is attributed to compressive damage to tissues surrounding the swim bladder and gastrointestinal tract, which may contain small gas bubbles. Effects of detonation pressure exposures to fish have been assessed in Hannay and Zykov (2022) according to the SPL limits for onset of mortality or injury leading to mortality due to explosives, as recommended by the American National Standards Institute (ANSI) expert working group (Popper et al. 2014) and provided in Table 5-4. The onset of mortality and physical injury thresholds for underwater explosives are the same for all fish species groups. For fish species that use swim bladders for hearing, Popper et al. (2014) suggest a high likelihood of temporary threshold shift (TTS) and recoverable injury at near and intermediate distances, where near refers to within a few tens of meters and intermediate refers to a few hundreds of meters. For fish species with swim bladders not used for hearing, the guidelines indicate high likelihood of recoverable impairment at near and intermediate distances but low levels of TTS at intermediate distances. For fish without swim bladders, the guidelines indicate low likelihood of recoverable injury at intermediate distances, moderate likelihood of TTS at intermediate distances, and low levels of both effects at far distances of a few kilometers (Table 5-4).

Table 5-4. Recommended Fish Injury thresholds for explosives from Popper et al. (2014)

Type of Animal	Onset of Mortality	Onset of Physical Injury	Recoverable Injury	Temporary threshold shift (TTS)	Masking	Behavior
Fish: no swim bladder (particle motion detection)	229 – 234 dB (L_{PK})	206 dB (L_{PK}) 187 dB (L_E)	(N) High (I) Low (F) Low	(N) High (I) Moderate (F) Low	N/A	(N) High (I) Moderate (F) Low
Fish where swim bladder is not involved in hearing (particle motion detection)			(N) High (I) High (F) Low	(N) High (I) Moderate (F) Low		(N) High (I) High (F) Low
Fish: where swim bladder is involved in hearing (primarily pressure detection)			(N) High (I) High (F) Low	(N) High (I) High (F) Low		(N) High (I) High (F) Low

L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
L_E = frequency weight sound exposure level in decibels referenced to 1 microPascal squared second; also written as SEL
Note: N = near (distance within a few tens of meters), I = intermediate (distance within a few hundreds of meters), F= far (distance within a few kilometers).
Source: Hannay and Zykov (2022); Popper et al. (2014); NMFS 2023

The greatest exceedance distance to the onset of injury for the largest UXO size (454 kg) with no noise mitigation measures is 847 meters (Table 5-5). During UXO detonation, noise mitigation would be required, and the likely achieved noise mitigation would be approximately 10 dB. Results show that when mitigation measures are applied, the maximum distance to the onset of injury threshold exceedance for the largest UXO size is reduced to 290 meters from the source, thereby, further reducing the risk of injury to fish from UXO detonation (Table 5-5). The implementation of mitigation measures coupled with the unlikely detonation of UXO, the low number of potential detonations required for the Proposed Action (modeled for no more than 10), further reduces the potential for exposure to finfish and other EFH species.

Table 5-5. Unmitigated and mitigated maximum exceedance distances for onset of injury for fish without and with a swim bladder due to peak pressure exposures for various UXO sizes. The threshold of 229 dB re 1 μPa is from Popper et al. (2014).

Species	Onset of Mortality L_{PK} (dB re 1 μPa)	All sites: Maximum distance to L_{PK} threshold exceedance (m)				
		E4 (2.3 kg)	E6 (9.1 kg)	E8 (45.5 kg)	E10 (227 kg)	E12 (454 kg)
All fish hearing groups (unmitigated)	229	145	230	393	671	847
All fish hearing groups (10 dB mitigation)	229	49	80	135	230	290

dB = decibel; kg = kilogram; m = meter; UXO = unexploded ordnance
L_{pk} = peak sound pressure level in decibels referenced to 1 microPascal squared; also written as SPL_{pk}
Note: E4 to E12 are UXO charge sizes with corresponding weight in kilograms
Source: Hannay and Zykov (2022)

5.1.1.3.3.1 Direct Effects on EFH and EFH Species

- Short-term, localized, adverse effects on EFH and EFH species/life stages for all Hearing Categories.
- Short-term, localized, adverse effects on EFH and EFH species/lifestages would affect the following groups:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Mobile Benthic/Epibenthic – Soft Bottom
  - Sessile Benthic/Epibenthic – Complex
  - Mobile Benthic/Epibenthic – Complex
  - Pelagic
  - Prey Species – Benthic/Epibenthic
  - Prey Species – Pelagic

5.1.1.3.4 Underwater Sound (Vessels)

The impacts and direct and indirect effects on 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.

5.1.1.4 Installation of Scour Protection

5.1.1.4.1 Habitat Loss/Conversion

The placement of scour protection (e.g., rock, mattresses, sandbags) around the WTG and OSP foundations would convert an estimated 376 acres of soft-bottom habitat to complex, hard-bottom habitat when using monopile foundations and 403 acres when using piled-jacket foundations. If suction-bucket jackets are used, maximum seabed disturbance with scour protection from up to 85 WTG/OSP positions using suction-bucket jackets and the remaining 64 WTG/OSP positions using piled-jacket foundations would be 598 acres. The soft-bottom benthic habitats that existed previously in the footprint of the scour protection would no longer be available to EFH species for the entire 30-year life of the Project through decommissioning when the foundations and scour protection are removed. Over time, these concrete and natural rock surfaces would become colonized by sessile organisms and would gradually evolve into functional habitat for EFH species that prefer complex habitat. The projected increase in abundance of epibenthic and demersal fish species resulting from the reef effect (Methratta and Dardick 2019) suggests a beneficial expansion of available EFH for species associated with complex benthic habitat like Atlantic cod, black sea bass, and scup. However, it could take a decade or more for the reef effect to develop before fully functional habitat status is achieved (Auster and Langton 1999; Collie et al. 2005; Tamsett et al. 2010). Therefore, the addition of complex benthic habitat is expected to provide a beneficial increase in available EFH lasting for approximately 20 years of Project life. These features may or may not be removed when the Project is decommissioned, depending on the habitat value they provide.

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 affected due to the placement of 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 scour protection. EFH-designated species that would likely be affected by crushing and burial effects of installation of scour protection are similar to those listed in Section 5.1.1.1.

The design and type of scour protection to be used at foundation installation sites will be dependent on location-specific depths, currents, and sediment characteristics (Matutano et al. 2013). In North Sea wind farms, the addition of scour protection has been found to result in higher abundance and diversity of epibenthic species (ter Hofstede et al. 2022) with different forms of scour protection likely having varying effects on fauna (Lengkeek et al. 2017). Rock (i.e., crushed rock or boulders) is the most commonly used material for scour protection as it is strong, stable, erosion resistant, and suitable for benthic flora and fauna settlement (Glarou et al. 2020). The addition of rocky scour protection has been found to have a positive impact on benthic macrofauna and associated fish species (Coolen et al. 2019) by providing three-dimensional hard-substrate habitat which is used by marine life to settle, forage, and shelter (ter Hofstede et al. 2022). Increasing habitat complexity vertically and horizontally by using a variation in rock sizes or by making heaps and berms may facilitate a greater reef effect by introducing more surface area for settlement of benthic invertebrates and offering different sized cavities in which rock-dwelling species can shelter (ter Hofstede et al. 2022). Adding complexity through design manipulations is also possible on concrete-gravel aggregates as seen in artificial reefs (Glarou et al. 2020), however, concrete scour protection used in offshore wind farms such as concrete mattresses may take 3 to 12 months to fully cure following placement, during which time the hard substrate would be toxic to eggs, larvae, and invertebrates (Lukens and Selberg 2004). While the use of synthetic frond material (i.e., artificial seaweeds/reefs/frond mats) as scour protection does not provide adequate surface area and space for colonization, they mimic vegetation and can provide added ecological function when used in combination with other scour protection materials (Langhamer 2012). Lengkeek et al. (2017) categorized scour protection materials according to their potential for enhancing ecological function. Large structures providing holes such as concrete with holes, artificial reefs, and drainage pipes may promote aggregation and increase the abundance of large mobile species (e.g., Atlantic cod) by providing adequate shelter. Materials that mimic natural biogenic substrates such as shell material and biorock can promote the settlement of bivalves and other molluscs. Smaller-scale structures providing fine habitat complexity such as fiber-mesh enclosed stone bundles, in addition to the previous scour protection material categories, may enhance overall native biodiversity. In general, scour protection around wind turbine foundations have the potential to provide food, shelter, and reproduction grounds for fish, as well as settlement grounds for bivalves, macroalgae, and other benthic species (Glarou et al. 2020).

5.1.1.4.1.1 Direct Effects on EFH and EFH Species

- Permanent, adverse effects on EFH and EFH species resulting from decrease in preferred habitat:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Mobile Benthic/Epibenthic – Soft Bottom
    - Prey Species – Benthic/Epibenthic
- Long-term, beneficial effects on EFH and EFH species resulting from increase in preferred habitat:
    - Sessile Benthic/Epibenthic – Complex
    - Mobile Benthic/Epibenthic – Complex
    - Pelagic
    - Prey Species – Pelagic

5.1.1.4.1.2 Indirect Effects on EFH and EFH Species

- Permanent, adverse effects on 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
  - Mobile Benthic/Epibenthic – Complex
  - Prey Species – Benthic/Epibenthic
  - Prey Species – Pelagic

5.1.1.4.2 Sediment Suspension/Redeposition

Installation of the scour protection for the WTGs and OSPs would disrupt approximately 376 acres of primarily soft-bottom benthic habitat when using monopile foundations and 403 acres when using piled-jacket foundations. If suction-bucket jackets are used, maximum seabed disturbance with scour protection from up to 85 WTG/OSP positions using suction-bucket jackets and the remaining 64 WTG/OSP positions using piled jacket foundations would be 598 acres. 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 on benthic habitat would occur locally and temporarily at each of the proposed WTG and OSP locations because of the predominately sandy composition of the upper sediments in the Project area. EFH-designated species that would likely be affected sediment suspension associated with the installation of scour protection are similar to those listed in Section 5.1.1.1.

5.1.1.4.2.1 Direct Effects on EFH and EFH Species

- Short-term, localized decrease in quality of EFH resulting from suspended sediments and increased turbidity:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Mobile Benthic/Epibenthic – Soft Bottom
  - Pelagic
- Short-term, localized impacts from sedimentation:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Prey Species – Benthic/Epibenthic

5.1.1.4.2.2 Indirect Effects on EFH and EFH Species

- Short-term, localized loss of foraging opportunities:
  - Mobile Benthic/Epibenthic – Soft Bottom
  - Pelagic
- Short-term, localized decrease in quality of EFH in areas adjacent to Project activities:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Mobile Benthic/Epibenthic – Soft Bottom
  - Prey Species – Benthic/Epibenthic

5.1.2 Interarray and Offshore/Onshore Cable Installation

5.1.2.1 Vessel Activity

During installation of the interarray cables and ECCs, it is anticipated that one to three cable lay barge vessels and, one to five cable transport and lay vessels would be necessary for the installation of the interarray cables and offshore export cable (Table 2-5). Other vessels involved include anchor handling tugs, scour protection installation vessels, dredging vessels, and support vessels. Vessel activity would occur intermittently during the construction period beginning with the installation of the export cables in Q4 of 2026 and continuing through the completion of cable installation in Q3 of 2030 (Figure 2-2).

5.1.2.1.1 Habitat Disturbance

The cable laying vessel will use dynamic positioning and will not require the use of anchors. Some of the support vessels may require anchoring and/or spudding during the installation of the cables, which may disturb benthic EFH and EFH species associated with that habitat. Vessel anchoring associated with cable emplacement will occur along approximately 12 to 25 miles (20 to 40 kilometers) of the nearshore ECCs: through Mount Hope Bay and the Sakonnet River for the Brayton Point ECC, and in portions of the Falmouth ECC directly east and southeast of Martha’s Vineyard and portions nearest the landfall sites (Figure 2-13).. Anchored vessels are not expected be used for the interarray cable installation in the Lease Area (SouthCoast Wind 2023). The total estimated seabed disturbance resulting from vessel anchoring in identified ECC anchoring areas (Figure 2-13) is 2.8 acres (1.1 hectares) for the Brayton Point ECC and 8.9 acres (3.6 hectares) for the Falmouth ECC. Within the identified anchoring segments of the Brayton Point ECC, impacts from this activity are expected to occur over a variety of habitat complexity types comprised of 78 percent soft bottom habitats, 0.4 percent heterogenous complex habitats, 18 percent complex habitats, 0.1 percent large-grained complex habitats, and 3 percent anthropogenic material (SouthCoast Wind 2023, Appendix M.3). Within the identified anchoring segments of the Falmouth ECC, impacts from this activity are expected to occur over a variety of habitat complexity types comprised of 31 percent soft bottom habitats, 3 percent heterogenous complex habitats, 47 percent complex habitats, and 18 percent large-grained complex habitats (SouthCoast Wind 2023, Appendix M.3).

In addition to impacts to soft-bottom habitats and prey species from vessel anchoring presented in Section 5.1.1.1.1, habitat disturbance on EFH from anchoring during cable installation are expected to also impact complex habitats along the export cable routes. In areas of complex, hard bottom habitat, anchoring activities could change the composition of benthic habitat by creating furrows of soft bottom habitat through boulder and cobble substrates. This would permanently modify the distribution of substrates in the affected area, resulting in long-term to permanent effects on benthic habitat composition and benthic habitat structure. To minimize anchoring impacts and reduce impacts on EFH and EFH species, SouthCoast Wind has committed to an AMM to avoid anchoring on sensitive habitat during construction activities (Section 6.1). While benthic/epibenthic communities in soft bottom habitat would be recoverable in the short-term, benthic/epibenthic communities in complex habitat would be recoverable in the short-term to long-term. Anchoring activities could also result in the direct mortality of immobile, longfin squid egg mops and damage and/or disturb nests guarded by ocean pout attached to hard substrates.

5.1.2.1.1.1 Direct Effects on EFH and EFH Species

- Short-term loss/conversion of EFH (AMM for avoidance of sensitive habitat when anchoring):
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Mobile Benthic/Epibenthic – Soft Bottom
    - Sessile Benthic/Epibenthic – Complex

  - Mobile Benthic/Epibenthic – Complex
  - Pelagic
  - Prey Species – Benthic/Epibenthic
  - Prey Species – Pelagic
- Permanent, localized crushing and burial of EFH species:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Sessile Benthic/Epibenthic – Complex
  - Prey Species –Benthic/Epibenthic
- Short-term avoidance of anchoring activities by EFH species:
  - Mobile Epibenthic/Benthic – Soft Bottom
  - Mobile Epibenthic/Benthic – Complex
  - Pelagic
  - Prey Species – Benthic/Epibenthic
  - Prey Species – Pelagic

5.1.2.1.1.2 Indirect Effects on EFH and EFH Species

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

5.1.2.1.2 Sediment Suspension/Redeposition

In general, vessel activities (i.e., anchoring and/or spudding) associated with cable installation would cause short-term impacts on water quality intermittently throughout Project construction. These benthic disturbances would increase turbidity and suspend sediment in the water column. The potential impacts on water quality, and by extension, EFH and EFH-designated species, such as resuspension of sediments, would be short-term and localized. Impacts of sediment suspension on EFH from anchoring during array and export cable installation are expected to be similar to impacts that would occur during installation of the WTG and OSP foundations, as described in Section 5.1.1.1.2.

5.1.2.1.3 Underwater Noise (Vessels)

Impacts of vessel noise on EFH from anchoring during array cable installation are expected to be similar to impacts of vessel noise that would occur during installation of the WTG and OSP foundations, as described in Section 5.1.1.1.

5.1.2.2 Seabed Preparation (Including UXO Removal/Boulder Relocation/Dredging)

Seabed preparation may be required prior to installation of interarray and offshore export cables and may include seabed leveling and removal of surface or subsurface debris such as boulders, lost fishing gear, or lost anchors. A pre-lay grapnel run using a grapnel plow will be completed along the entire length of each export cable route (along the anticipated centerline) within the ECCs, and along the entire length of each interarray cable route within the Lease Area, shortly before cable installation. Excavation may be required where debris is buried or partially buried. The specific grapnel equipment has not been determined, but

SouthCoast Wind will coordinate with federal and state agencies as well as notify commercial and recreational fishermen prior to initiation of the pre-lay grapnel run. Seabed preparation would occur intermittently during the construction period beginning with the start of export cable installation in Q4 of 2026 and continuing through the completion of export and interarray cable installations in Q3 of 2030 (Figure 2-2).

Seabed leveling via constant flow excavator or dredging steep features, such as sand waves, via trailing suction hopper dredger or water injection dredger may be used to achieve the targeted cable burial depth. Sand wave clearance is not expected in the Brayton Point ECC or in the Lease Area in preparation for interarray cable installation. Sand wave clearance areas in the Falmouth ECC are expected to potentially occur within a 0.9 mile (1.4 kilometer) and 2.1 mile (3.4 kilometer) section north of Martha’s Vineyard, and a 2.1 mile (3.4 kilometer) section within the Muskeget Channel (Figure 2-13). Within the sandwave clearance segments of the Falmouth ECC, impacts from this activity are expected to occur over a variety of habitat complexity types comprised of 55 percent soft bottom habitats, 33 percent complex habitats, and 12 percent large-grained complex habitats (SouthCoast Wind 2023, Appendix M.3).

A boulder relocation plan is currently in development, but anticipated boulder clearance areas have been outlined (SouthCoast Wind 2023, Appendix M.3). These areas are defined as 49 feet (15 meters) in width for each cable installation. In areas where the use of a boulder clearance plow is necessary, the plow is pulled along the seabed and scrapes the seabed surface pushing boulders out of the cable corridor, flattening sand ripples in the process. In low-density boulder fields, an orange peel grabber may be utilized for boulder relocation minimizing impacts to sensitive and slow to recover habitats utilized by hard-bottom associated EFH species. The boulder grab will be used to the extent possible, and the use of the 49-foot-wide (15 meters) boulder plow will be minimized. If the use of boulder plow is necessary, the plow may be ballasted to only clear boulders and avoid the creation of a deep depression in the seabed. However, as boulders constitute complex benthic habitat, boulder relocation could potentially alter the composition of both the original and relocated habitat. Boulder relocation may result in effectively permanent alteration of benthic habitat where boulders are displaced into soft bottom habitat, or where boulders are removed exposing soft bottom habitats.

Boulder relocation is not expected to be needed along the interarray cable routes within the Lease Area. Along the Falmouth ECC, boulder clearance is anticipated to potentially occur within segments of the ECC spanning a total of 14.9 miles (24 kilometers) (Figure 2-13; INSPIRE 2022). Boulder clearance areas for the Falmouth ECC are not expected in federal waters and only within Massachusetts state waters. A 9.9-mile (15.9-kilometer) boulder clearance area occurs as the Falmouth ECC goes between Martha’s Vineyard and Nantucket. Benthic habitat was analyzed in the Muskeget Channel region, within an 8.2-mile (13.2-kilometer) section of the Falmouth ECC that consisted of the complex habitats of Coarse Sediments (1,091 acres), Coarse Sediments with Boulder Fields (22 acres), and Glacial Moraine A (1,008 acres; INSPIRE 2022). Additionally, a 5-mile (8.1-kilometer) boulder clearance area is expected as the Falmouth ECC crosses the Gravel Pavement and Glacial Moraine A in Nantucket Sound and approaches landfall. There is also a small area of Sand with SAV (0.06 acres) on the western edge of the Falmouth ECC approximately 0.6 miles (1 kilometer) from the southeast corner of Martha’s Vineyard (Table 3-5; INSPIRE 2022). Within the boulder relocation segments of the Falmouth ECC, impacts from this activity are expected to occur over a variety of habitat complexity types comprised of 23 percent soft bottom habitats, 3 percent heterogenous complex habitats, 44 percent complex habitats, and 29 percent large-grained complex habitats (SouthCoast Wind 2023, Appendix M.3). In the Falmouth ECC, up to 498 acres (202 hectares) may be temporarily impacted by boulder removal. Potential habitats impacted include 144 acres (58 hectares) of large-grained complex habitat, 220 acres (89 hectares) of complex habitat, 17 acres (7 hectares) of heterogenous habitat, and 117 acres (47 hectares) of soft bottom habitat.

Along the Brayton Point ECC, boulder clearance is anticipated to potentially occur within segments of the ECC spanning a total of 31.3 miles (50.4 kilometers) (Figure 2-13; INSPIRE 2022). Five segments over

23.1 miles (37.1 kilometers) within federal waters are mostly comprised of Sand with Boulder Fields, with some small sections of Glacial Moraine A. As the Brayton Point ECC crosses into Rhode Island state waters, the boulder clearance area continues through some dispersed Boulder Fields for another 6.4 miles (10.3 kilometers) before ending at the mouth of the Sakonnet River as it enters the estuarine waters of Narragansett Bay. In the southernmost area of Mount Hope Bay there is a 1.9-mile (3.0 kilometer) section of anticipated boulder clearance within Mud to Muddy Sand – Shell/Crepidula Substrate with scattered boulders and debris. Within the boulder relocation segments of the Brayton Point ECC, impacts from this activity are expected to occur over a variety of habitat complexity types comprised of 79 percent soft bottom habitats, 5 percent heterogenous complex habitats, 13 percent complex habitats, 3 percent large-grained complex habitats, and 0.3 percent anthropogenic material (SouthCoast Wind 2023, Appendix M.3). In the Brayton Point ECC, up to 1,135 acres (459 hectares) may be temporarily impacted by boulder removal. Habitat types potentially impacted include 4 acres (1.4 hectares) of anthropogenic habitat, 31 acres (13 hectares) of large grained complex habitat, 150 acres (61 hectares) of complex habitat, 56 acres (23 hectares) of heterogeneous complex habitat, and 894 acres (362 hectares) of soft bottom habitat.

5.1.2.2.1 Habitat Alteration

SouthCoast Wind has estimated that seabed preparation prior to cable installation would result in short-term disturbances to benthic habitat occur over an estimated area of up to 99 acres for interarray cables within the Lease Area, up to 690 acres within the Falmouth ECC, and up to 130 acres within the Brayton Point ECC (SouthCoast Wind 2023). Seabed preparation in these areas would be expected to disturb both soft-bottom and complex benthic habitats. Additionally, boulder fields are present along the Falmouth ECC including portions of the Muskeget Channel and in the Brayton Point ECC which includes sections of the Sakonnet River and Mount Hope Bay. Medium- and low-density boulder fields in large-grained complex habitats 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). 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.

Sand waves and biogenic depressions are a component of juvenile and adult EFH used by red and silver hake. Seabed preparation (i.e., sand wave clearance by dredging) and cable installation would flatten depressions and ripples and mega-ripples, and damage structure provided by habitat forming organisms, such as amphipod tubes. Amphipods are important prey for several soft bottom EFH species and life stages including red hake (juveniles), winter flounder (young-of-year, juveniles, and adults), and winter skates (juveniles and adults), and impacts on these biogenic features could result in limited prey availability for these species and refuge from predators. These combined effects would reduce habitat suitability within the cable installation footprint for EFH species that associate with soft bottom habitat. Sand wave clearance is anticipated to occur in segments of the Falmouth ECC within the Muskeget Channel and northeast of Martha's Vineyard (Figure 2-13). Sand waves are naturally dynamic features in soft bottom benthic habitats. As such, these habitat features are expected to recover rapidly from seabed preparation impacts, within 18 to 24 months following initial disturbance through natural sediment transport processes and recolonization by habitat-forming organisms from adjacent habitats. This conclusion is supported by knowledge of regional sediment transport patterns (Butman and Moody 1983; Dalyander et al. 2013), observed recovery rates from seabed disturbance at the nearby Block Island

Windfarm (HDR 2020), and recovery rates from similar bed disturbance impacts observed in other regions (de Marignac et al. 2009; Dernie et al. 2003; Desprez 2000).

Long-term to permanent impacts of artificial structures associated with the Project, as well as affected species are discussed in Section 5.1.3.1.

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

5.1.2.2.1.1 Direct Effects on EFH and EFH Species

- Short-term loss/conversion of EFH:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Mobile Benthic/Epibenthic – Soft Bottom
    - Sessile Benthic/Epibenthic – Complex
    - Mobile Benthic/Epibenthic – Complex
    - Pelagic
    - Prey Species – Benthic/Epibenthic
    - Prey Species – Pelagic
    - Juvenile Atlantic Cod HAPC
    - Southern New England HAPC

5.1.2.2.1.2 Indirect Effects on EFH and EFH Species

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

5.1.2.2.2 Sediment Suspension/Redeposition

Sediment suspension, increase in water column turbidity, and redeposition will occur as a result of seabed preparation activities. As previously discussed in Section 5.1.1.1.2, 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 on EFH resulting from a decrease in habitat quality for benthic species and life stages, with small sessile or slow-moving benthic EFH species and life stages experiencing greater impacts from deposition than larger, mobile species or life stages. Sediment redeposition would be minimal and close in vicinity to the trench centerline, minimizing impacts on demersal fish eggs. Sediment deposition thickness from cable emplacement would generally fall below 0.2 inch (5 millimeters) within 79 feet (24 meters) of the trench centerline (SouthCoast Wind 2023, Appendix F1). Direct impacts on foraging habitat are expected to be localized to the width of the trench and short-term as benthic organisms would recolonize the area.

5.1.2.2.2.1 Direct Effects on EFH and EFH Species

- Short-term decrease in quality of EFH resulting from suspended sediments and increased turbidity:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Mobile Benthic/Epibenthic – Soft Bottom
    - Prey Species – Pelagic
- Short-term, local impacts resulting from sedimentation:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Prey Species – Benthic
    - Juvenile Atlantic Cod HAPC
    - Southern New England HAPC

5.1.2.2.2.2 Indirect Effects on EFH and EFH Species

- Short-term loss of foraging opportunities:
    - Mobile Benthic/Epibenthic – Soft Bottom
    - Pelagic
- Short-term decrease in quality of EFH in areas adjacent to Project activities:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Mobile Benthic/Epibenthic – Soft Bottom
    - Prey Species – Benthic/Epibenthic

5.1.2.2.3 Entrainment

Some types of seabed preparation equipment that use hydraulic systems (e.g., constant flow excavator; trailing suction hopper dredgers) and may be used for seabed leveling or sand wave clearance in segments of the Falmouth ECC north of Martha’s Vineyard and within the Muskeget Channel make water withdrawals, which can entrain planktonic larvae of benthic fauna (e.g., larval polychaetes, mollusks, crustaceans) and fish. Hydraulic dredging methods pose a high risk of entrainment to benthic or epibenthic eggs, larvae, and juvenile fish through the direct uptake of organisms by the suction field generated at the draghead during dredging operations (Reine et al. 1998). While potential for entrainment may be high, overall mortality rates of entrained fish may be lower depending on the scale of the dredging operation and type of hydraulic dredger (Wenger et al. 2017). The mortality rate of estuarine fish entrained by hydraulic dredging activities in Grays Harbor, Washington was found to be 38 percent when a suction hopper dredger was used (Armstrong et al. 1982). Because of the limited volume of water withdrawn, BOEM does not expect population-level impacts on any given species. This is because the rate of egg and larval survival to adulthood for many species is naturally very low (MMS 2009).

5.1.2.2.3.1 Direct Effects on EFH and EFH Species

- Loss of EFH and EFH species due to water intake for eggs, larvae, and small juveniles:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Mobile Benthic/Epibenthic – Soft Bottom
    - Pelagic

  - Prey Species – Benthic/Epibenthic
  - Prey Species – Pelagic

5.1.2.2.3.2 Indirect Effects on EFH and EFH Species

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

5.1.2.2.4 Underwater Noise (Vessels)

The impacts on EFH and EFH species resulting from underwater sound generated by vessels associated with seabed preparation would be similar to those impacts analyzed in Section 5.1.1.1.

5.1.2.3 Trenching/Cable Installation

5.1.2.3.1 Habitat Loss/Conversion

The maximum total installed interarray cable length is 497 miles (800 kilometers). Interarray cable installation will be completed via jetting, wherever possible, with alternative methods that include surface lay, trenching, and plowing. Direct impacts on EFH due to habitat disturbance are expected along the entire length of the interarray cable within the 19.7 foot (6 meter) wide surface impact along each cable corridor (SouthCoast Wind 2023). Both jetting (e.g., vertical injector, jetting ROV/sled) and mechanical (e.g., plowing, trenching) cable installation methods would produce similar crushing and burial effects, benthic habitat disturbance, and suspended sediment impacts to EFH and associated species. Additionally, the water intake from jetting methods would cause entrainment impacts on pelagic eggs and larvae, whereas the mechanical methods would not. An estimated 1,186 acres of short-term benthic disturbance in soft-bottom habitat is anticipated during the interarray cable installation process in the Lease Area (SouthCoast Wind 2023). It is anticipated that pelagic species and motile life stages will avoid construction activities based on typical installation speeds, and direct impacts are not anticipated. Direct impacts on foraging habitat are expected to be localized to the width of the trench and short-term as benthic organisms would recolonize the area. Indirect impacts on EFH could occur as a result of sediment suspension, temporarily decreasing foraging success due to increased turbidity. It would be expected that normal foraging behavior would resume following completion of installation and settlement of suspended sediments. Sediment suspension impacts are discussed further within this section.

The Brayton Point and Falmouth ECCs will be placed by the same methods described previously for array cables, depending on site conditions. The maximum total cable corridor length is 124 miles (200 kilometers) for the Brayton Point ECC and 87 miles (140 kilometers) for the Falmouth ECC. Direct impacts on EFH due to habitat disturbance are expected along the entire length of each corridor within the 19.7 foot (6 meter) wide surface impact along each cable corridor (SouthCoast Wind 2023). Cable installation is expected to cause short-term benthic disturbance over an estimated area of 242 acres per cable bundle for the Brayton Point ECC and 186 acres per cable for the Falmouth ECC. During cable emplacement in the Brayton Point ECC, impacts from this activity are expected to occur over a variety of habitat complexity types comprised of 79 percent soft bottom habitats, 5 percent heterogenous complex habitats, 13 percent complex habitats, 3 percent large-grained complex habitats, and 0.3 percent anthropogenic material (SouthCoast Wind 2023, Appendix M.3). Within the Falmouth ECC, impacts from cable emplacement are expected to occur over a variety of habitat complexity types comprised of 64 percent soft bottom habitats, 1 percent heterogenous complex habitats, 26 percent complex habitats, and 9 percent large-grained complex habitats (SouthCoast Wind 2023, Appendix M.3).Under Alternative C, the EFH within the Sakonnet River would be avoided by rerouting the cable corridor to have more of an onshore component on Aquidneck Island or Little Compton and reduce the length of the Brayton Point offshore ECC by either 9 or 12 miles (14.5 or 19.3 kilometers).

Installation of the interarray cable and ECCs could result in direct impacts such as crushing and burial of slow-moving or sessile organisms and life stages. 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 will vary depending on how benthic and demersal habitats exposed to these impacts are used by EFH-designated species. Benthic and epibenthic life stages will 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 will be able to avoid direct impacts related to these activities.

The sea-to-shore transition will occur where the onshore and offshore segments of the export cable meet. In the Brayton Point ECC, four HDD exit pits are anticipated in each landfall location (SouthCoast Wind 2023, Appendix M.3). For the HDD exit pits and support area south of Aquidneck Island (Boyds Lane and Park Avenue), a total seafloor impact of up to 0.46 acres is anticipated only to occur over soft-bottom habitats. North of Aquidneck Island, the HDD exit pits and support area at the RIDEM/Aquidneck Land Trust landfall option and the Mount Hope Bridge landfall option will likely impact up to 0.31 and 0.16 acres of seafloor, respectively, with both locations consisting of predominantly complex habitats due to the presence of *Crepidula* substrate. At the Roger Williams University landfall option also north of Aquidneck Island, a potential impact of up to 0.33 acres is expected over habitats made up of 70-percent complex and 30-percent soft bottom (SouthCoast Wind 2023, Appendix M.3). At the Brayton Point landfall location, a seafloor impact of up to 0.27 acres is anticipated over 100 percent anthropogenic material (dredged material deposit) at the Taunton River landing option while 0.24 acres of soft-bottom habitat would be impacted at the Lee River landfall option. For all landfall options at the Falmouth landfall location (Central Park, Shore St., Worcester Ave.), up to 0.4 acres of seafloor impact in soft-bottom habitats is expected from HDD activities (SouthCoast Wind 2023, Appendix M.3). Cofferdam installation, dredging and sidecast, and vessel anchoring at the sea-to-shore transitions could also result in crushing and burial effects.

In addition to crushing and burial impacts, installation methodologies could reshape benthic structures and habitats depending on the cable installation method used. Jetting methods, which would flatten depressions and sand waves, could temporarily reduce benthic habitat suitability for juvenile and adult red and silver hake within the cable installation footprint. Prey organisms that use these habitats would also be displaced, potentially affecting habitat suitability for EFH species. In contrast, mechanical trenching may create short-term depressions that would serve the same habitat function and potentially leave little impact on juvenile and adult red and silver hake. However, it is difficult to quantify features like sand depressions and sand waves because these habitats are dynamic and shaped by sediment transport processes. Natural recovery from anthropogenic disturbance is likely to occur within several months of the disturbance, depending on timing relative to winter storm events.

The invasive tunicate *Didemnum vexillum* has been expanding its presence in New England waters. Benthic monitoring at the Block Island Wind Farm has shown that this species is part of a diverse faunal community on morainal deposits and is an early colonizer along the edges of anchor scars left in mixed sandy gravel with cobbles and boulders (Guarinello and Carey 2020). Studies have shown that activities that cause fragmentation of *D. vexillum* colonies can facilitate its distribution (Lengyel et al. 2009; Morris and Carman 2012). It is important to minimize or eliminate activities that return fragmented colonies of

D. vexillum to the water column, to reduce the spread of this invasive species (Morris and Carman 2012). The effects of cable installation within hard bottom habitat where *D. vexillum* is present could fragment the invasive colonies. Also, the addition of new hard substrate from scour protection may provide suitable habitat and a potential for this invasive species to expand its geographic range. This should be less of a concern in the Sakonnet River, with the only rocky substrate consisting of Mixed-Size Gravel in Muddy Sand to Sand (7%) and Anthropogenic Rock Rubble (0.2%; Table 3-7).

HAPC for juvenile Atlantic cod and juvenile and adult summer flounder is likely to be temporarily affected by cable installation activities. Juvenile Atlantic cod HAPC would be crossed by both the Brayton Point ECC and Falmouth ECC as the cable routes approach landfall. No SAV or macroalgal habitats were observed in the benthic surveys of the Brayton Point ECC, but macroalgae was observed at seven nearshore benthic sampling stations along the Falmouth ECC. Eelgrass was also observed at the Falmouth landing area. Any impacts on macroalgae or aquatic vegetation would constitute an adverse effect on HAPC for summer flounder. Summer flounder and Atlantic cod are expected to be able to recolonize most areas once construction is complete. Impacts on HAPC would be minimized by the use of trenchless technologies such as HDD, as practicable, which can be used to install the cable beneath overlying sediments and SAV without direct physical disturbance. Impacts on HAPC would be short-term and limited to the duration of construction.

5.1.2.3.1.1 Direct Effects on EFH and EFH Species

- Short-term loss/conversion of EFH:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Mobile Benthic/Epibenthic – Soft Bottom
  - Sessile Benthic/Epibenthic – Complex
  - Pelagic
  - Prey Species – Benthic/Epibenthic
  - Prey Species – Pelagic
  - Summer Flounder HAPC
  - Juvenile Atlantic Cod HAPC
- Permanent, localized crushing and burial of EFH species:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Sessile Benthic/Epibenthic – Complex
  - Prey –Benthic/Epibenthic

5.1.2.3.1.2 Indirect Effects on EFH and EFH Species

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

5.1.2.3.2 Sediment Suspension and Redeposition

Cable installation activities would generate localized plumes of suspended sediments within the immediate proximity of the trench excavation and reburial. As described in Section 5.1.1.1, egg and larval life stages are highly sensitive to sediment deposition, with certain species (e.g., winter flounder) experiencing mortality at burial depths of less than 0.1 inch (3 millimeters) (Michel et al. 2013). Demersal eggs, such as those of the longfin squid, are known to have high rates of egg mortality if egg masses are exposed to abrasion or burial making them highly susceptible to impacts from sediment redeposition though impacts may vary based on season or time of year (BOEM 2023, Appendix D). Modeling of sediment deposition associated with cable emplacement for the Proposed Action found that the redeposition of the sediment occurs relatively locally. Most of the released mass settles out quickly and is not transported for long by the currents. Cable emplacement would generally result in sediment deposition of greater than 0.2 inch (5 millimeters) within 79 feet (24 meters) of the trench centerline although such thicknesses can be locally observed up to 590 feet (180 meters) from the cable route (SouthCoast Wind 2023, Appendix F1). A thicker layer of deposits over a smaller area tends to be observed in the vicinity of deeper sections of the export cable routes and in the vicinity of the interarray cables, which is the consequence of the lower currents present in these areas resulting in less transport of sediment away from the cable installation site. Sediment plume modeling (SouthCoast Wind 2023, Appendix F1) showed that a deposition thickness of 0.2 inch (5 millimeters) and associated impacts would occur over an area of 311.4 acres during installation of interarray cables in the Lease Area, and 113.7 acres, 158.1 acres, and 279.2 acres in the Nantucket Sound (KP 0 to KP 20), Muskeget Channel (KP 20 to KP 45) (Figure 5-1), and southern export cable route (KP 45 to KP 88) portions of the Falmouth ECC, respectively, during export cable installation. Sediment transport modeling in the Brayton Point ECC (SouthCoast Wind 2023, Appendix F3) determined that a deposition thickness of 0.2 inch (5 millimeters) was likely to occur over a 29.6 acre area in Mount Hope Bay (KP 0 to KP 10), a 86.5 acre area in the Sakonnet River (KP 15 to KP 34), a 200.2 acre area offshore of the Sakonnet River (KP 34 to KP 78), and a 200.2 acre area offshore of Martha’s Vineyard (KP 78 to KP 152). 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). Initial sediment transport modeling for cable installations along the Falmouth ECC central route showed a sediment deposition thickness of 0.2 millimeters extending up to 721 meters from the cable centerline for the cable segment to the east of Martha's Vineyard (Figure 5-1). Based on these results SAV beds east of Martha's Vineyard are unlikely to be affected by sediment deposition.

Juvenile fish are expected to be able to avoid burial effects from sediment deposition and would primarily respond to elevated total suspended sediment (TSS) concentrations in the water column. Modeling of suspended sediments associated with the Proposed Action, estimated that maximum TSS concentrations would generally range from 100 to 300 milligrams per liter within 420 feet (128 meters) of the cable trench and extend to a maximum of 1,214 feet (370 meters) from the cable corridor centerlines, affecting a cumulative area of 4,569 acres for the entirety of the offshore export cable corridors and interarray cable routes (SouthCoast Wind 2023, Appendix F1). Concentrations of this magnitude and duration are typically associated with behavioral avoidance and sublethal physiological effects on juvenile marine and estuarine fishes (Michel et al. 2013; Wilber and Clarke 2001).

Adult fish are expected to be able to avoid burial effects from sediment deposition and would primarily respond to elevated TSS concentrations in the water column. Short-term exposure to TSS concentrations exceeding 1,000 milligrams per liter has been associated with sublethal and behavioral avoidance effects on adult marine and estuarine fishes, while concentrations of less than 500 milligrams per liter are more commonly associated with behavioral avoidance (Michel et al. 2013; Wilber and Clarke 2001). Modeling of suspended sediments associated with the Proposed Action estimated that maximum TSS concentrations from cable emplacement would generally exceed 650 milligrams per liter within 226 feet (69 meters) of the cable trench temporarily exposing adult fish to sediment suspension effects over this area.

Cable installation would expose adult bivalves to sublethal effects of suspended sediments at TSS concentrations of 1,000 milligrams per liter or higher (Wilber and Clarke 2001). Further, sediment deposition depths between 0.4 and 1.2 inches (10 and 30 millimeters) could result in sublethal to lethal effects on juvenile and adult bivalves. Modeling of suspended sediments associated with the Proposed Action estimated that maximum TSS concentrations from cable emplacement of 1,000 milligrams per liter would occur as far out as 112 feet (34 meters) from the cable trench and that sediment depths of 0.4 inches (10 millimeters) would generally occur within 223 feet (68 meters) of the trench (SouthCoast Wind 2023, Appendix F1), temporarily exposing bivalves to sediment suspension and deposition effects within this area.

During cable installation within the estuarine environment of the Brayton Point ECC, suspended sediment concentrations over 100 milligrams per liter covered a larger area in Mount Hope Bay than in the Sakonnet River (SouthCoast Wind 2023, Appendix F3; Figure 5-2 and Figure 5-3). Based on time-integrated sediment transport modeling simulations for cable installation trenching, concentrations in the lowest range of 10 milligrams per liter may last for several hours after resuspension, while water column concentrations of 200 milligrams per liter or more are not expected to last longer than 2 hours. The highest modeled concentrations of 500 milligrams per liter were expected to only exist for 30 minutes to 1 hour (SouthCoast Wind 2023, Appendix F3). At any given location the high concentrations diminish rapidly and the low concentrations diminish to background in only a few hours. The ultimate fate of the resuspended sediments is to resettle onto the seabed. Depending on the amount and type of sediments resuspended and the local current regime they can settle close to or far from the resuspension point. These factors also affect the sedimentation depth, i.e., how thick a layer the deposited sediments can create. As with the water column concentrations, the farther the sediments are transported the more area they cover when settling, but at a lower thickness than if the entire mass settles near the resuspension point.

The model-predicted deposition thickness and settled-sediment coverage area associated with export cable installation operations in Mount Hope Bay and the Sakonnet River showed a clear line of deposition that followed the ECC route with majority of resuspended sediment quickly settling back to the seabed (SouthCoast Wind 2023, Appendix F3; Figure 5-4 and Figure 5-5), with the exception of the entrance to Mount Hope Bay where strong currents that run in and out of the bay perpendicular to the ECC resuspended sediment for longer durations. The highest deposition thicknesses was contained primarily within a 65-foot (20-meter) corridor around the ECC centerline. A 0.04-inch (1-millimeter) deposition thickness extended to a maximum of 406 feet (124 meters) and 528 feet (161 meters) while the 0.02-inch (0.5-millimeter) deposition thickness extended to 876 feet (267 meters) and 663 feet (202 meters) in Mount Hope Bay and the Sakonnet River, respectively. Thinner deposits can be found at greater distances for silt and clay particles that have low fall velocities and therefore experience greater travel distances. Depositions exceeding 0.4 inches (1 millimeter) covered a maximum area of 143 acres (58 hectares) in the Sakonnet River and 104 acres (42 hectares) in Mount Hope Bay.

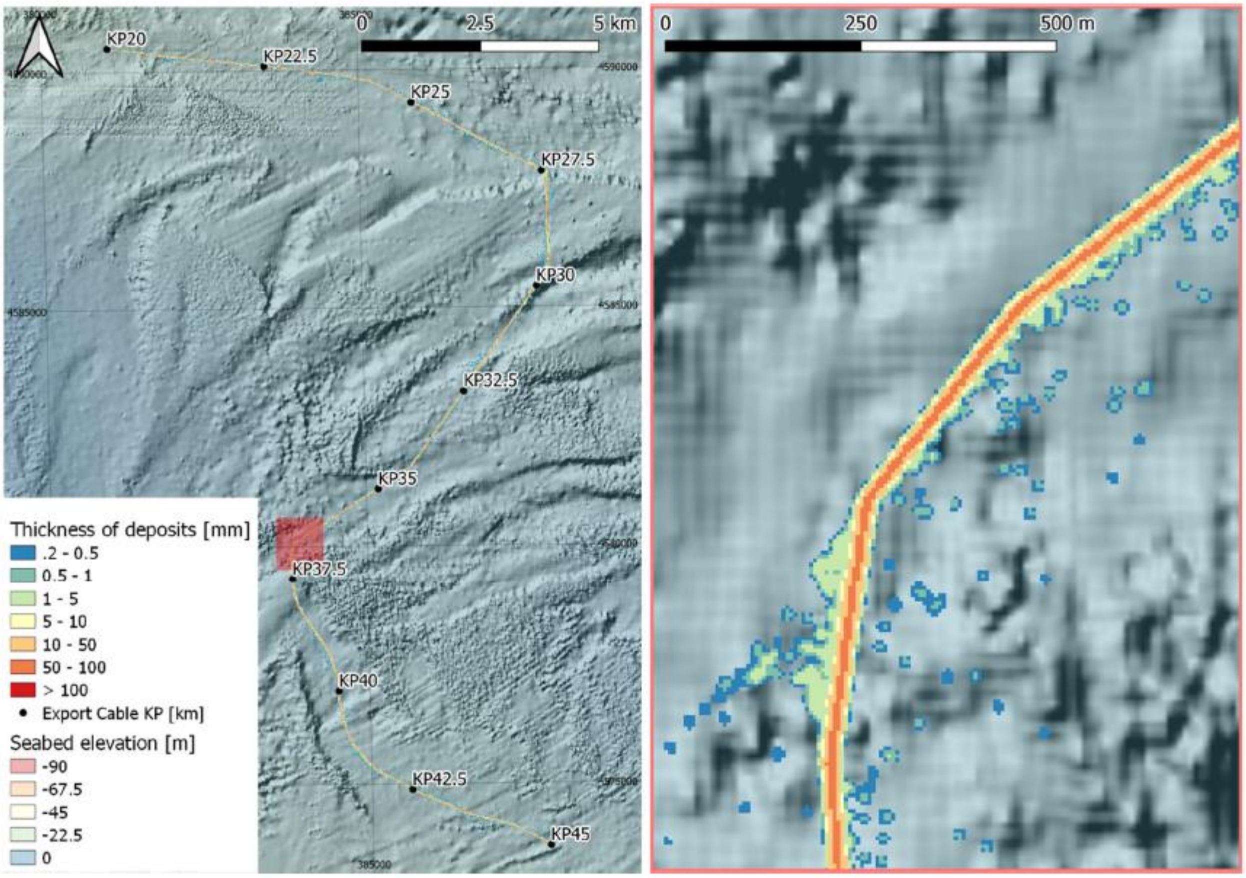
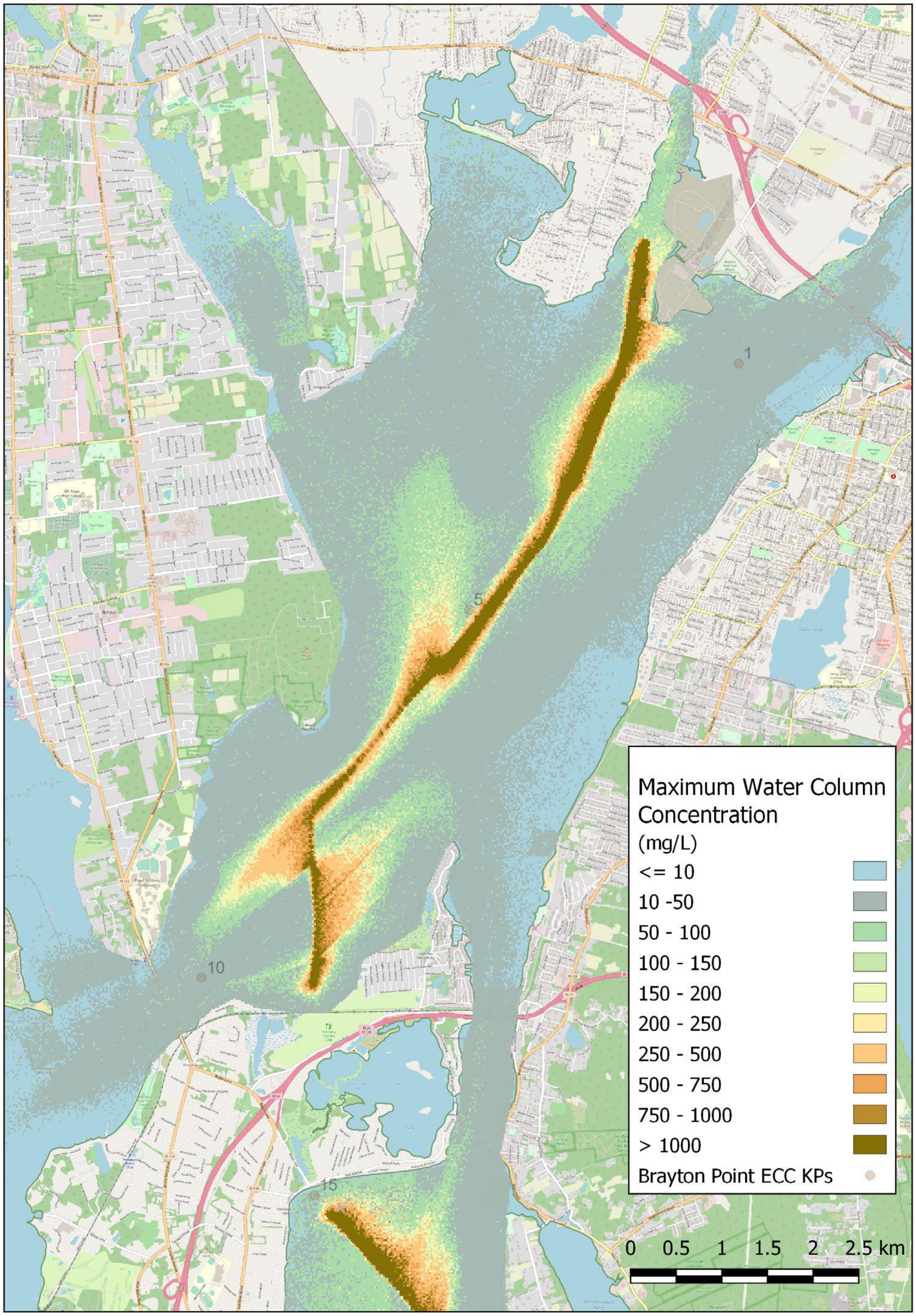
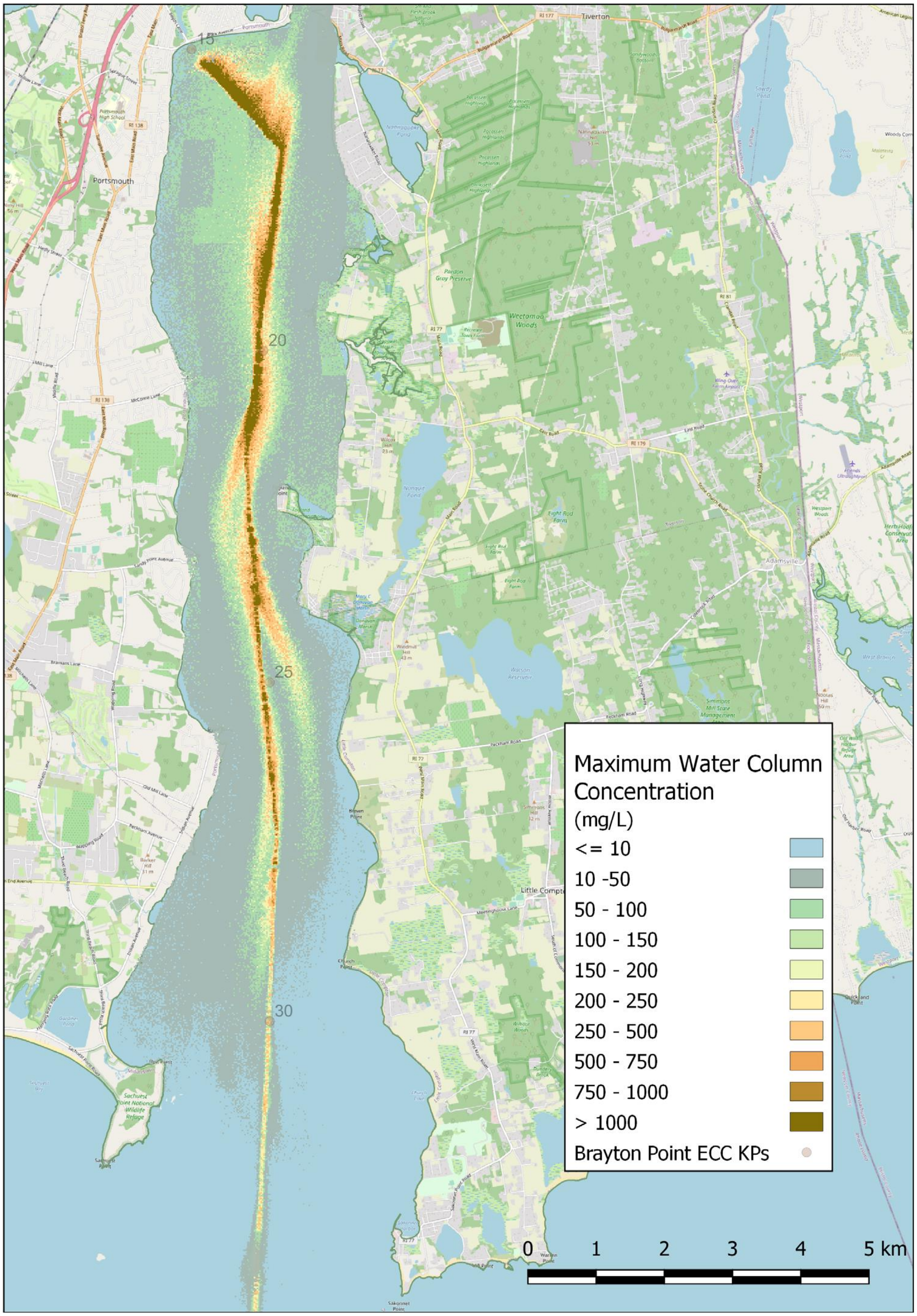


Figure 5-1. Map of deposition thickness associated with the offshore export cable installation for the Falmouth ECC, KP 20 to KP 45.



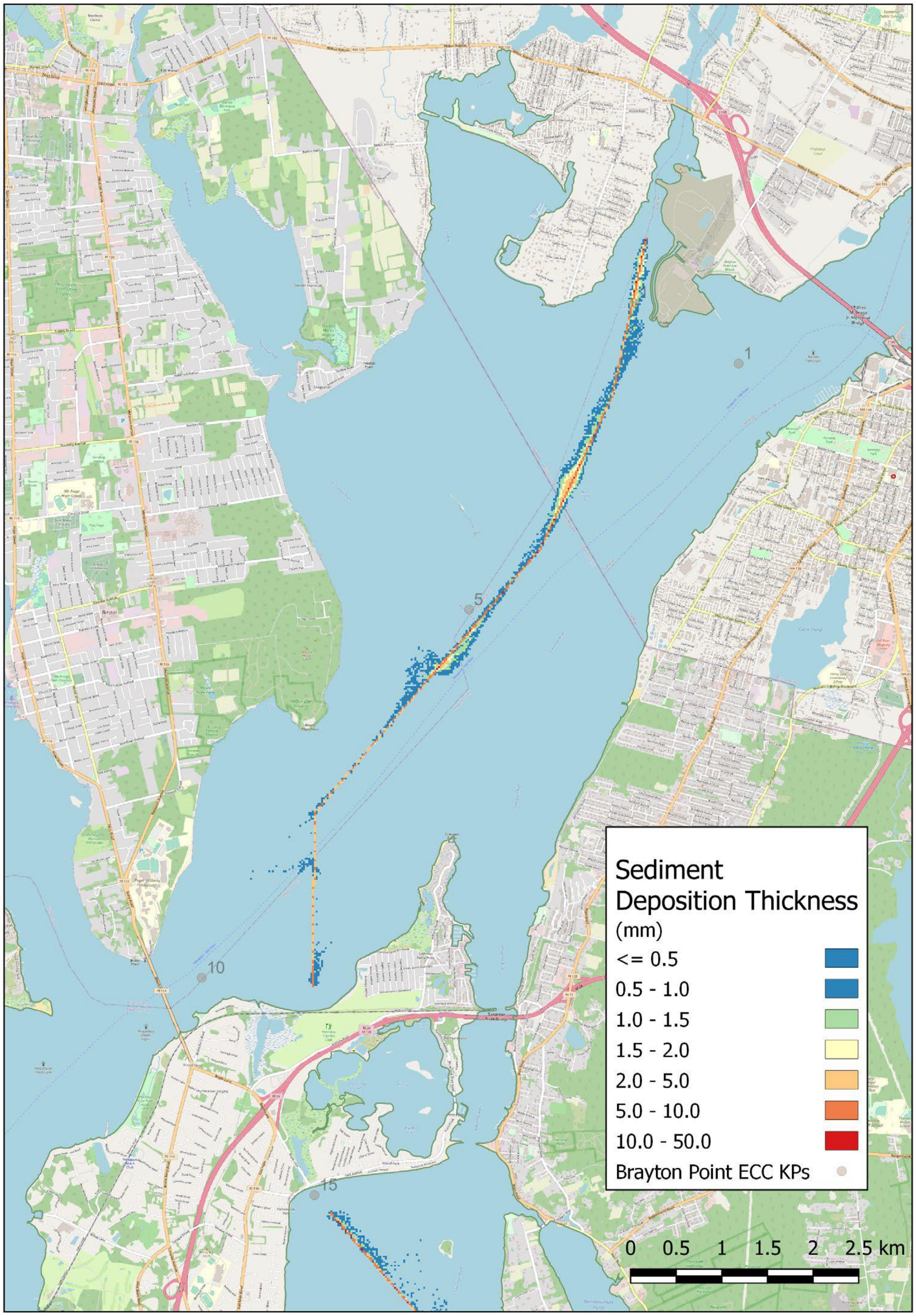
Source: COP Appendix F3, Figure 4-3; SouthCoast Wind 2023

Figure 5-2. Map of maximum sediment concentration in the Mount Hope Bay portion of the Brayton Point ECC, KP0 to KP10



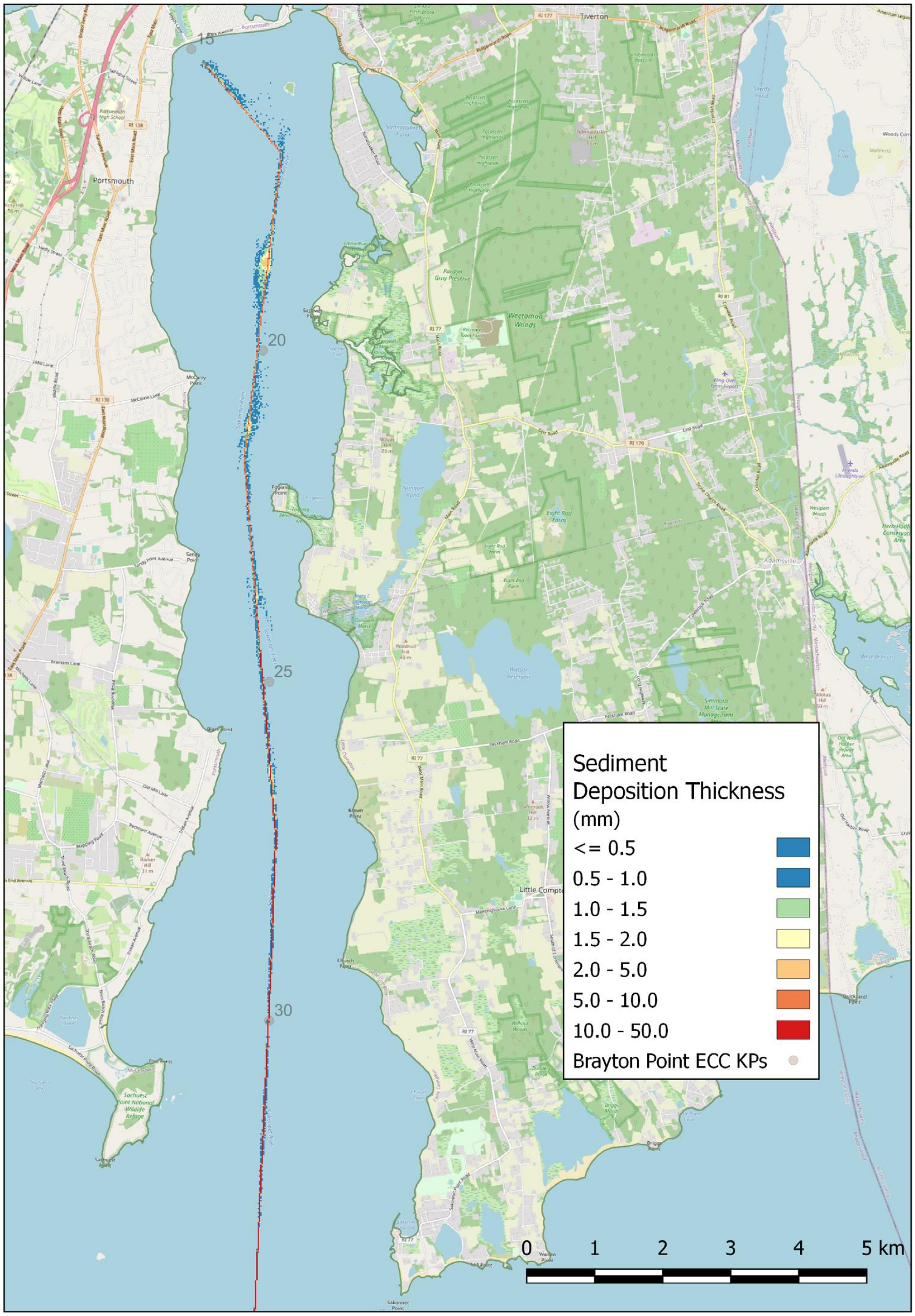
Source: COP Appendix F3, Figure 4-4; SouthCoast Wind 2023

Figure 5-3. Map of maximum sediment concentration in the Sakonnet River portion of the Brayton Point ECC, KP15 to KP34



Source: COP Appendix F3, Figure 4-12; SouthCoast Wind 2023

Figure 5-4. Map of maximum seabed sediment deposition thickness in the Mount Hope Bay portion of the Brayton Point ECC, KP0 to KP10



Source: COP Appendix F3, Figure 4-13; SouthCoast Wind 2023

Figure 5-5. Map of maximum seabed sediment deposition thickness in the Sakonnet River portion of the Brayton Point ECC, KP15 to KP34

Modeling of dredging effects at the HDD exit pit showed very limited impact in terms of redeposited sediment, with deposits exceeding 0.20 inch (5 millimeters) thickness at respective maximum distances of 85 feet and 105 feet (26 meters and 32 meters) for the Neap and Spring Tide scenarios in Falmouth (SouthCoast Wind 2023, Appendix F1). However, in very close proximity to the HDD exit pit in Falmouth, the thickness of deposits can exceed 0.3 feet (0.1 meter) (SouthCoast Wind 2023, Appendix F1). The sedimentation footprint for the Brayton Point HDD sites was small with a maximum coverage of the 1 mm (0.04 inches) thickness contour of approximately 5.7 hectares (14 acres), extending a maximum distance of 212 meters (695 feet) from the HDD site, and 9.72 hectares (24.0 acres) for the 0.5 mm (0.02 inches) thickness contour, extending a maximum distance of 294 meters (965 feet) from the HDD site. (SouthCoast Wind 2023, Appendix F3). TSS levels associated with HDD dredging at the Falmouth landfall sites are much smaller than those associated with cable trenching and dredging. TSS levels exceeding 100 milligrams per liter are predicted at a maximum distance of 118 feet (36 meters), affecting a cumulative area equal or less than one acre. In all simulated scenarios the maximum TSS level dropped below 10 milligrams per liter within two hours and below 1 milligram per liter after less than four hours. The TSS concentrations for the HDD sites associated with the Brayton Point ECC landfall locations exceeding 100 milligrams per liter travelled a maximum distance of 1.2 kilometers (0.75 miles) and dissipated in approximately 2 hours at the Brayton Point site, and were similar at the Mount Hope Bay Entrance site on the north side of Aquidneck Island, but half that at the Aquidneck site in the Sakonnet River site. The area where TSS levels were 100 milligrams per liter or greater was contained within an average of 12 hectares (29 acres). The level of mortality for highly sensitive species may include TSS values >1,000 milligrams per liter that persist for 24 hours. The minor short-term increase in turbidity would not affect nearshore seagrass and macroalgae habitat (SouthCoast Wind 2023, Appendix K).

5.1.2.3.2.1 Direct Effects on EFH and EFH Species

- Short-term decrease in quality of EFH resulting from suspended sediments and increased turbidity:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Mobile Benthic/Epibenthic – Soft Bottom
  - Pelagic
  - Summer Flounder HAPC
  - Juvenile Atlantic Cod HAPC
- Short-term, local impacts resulting from sedimentation:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Prey Species – Benthic/Epibenthic

5.1.2.3.2.2 Indirect Effects on EFH and EFH Species

- Short-term loss of foraging opportunities:
  - Mobile Epibenthic/Benthic – Soft Bottom
  - Pelagic
- Short-term decrease in quality of EFH in areas adjacent to Project activities for:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Mobile Benthic/Epibenthic – Soft Bottom
  - Prey Species – Benthic

5.1.2.3.3 Entrainment

In areas where a jetting method is used for cable installation (e.g., vertical injector, jetting ROV/sled), the surface-oriented intake of the jetting tool would potentially entrain pelagic eggs and larvae through water withdrawals but would not affect organisms on the seafloor. Entrainment occurs when small aquatic organisms, including plankton, fish eggs, and larvae pass through the intake screen during water withdrawal while impingement may occur when fish or other larger organisms are pinned or trapped against the screens of the intake. Mortality is expected for most impinged and entrained organisms though the intake is screened to minimize entrainment of small fish. Ichthyoplankton (fish eggs and larvae) and potentially very small, slow-moving juvenile fish would likely be entrained during the operation and larger organisms could be impinged. Because of the limited volume of water withdrawn in comparison to the total available pelagic habitat, entrainment effects would be highly localized to the position of the water intake, short-term, and not expected to result in population-level impacts on any given species (SouthCoast Wind 2023, Appendix N).

5.1.2.3.3.1 Direct Effects on EFH and EFH Species

- Loss of EFH and EFH species due to water intake for eggs, larvae, and small juveniles:
    - Pelagic
    - Prey Species – Pelagic

5.1.2.3.3.2 Indirect Effects on EFH and EFH Species

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

5.1.2.3.4 Horizontal Directional Drilling Releases

During installation of the estuarine portion of the ECCs, impacts on EFH will be minimized, where practicable, by the use of trenchless installation methods, which install the cable beneath overlying sediments without direct physical disturbance. During HDD, a sediment mix including drilling clay/mud (i.e., bentonite) is used, that will pose little to no threat to water quality or benthic resources (SouthCoast Wind 2023). During drilling, reaming, or pulling events, some drilling mud may be released from the end of the bore hole. Therefore, each HDD will have an exit pit to receive the drilling mud. Bentonite is heavier than water, so it will remain in the exit pit and then be removed through a vacuum or suction dredge. HDD conduits will be drilled for landfall. An HDD entry pit would be required for each cable duct. Trenchless installation (e.g., HDD) has the potential for impact in the event of inadvertent return of drilling fluids, thus causing adverse impacts on water quality through increases in turbidity, as well as hazardous chemical impacts on EFH and EFH-designated species. Best management practices (Table 6-1), 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. Sensitive habitat will be avoided wherever possible, and impacts minimized should the cable need to traverse a unique habitat (e.g., complying with seasonal work windows and other best management practices). Affected species will 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.

During HDD operations, both planned and unplanned releases of drill mud may occur. Unplanned releases involve potential of a frac-out, or drill mud escaping through geologic fractures in the bore hole (Howitt et al. 2012). Planned releases involve the amount of mud that is released during HDD pilot hole punch-out. The amount of planned release is calculated pre-punch out, and a gravity cell (steel box) is often used to mitigate the release and cleanup of drill mud. In a previous survey of habitats immediately around an HDD exit bore hole consisting of coarse sediments with branching algae and common slipper shells, no evidence was found of drill mud covering the area, suggesting the hydraulic pump system was effective in removing drill cuttings and mud and/or natural processes (currents, storms) washed away excess mud and cuttings (Epsilon Associates, Inc. and CR Environmental, Inc. 2015). In an inadvertent release of drill mud associated with a 2010 HDD project in Western Australia, the released mud covered 4,542 square feet (422 square meters) of seafloor habitat to an average depth of 5.9 inch (15 centimeters; Howitt et al. 2012). This mud escaped through geologic fractures in the sediment, smothering sensitive habitat that was supposed to be avoided through HDD activities. Surveyors found that directly after impact, drill mud completely covered 75 percent of macroalgae in the area; however, within a month, the covered area reduced to 818 square feet (76 square meters) and average depth decreased to 1.4 inch (3.5 centimeters). Four months after the inadvertent release there was no longer any presence of drill mud and macroalgae started to recolonize the area (Howitt et al. 2012). Long-term, substantial alteration of EFH due to sedimentation, from bentonite clay, associated with HDD is not expected as previous projects and research in nearby waters indicate limited deposition and rapid recovery to biotic communities near exit bore holes.

SouthCoast Wind will have an HDD Contingency Plan in place to mitigate, control, and avoid unplanned discharges related to HDD activities. This plan will include measures to prevent inadvertent returns of drilling fluid to the extent practicable and measures to be taken in the event of an inadvertent return.

5.1.2.3.5 Underwater Sound

Underwater noise would be generated during the installation of the interarray cables and ECCs, but the types of sound would be characterized as continuous, as opposed to impulsive (i.e., such as that produced during impact pile driving) and would, therefore, not cause the same types of impacts as impact pile driving. Any noise impacts would be short-term and would extend only a short distance beyond the emplacement corridor. Noise generated by the cable installation equipment is not likely to result in injury or mortality for finfish in the immediate vicinity of the activity but may cause short-term behavioral changes in a broader area. Following the completion of cable installation, finfish would be expected to return to the affected areas.

5.1.2.3.5.1 Direct Effects on EFH and EFH Species

- Short-term, direct effects on EFH and EFH species and life stages for all Hearing Categories, with greatest impacts on 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
  - Mobile Benthic/Epibenthic – Complex
  - Pelagic
  - Prey Species – Benthic/Epibenthic
  - Prey Species – Pelagic

5.1.2.4 Cable Protection

Cable protection may be required where burial cannot occur, sufficient depth cannot be achieved, or protection is required due to crossing other cables or pipelines. Concrete mattresses and/or fronded mattresses and placement of rocks or rock berms may be used to protect the cable (Section 2.2.2). Approximately 10 percent of the interarray and Falmouth ECC cable routes may require cable protection as well as 15 percent of the Brayton Point ECC (SouthCoast Wind 2023). Installation of cable protection would cause permanent and localized habitat conversion and short-term and localized sediment suspension and subsequent redeposition that would adversely affect EFH and EFH-designated species.

5.1.2.4.1 Habitat Loss/Conversion

The placement of cable protection (i.e., mattresses, rock placement, half shells) in portions along the 497 mile (800 kilometer) interarray cable corridor would convert an estimated 122 acres of predominantly soft-bottom habitat to complex, hard-bottom habitat (SouthCoast Wind 2023). Along the 124-mile (200-kilometer) Brayton Point ECC, cable protection is anticipated to be applied over an area of 112 acres (two cable bundles) consisting of 79 percent soft bottom habitats, 5 percent heterogenous complex habitats, 13 percent complex habitats, 3 percent large-grained complex habitats, and 0.3 percent anthropogenic material (SouthCoast Wind 2023, Appendix M.3). In the 87-mile (140-kilometer) Falmouth ECC, cable protection is expected to be needed over an area of 135 acres (five cables) consisting of 64 percent soft bottom habitats, 1 percent heterogenous complex habitats, 26 percent complex habitats, and 9 percent large-grained complex habitats (SouthCoast Wind 2023, Appendix M.3). Where cable protection is applied, soft-bottom benthic habitats would no longer be available to EFH species for the entire 30-year life of the project through decommissioning when the foundations and scour protection are removed. Non-complex benthic habitat, including small sand waves and depressions in the seabed, may be present in the Lease Area and along the ECC and may provide EFH for some species in the area (e.g., hakes, flounders). Conversion or loss of non-complex benthic habitat could influence the local food web by introducing habitat for colonizing organisms. Conversion of soft-bottom habitat to complex, rocky habitat would support a different suite of species and could even aid in dispersal pathways (Adams et al. 2014). 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 would be adversely affected in the short term to long term by alteration of natural habitat and the placement of protective structures. While the local food web may shift with the conversion of habitat, large-scale effects on ecosystem trophic structure are not expected (Raoux et al. 2017). Impacts on the suitability of EFH for managed species due to food web effects are not anticipated. The effect of the cable protection structure would depend on the size and type of material used as well as the characteristics of the surrounding area and the populations of marine organisms present (Langhamer 2012). As described for the WTG and OSP foundation scour protection (Section 5.1.1.4), the natural rock surfaces provided by the cable protection would become colonized by sessile organisms and would gradually develop into functional habitat for EFH species. However, the degree of habitat complexity would differ depending on the type of cable protection used. Rock placement and rock berms would introduce more relief and complexity compared to low-profile mattresses and may elicit varying responses from fish and invertebrate species in the area. The projected overall increase in abundance of epibenthic and demersal fish species resulting from the reef effect suggests a beneficial expansion of available EFH for species associated with complex benthic habitat. However, because it could take a decade or more for the reef effect to develop before fully functional habitat status is achieved, the addition of complex benthic habitat is expected to provide a beneficial increase in available EFH lasting for the life of the Project. The benthic sessile community that colonized the half-shell cable protection of an HVDC cable in the Bass Strait in Australia was found to be similar to that of the surrounding basalt reef area (Sherwood et al. 2016). Cable protection structures installed over natural hard substrates are expected to have limited reef effects while those installed over soft sediments can generate a stronger reef effect and host new benthic communities as a result of the increased habitat complexity compared to the surrounding environment (Taormina et al. 2018). Where fronded mattresses are used for cable protection, the potential for sand berm formation may prove beneficial to soft bottom EFH species though it may take years for sand berms to develop depending on local sedimentation rates. Matching the cable protection material used with existing seabed conditions to minimize adverse effects on EFH species will be carried out as project parameters allow. The resulting seabed features from cable protection placement may or may not be removed when the Project is decommissioned, depending on the habitat value they provide.

5.1.2.4.1.1 Direct Effects on EFH and EFH Species

- Permanent, adverse effects on EFH and EFH species resulting from decrease in preferred benthic habitat:
    - Sessile Benthic/Epibenthic – Soft Bottom
    - Mobile Benthic/Epibenthic – Soft Bottom
    - Prey Species – Benthic/Epibenthic
- Long-term, beneficial effects on EFH and EFH species resulting from increase in preferred benthic habitat:
    - Sessile Benthic/Epibenthic – Complex
    - Mobile Benthic/Epibenthic – Complex

5.1.2.4.1.2 Indirect Effects on EFH and EFH Species

- Permanent, adverse effects on 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
    - Mobile Benthic/Epibenthic – Complex
    - Prey Species – Benthic/Epibenthic

5.1.2.4.2 Sediment Suspension/Redeposition

Installation of cable protection (i.e., mattresses, rock placement, half shells) may temporarily increase suspended sediments and increase water column turbidity due to the disturbance of bottom sediments. Impacts on benthic habitat would occur locally and temporarily within each previously discussed cable corridor. These seabed disturbances could result in short-term suspended sediment and direct mortality of sessile or slow-moving organisms due to burial upon sediment deposition. However, the spatial extent of suspended sediment and redeposition levels that would result in impacts on EFH is expected to be smaller than that described for cable emplacement in Section 5.1.2.3. The EFH-designated species that would likely be affected by suspended sediment from installation of cable protection are similar to those listed in Section 5.1.2.3.

5.1.3 Operation/Presence of Structures

Project operations and maintenance would result in long-term and permanent direct and indirect effects on the environment that could affect habitat suitability for managed species. Long-term direct and indirect effects are those effects expected to last at least 2 years or more while permanent impacts would extend through the 35-year life of the Project or longer.

The installation of the Project would alter water column and benthic EFH used by a variety of EFH species. The placement of the WTG and OSP foundations, excavation and reburial of transmission cables, placement of scour and cable protection, and relocation of unavoidable boulders in the Project area would produce long-term and permanent effects on benthic habitat of varying significance and duration. In some cases, existing habitats will be converted to new habitat types and this habitat conversion would be effectively permanent.

The type, extent, and duration of long-term and permanent effects on EFH resulting from operation and maintenance are described in the following sections.

5.1.3.1 Artificial Substrate (WTG/OSP/Scour Protection)

5.1.3.1.1 Habitat Loss/Conversion

Habitat loss and conversion resulting from the presence of WTG and OSP foundations and associated scour protection are discussed in detail in Sections 5.1.1.2 and 5.1.1.4.

5.1.3.1.2 Underwater Sound

The operation of the WTGs would produce non-impulsive, low-frequency underwater noise and particle motion effects. Operational noise would occur continuously in the waters immediately surrounding the WTGs over the approximate 30-year lifespan of the Project from the completion of construction until decommissioning.

The WTGs are expected to generate operational noise on the order of 110 to 125 dB RMS within the 10-Hz to 8-kHz frequency range and particle acceleration effects on the order of 10 to 30 dB re 1 $\mu m/s^2$ at a reference distance of 164 feet (50 meters; Tougaard et al. 2020). These noise effects are below injury and behavioral effects thresholds (150 dB re 1 µPa SPL) for fish species, indicating that potentially significant underwater noise effects from the Proposed Action on habitat suitability would be restricted to a very small area around each monopile. For example, applying the practical spreading loss model to source noise level of 125 dB RMS at 10 meters, noise levels exceeding the behavioral effects threshold for fish would be limited to within 5 feet (1.5 meters) of the monopile surface. An individual fish belonging to the hearing specialist group would have to remain within 1 foot (0.3 meter) of the pile surface for 24 hours to experience temporary threshold shift. Cod and other hearing specialist species are also potentially sensitive to particle motion effects. Elliot et al. (2019) compared available research on particle motion sensitivity in fish to observed detectable particle motion effects 164 feet (50 meters) from the foundations of the Block Island Windfarm during turbine operation. Their observations suggest that particle motion effects in the 1- to 6-kHz range could occasionally exceed the lower limit of observed behavioral responses in hearing specialists within these limits.

Some degree of habituation to these operational noise and particle motion effects is to be anticipated. Bejder 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 observations indicate that the WTG operations could have limited adverse effects on habitat suitability for EFH 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. Potential adverse effects on habitat suitability for fish belonging to the hearing specialist group are estimated to extend up to 164 feet (50 meters) from each foundation. This equates to potential adverse effects over approximately 389 acres of habitat during the operation of 149 monopile foundations of 52.5-foot (16-meter) diameter.

5.1.3.1.2.1 Direct Effects on EFH and EFH Species

- Permanent, local avoidance responses to operational noise in hearing specialist species:
  - Mobile Benthic/Epibenthic – Soft Bottom
  - Mobile Benthic/Epibenthic – Complex
  - Pelagic
  - Prey Species – Benthic/Epibenthic
  - Prey Species – Pelagic
  - Southern New England HAPC

5.1.3.2 Hydrodynamic Effects

The presence of the WTG and OSP foundations during operation would potentially cause hydrodynamic effects, including changes in water flow, changes in vertical mixing and associated primary production, thermal dynamic shifts, bottom shear stress effects, and changes in larval distribution patterns. The general understanding of offshore wind-related impacts on hydrodynamics is derived primarily from European based studies. A synthesis of European studies by Van Berkel et al. (2020) summarized the potential effects of wind turbines on hydrodynamics, the wind field, and fisheries. Local to a wind facility, the range of potential impacts include increased turbulence downstream, remobilization of sediments, reduced flow inside wind farms, downstream changes in stratification, redistribution of water temperature, and changes in nutrient upwelling and primary productivity. Human-made structures, especially tall vertical structures such as foundations, alter local water flow at a fine scale by potentially reducing wind-driven mixing of surface waters or increasing vertical mixing as water flows around the structure (Carpenter et al. 2016; Cazenave et al. 2016; Segtnan and Christakos 2015). When water flows around the structure, turbulence is introduced that influences local current speed and direction. Turbulent wakes have been observed and modeled at the kilometer scale (Cazenave et al. 2016; Vanhellemont and Ruddick 2014). While the magnitude of impacts on current speed and direction decreases rapidly with distance from monopiles, there is a potential for hydrodynamic effects out to a kilometer from a monopile (Li et al. 2014). Direct observations of the influence of a monopile extended to at least 984 feet (300 meters); however, changes were indistinguishable from natural variability in a subsequent year (Schultze et al. 2020). The range of observed changes in current speed and direction 984 to 3,281 feet (300 to 1,000 meters) from a monopile is likely related to local conditions, wind farm scale, size of WTGs, and sensitivity of the analysis. These localized hydrodynamic effects would last over the approximate 30-year lifespan of the Project from completion of construction through decommissioning.

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). Temperature anomalies created by mixing at each monopile would likely resolve quickly due to strong forcing toward stabilization (Schultze et al. 2020).

The 147 WTGs are likely to create individual localized hydrodynamic effects that could have localized effects on food web productivity and pelagic eggs and larvae. Given their planktonic nature, altered circulation patterns could transport pelagic eggs and larvae out of suitable habitat, leading to reduced survival. However, effects on egg and larval survival from altered circulation patterns could be offset by increased primary productivity in the wake of the monopiles. Turbulence down-current of the monopiles could introduce nutrients to the surface mixed layer that promote primary production, increasing the forage base for pelagic larvae (Floeter et al. 2017). These offsetting effects are expected to be highly localized and small relative to the size of the Project area and the natural mortality rate of ichthyoplankton. Pelagic juvenile and adult fish may experience hydrodynamic effects down-current of the WTG and OSP foundations. These effects may include decreased current speeds and minor changes to seasonal stratification regimes, which could cause reduced habitat suitability for some EFH species in localized areas. Pelagic juveniles and adults would likely avoid habitat with decreased suitability. Hydrodynamic effects are expected to vary depending on seasonal and tidal hydrodynamic cycles.

Areas adjacent to offshore wind farms may experience altered hydrodynamic circulation resulting from structural changes in stratification (Christiansen et al. 2022). Changes in current flow and tidal mixing may potentially affect primary productivity due to alterations in nutrient availability in areas such as Nantucket Shoals. However, the magnitude of impact on specific marine ecosystems and biogeochemistry remains uncertain. There are few empirical data showing the impact of WTGs on ocean stratification (Tagliabue et al. 2021), although recent models have demonstrated ocean mixing as a result of the wind-wake effect of smaller WTGs in the North Sea (Carpenter et al. 2016; Floeter et al. 2017; Dorrell et al. 2022). Interannual changes in net primary productivity in the North Atlantic are poorly correlated with parallel changes to stratification and emphasize the importance of other physical mechanisms, especially the Gulf Stream (Tagliabue et al. 2021). In addition, Golbazi et al. (2022) modeled surface effects of next-generation large turbines (>10 megawatts) along the Atlantic OCS and found that due to the higher hub heights of larger turbines (vs. the smaller turbines in the North Sea), meteorological changes at the water surface would be nearly imperceptible.

5.1.3.3 Operational Water Quality

Vessels used during offshore construction activities may routinely release bilge water, engine cooling water, deck drainage, or ballast water. Vessels and the construction activities offshore will comply with the regulatory requirements related to the prevention and control of discharges. Such releases would quickly be dispersed and diluted and would cease when construction is complete. Discharges are expected to occur as allowed by law, and will be temporary, short-term, and highly localized. Due to expected dispersion and dilution, no negative effects of discharges to animals or vegetation are expected. Vessel traffic associated with the Proposed Action would also increase the risk of accidental releases of fuels, fluids, and hazardous materials. Fuel spills or leaks from vessels could affect fish and EFH. Vessels engaged in construction may also experience unplanned releases of oil, solid waste or other materials. During the construction period, increased vessel traffic in the area of construction and at nearby ports may increase the likelihood of unplanned releases. While the risk of accidental releases is expected to be highest during construction, accidental releases could also occur to some extent during O&M and decommissioning. Temporary avoidance by fish is expected during construction activities, similar to the avoidance behaviors observed during heavy pleasure boat use, ferry traffic, or heavy fishing activity. Therefore, the risk of fish direct exposure to such events is very small. As applicable, vessels used for Project activities will follow USCG regulations concerning chemical use and management, as well as any relevant federal, state, and local regulations.

There would also be a low risk of leaks of fuel, fluid, or hazardous materials from any of the 149 WTGs and OSPs anticipated for the Project. BOEM has modeled the risk of spills associated with WTGs and determined that a release of 128,000 gallons is likely to occur no more frequently than once every 1,000 years and a release of 2,000 gallons or less is likely to occur every 5 to 20 years (Bejarano et al. 2013).

SouthCoast Wind has developed an oil spill response plan (Appendix AA, SouthCoast Wind 2023) with measures to avoid accidental releases and a protocol to respond to such a release if one occurs. The chemical inventory for the proposed Project will align with what is typically used in offshore and onshore wind projects. A sample inventory of fuel oil, lubricant, coolants, and dielectric fluid used in WTGs and OSPs is also listed in Appendix AA, Oil Spill Response Plan (SouthCoast Wind 2023), as per 30 CFR Part 254. SouthCoast Wind will comply with regulations related to the prevention and control of unplanned releases and adhere to all regulations under the USEPA Clean Water Act. Effects on EFH due to oil spill or chemical release are extremely unlikely to occur and discountable given the relatively low volumes involved and the mitigation measures that will be implemented.

5.1.4 Operation/presence of Interarray and Offshore/Onshore Cables

5.1.4.1 Power Transmission (EMF, Heat)

The interarray cables and export cables would generate intermittent induced magnetic and electrical field effects and substrate heating effects whenever they are under power through the life of the Project. The interarray cables and export cables associated with the Project could produce AC and DC EMF emissions. EMFs produced by AC and DC cables differ significantly in that AC transmissions vary in direction while DC transmissions are static (i.e., have a frequency of 0 Hz) (SouthCoast Wind 2023, Appendix P2). DC magnetic fields, such as those associated with submarine cables, can also combine with the Earth’s static geomagnetic field altering the direction and/or magnitude of the resulting cable EMF. DC cable EMF interaction with the Earth’s geomagnetic field will depend on the direction/orientation of the cable at the emplacement location (SouthCoast Wind 2023, Appendix P2). Additionally, DC electromagnetic fields average three times higher amplitude compared to those produced by AC cables (Hutchison et al., 2020b). In addition to the electromagnetic differences of AC and DC cables, Taormina et al. 2018, found that heat emission was higher in AC cables than DC cables at equal transmission rates. Since AC cables incorporate three different internal grounding mechanisms, cable width is greater compared to DC cables resulting in a larger area exposed to cable-generated heat.

Magnetic and electrical field effects would be present whenever wind speeds are sufficient to turn WTGs. As such, these effects are anticipated to be continuous, with intermittent interruptions during periods of no wind. Exposure to EMF could be short- or long-term, depending on the mobility and behavior of the species/life stage. The transmittance of EMF waves would largely depend on the burial depth and configuration of the cables, protective materials placed above them and the operational loads on those cables. A recent report prepared for BOEM (CSA Ocean Sciences Inc. and Exponent 2019) concluded that AC undersea power cables associated with offshore wind energy projects within the southern New England area will generate weak EMF at frequencies outside the known range of detection by electrosensitive and magnetosensitive fishes. Even if magnetosensitive and electrosensitive marine species were known to detect and respond to 60-Hz AC EMF from submarine cables, a large fraction of marine species would still have very low sensitivity to submarine cable EMF due to the limited amount of time, if any, that they would typically spend near the submarine cables where non-negligible exposures to EMF could occur. EMF from DC cables, as proposed for the Brayton Point ECC, is lower than that for AC cables studied.

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

- Benthic habitats used by EFH fish and invertebrate species having benthic or epibenthic eggs and larvae. Minimum physiological effect thresholds are defined as follows (Brouard et al. 1996):
    - Magnetic field: 1,000 milligauss (observed developmental delay)
    - Electrical field: >500 millivolts per meter (mV/m)

- Bottom habitats used by benthic or epibenthic life stages of EFH finfish species. Minimum physiological effect thresholds are defined as follows (Armstrong et al. 2015; Basov 1999; Bevelhimer et al. 2013; Orpwood et al. 2015):
    - Magnetic field: >1,000 milligauss
    - Electrical field: 20 millivolts per meter (mV/m)
- Demersal habitats (from 3.3 to 26.2 feet [1 to 8 meters] off the seabed) used by pelagic life stages of EFH finfish and invertebrates:
    - Same thresholds as above
    - Magnetic field – squid: >800 milligauss (Love et al. 2015)
- Bottom habitats used by benthic and epibenthic life stages of EFH shark and skate species. Minimum effect thresholds are defined as follows (Bedore and Kajiura 2013; Hutchison et al. 2020b; Kempster et al. 2013):
    - Magnetic field: Detection, unknown; behavioral, 250–1,000 milligauss (species-specific)
    - Electrical field: Detection, 20–50 microvolts/centimeter (2-5 millivolts/meter) for fields <20 Hz, no response to electrical fields above 20 Hz
- Benthic and infaunal habitats used by EFH shellfish species, and benthic invertebrate prey organisms for EFH species

Predicted magnetic fields during operations has been modeled for different installation scenarios (Table 5-6). Magnetic field strength reduces substantially at farther distances away from the centerline. Modeling at 25 feet (7.6 meters) from the centerline shows 84 percent or more in magnetic field strength reduction for all scenarios except Landside Beach (26 percent) due to the low initial magnetic field strength due to a 52.8-foot (16.1-meter) burial depth.

Table 5-6. Modeling parameters and results for submarine cable installation

Installation Scenario	Predicted Resultant Magnetic Field (milligauss)			
	Burial Depth	Maximum Directly Above Cable Centerline(a)	±10 feet (± 3 meters) from Outer Cables(b)	±25 feet (± 7.6 meters) from Outer Cables(b)
Seabed – Likely case	6.60 feet (2 meters)	85.5	28.8	6.50
Seabed – Conservative case	On surface	1,859.0	41.9	6.90
Landside Beach – Worcester Ave.	52.8 feet (16.1meters)	3.80	3.40	2.80
Landside Beach – Shore St.	9.80 feet (3 meters)	39.3	20.5	6.20
Transition Joint Bay – Worcester Ave.	6.60 feet (2 meters)	77.2	36.8	10.3
Transition Joint Bay – Shore St.	6.60 feet (2 meters)	86.0	28.8	6.80

Source: modified from COP Appendix P1, Table 3.2 and Table 3.3; SouthCoast Wind 2023

5.1.4.1.1 Direct Effects on EFH and EFH Species

- Permanent, negligible to minor behavioral effects on electrically-sensitive EMF species:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Mobile Benthic/Epibenthic – Soft Bottom
  - Sessile Benthic/Epibenthic – Complex
    - Mobile Benthic/Epibenthic – Complex
    - Prey Species – Benthic
    - Summer Flounder HAPC
    - Juvenile Atlantic Cod HAPC
    - Southern New England HAPC
- Permanent adverse substrate heating effects on EFH shellfish species:
  - Sessile Benthic/Epibenthic – Soft Bottom
  - Mobile Benthic/Epibenthic – Soft Bottom
  - Sessile Benthic/Epibenthic – Complex
  - Mobile Benthic/Epibenthic – Complex
  - Prey Species – Benthic
  - Summer Flounder HAPC
  - Juvenile Atlantic Cod HAPC
  - Southern New England HAPC

The specific effects of transmission cables on EFH species and the supporting rationale for these determinations are summarized in the following sections.

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

Benthic eggs and larvae of fish and invertebrates could settle in areas along the interarray cable and ECCs, including both buried and exposed cable segments. The maximum induced magnetic field and electrical field generated in the ECCs would be 1,859 milligauss directly above the cable centerline in the most conservative case when export cables are laid on surface with cable protection, but 85.5 milligauss on the seabed in the more likely scenario when cables are buried at least 6.6 feet (2 meters) below the surface (Table 5-4). Induced electrical field effects in aquatic species are a function of body size, with smaller-bodied organisms experiencing a smaller induced field effect than larger organisms. Induced electrical field effects on eggs and larvae would be insignificant based on their small body size.

While there are limited species-specific data on egg and larval sensitivity to EMF effects, research on fish sensitivity to magnetic and electrical fields suggests that the effects of EMF from the interarray cables and export cables on benthic eggs and larvae would be insignificant. For example, Cameron et al. (1985) determined that magnetic fields on the order of 1,000 milligauss are required to produce observable developmental delay on the eggs of euryhaline Japanese rice fish. Brouard et al. (1996) exposed rainbow trout embryos to electrical fields ranging as high as 5,000 millivolt/meter and observed no evident effects on development or subsequent survival. In their study on larval fish behavior in response to magnetic fields, Cresci et al. (2022) found that the swimming speed and acceleration of larval Atlantic haddock were significantly reduced when exposed to 50 to 150 microTesla (500 to 1,500 milligauss). These test exposures are approximately five times greater than the potential EMF levels resulting from interarray cable and ECC operations when cables are buried at least two meters below the surface (85.5 milligauss). These findings indicate that the EMF effects of this project component on benthic EFH for the eggs and larvae would be insignificant.

5.1.4.1.3 EMF Effects on Habitats Used by Benthic or Epibenthic Juveniles and Adults

Several EFH species and their fish prey species use benthic or epibenthic habitats within 3.3 feet (1 meter) of the seabed during their life cycle that overlap with the interarray and export cable paths, including both buried and exposed cable segments. While there are limited species-specific data on the magnetic and electrical field sensitivity for juvenile and adult fish, the available data generally indicate that the minimum magnetic field exposure threshold for behavioral effects exceeds 1,000 milligauss for most fish species (e.g., Armstrong et al. 2015; Bevelhimer et al. 2013; Orpwood et al. 2015). The minimum threshold for observable detection of electrical fields in electrosensitive fish species is on the order of 20 millivolt/meter (Basov 1999). The magnetic and electrical field exposure thresholds are greater than the maximum potential EMF levels likely to result from interarray cable and ECC operations, indicating that EMF effects of this project component on benthic EFH for the juveniles and adults would be insignificant. Consistent with this, in a review of EMF effects produced by offshore wind energy, Copping et al. (2016) concluded that the electrical fields generated would have no observable effects on the physiology or behavior of fish in close proximity to the interarray cables or export cables.

A series of biological field surveys along the Monterey Accelerated Research System cable off the coast of California tracked the presence of different marine species both before and after the installation and energization of a submarine communication/DC power cable energized to 10 kV. Over 30,000 individuals from 154 taxonomic groups were observed between 2004 and 2015 (Kuhnz et al. 2015). Based on these data, authors concluded that the Monterey Accelerated Research System cable has had negligible impact on biological assemblages. Similarly, diver studies conducted at sites along the HVDC Basslink submarine cable indicated no adverse effects on fish communities, but where burial was impractical and the cable was protected with an iron shell, various fish species were observed to be associated with this vertical structure (Sherwood et al. 2016). Research conducted by Klimley et al. (2017) at the Trans Bay DC undersea cable near San Francisco, California, found that migration success and survival of chinook salmon and green sturgeon was not impacted by the cable EMF although temporary alterations in behavior were observed. Salmon appeared to linger at the activated cable, while migration time for sturgeon increased or decreased depending on the direction of migration. While DC undersea power cables resulted in altered patterns of fish mobility, these changes were temporary and did not interfere with migration success or population health.

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 3 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). 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).

5.1.4.1.4 EMF Effects on Habitats Used by Pelagic Fish

Pelagic fish may periodically use demersal habitats at or near 3.3 feet (1 meter) of the seabed during their life cycle but are not likely to come close to buried undersea power cables during normal migratory or foraging activities (CSA Ocean Sciences, Inc. and Exponent 2019). This may include habitats overlapping buried and exposed segments of the interarray and export cables. Pelagic magnetosensitive fish species such as Atlantic salmon, Atlantic yellowfin tuna, and sharks that typically spend their time in the water column well above the seafloor will only rarely come into contact with EMF from submarine cables. Prey organisms for pelagic fish species may also occur within this EMF exposure zone. Applying the effect thresholds and rationale presented in the previous section, the EMF effects of interarray cable and ECC operations on demersal habitats used by pelagic fish and their prey would be insignificant.

5.1.4.1.5 EMF Effects on Habitats Used by Pelagic Invertebrates

Two pelagic EFH invertebrate species, longfin squid and shortfin squid, may periodically use demersal habitats at or near 3.3 feet (1 meter) of the seabed during their life cycle. This may include habitats overlapping buried and exposed segments of the interarray and export cables. Prey organisms within this zone would also experience EMF exposure. While directed studies are lacking, there is little evidence that cephalopods, such as squid, are electromagnetically sensitive (Normandeau 2011; Williamson 1995). Anecdotal observations suggest that EMF from submarine power cables has no effect on cephalopod behavior. Love et al. (2015) observed no differences in octopus predation on caged crabs placed immediately adjacent to a powered HVAC electrical cable producing induced magnetic fields ranging from 450 to 800 milligauss, and at a control site adjacent to an unpowered cable. The lack of effects on predation behavior suggests that cephalopods are insensitive to EMF effects of this magnitude. Given that the largest projected magnetic field effects from the interarray cable are 1 to 2 orders of magnitude lower than these values, it is reasonable to conclude that the EMF effects of this project feature on EFH used by longfin squid would be insignificant.

5.1.4.1.6 EMF Effects on Habitats Used by Sharks and Skates

Several shark and skate species have one or more life stages that use demersal or epibenthic habitats overlapping the proposed interarray cables and ECCs. Further, shark species and life stages that primarily use pelagic habitat may periodically use demersal habitats at or near 3.3 feet (1 meter) of the seabed during their respective life cycles. While sharks and rays demonstrate sensitivity to bioelectrical fields of less than 1 millivolt/meter (Adair et al. 1998; Ball et al. 2016; Bedore and Kajiura 2013; Kempster et al. 2013), fields with frequencies greater than 20 Hz are beyond the detection range of most electrosensitive organisms (Bedore and Kajiura 2013). In a laboratory study, demersal catsharks 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). Therefore, the 60-Hz AC electrical fields that would be generated by the interarray and export cables are not expected to be detectable by elasmobranchs. The minimum sensitivity of sharks and rays to magnetic fields is unknown, but some species have exhibited behavioral responses (i.e., increased exploratory and foraging behavior) to field strengths ranging from 250 to 1,000 milligauss (Hutchison et al. 2018, 2020b; Normandeau 2011), which are an order of magnitude above the maximum induced magnetic fields that would be generated by the cables. The induced electrical fields that would be generated in even the largest fish are less than those generated by muscular and nervous activity in living animals (approximately 10 millivolt/meter) and are therefore expected to be undetectable (Adair et al. 1998). Based on the above evidence, it is reasonable to conclude that the EMF effects of the interarray cables and ECCs on EFH used by epibenthic or demersal sharks and skates would be insignificant. The 60-Hz AC electrical fields that would be generated by the cables are above the known detection frequency limit of 20 Hz, while the maximum induced magnetic field and induced electrical fields that would be generated by the cables are well below the known or probable detection limits of these species. Therefore, it is reasonable to conclude that the EMF effects of this project component on EFH used by sharks and rays would be insignificant. EFH species that may potentially be exposed to EMF include the winter skate and little skate whose essential fish habitats overlap the Lease Area and both the Brayton Point and Falmouth ECCs.

5.1.4.1.7 EMF and Heat Effects on Habitats Used by Benthic Invertebrates

Several benthic invertebrate species have one or more life stages that use benthic habitats overlapping the proposed interarray cable and ECCs. The potential for EMF and heat effects of cable operation on benthic invertebrates is of particular concern because they are sessile and would be exposed to stressors over prolonged periods. However, compared to fish, relatively little is known about the response of marine invertebrates to EMF. Love et al. (2015) examined rock crabs located alongside unburied AC cables located off the coast of California. Data were generated from adjacent to both unenergized and energized cables in order to determine effects of EMF from the energized cables. Field observations indicated that no behavioral responses (e.g., avoidance of the area surrounding the energized cable) were observed among crabs near the energized cable compared with responses of crabs near the unenergized cable (Love et al. 2015). Hutchison et al. (2018) found that the EMF from a DC undersea power cable did not act as a barrier to movement of the American lobster though temporary alterations in behavior were observed. The available evidence on invertebrate sensitivity to EMF suggest that the interarray cables and export cables could produce sufficient EMF to cause adverse effects on benthic invertebrates, but the specific sensitivity of EFH species likely to occur in the cable path remains unclear. Studies have suggested that EMF perception, based on sensory ability and detection, likely varies through a species life history, and the species-specific movement ecology affects the probability for exposure to EMF based on the likelihood of encounters (Hutchison et al. 2020b). Commercially important invertebrates are largely opportunistic and periodic. Opportunistic and periodic species are more resilient to environmental disturbances particularly those impacting early stages (egg, larvae, juvenile) as they manage to offset the disturbances by high fecundity, early dispersal, and natural mortality rates (Gross et al. 2002). The maximum likely induced magnetic field of 85.5 milligauss that would be generated by the operational cables would attenuate to 6.5 milligauss within 25 feet (7 meters) of the cable. Applying this value as a conservative physiological effect threshold over the entire length of the interarray and ECC amounts to 3,940 acres of EFH exposed to potentially significant EMF effects on habitat suitability.

In addition to EMF effects, buried segments of the interarray cables and ECCs would generate sufficient heat to raise the temperature of the surrounding sediments by as much as 50 to 68 degrees Fahrenheit (°F) (10 to 20 degrees Celsius [°C]) above ambient within 1.3 to 2 feet (0.4 to 0.6 meter) of the cable. Substrate temperature changes of this magnitude could adversely affect habitat suitability for juvenile and adult life stages of Atlantic surf clam and ocean quahog (Acquafredda et al. 2019; Harding et al. 2008), as well as other benthic infaunal species. A cable buried at 6.6 feet (2.0 meters) below the seafloor sees a four-fold reduction in seafloor EMF levels compared to a cable buried at 3.3 feet (1.0 meter). Because the interarray and export cables would be buried to a minimum depth of 8.2 feet (2.5 meters) along the majority of their length, heat effects from buried cable segments on benthic infauna are expected to be negligible.

5.1.4.2 Cable Protection

Community structure changes resulting from installation of cable protection are discussed in detail in Section 5.1.2.4.

5.1.4.3 Power Conversion (AC/DC Conversion)

As noted in Section 2.2, SouthCoast Wind is proposing at least one HVDC converter OSP in the northern portion of the Lease Area (associated with Project 1) and its current preference is for a second HVDC converter OSP to be installed in the southern portion of the Lease Area (associated with Project 2). Potential impacts associated with the CWIS for HVDC converter OSPs include a temperature change at the heated effluent discharge site, impingement of fish, and entrainment of planktonic life stages of fish and invertebrate species. The analysis in the following subsections is based on the SouthCoast Wind Offshore Converter Station NPDES Permit Application (TetraTech and Normandeau Associates, Inc. 2023) for the HVDC converter OSP proposed in the northern portion of the Lease Area (associated with Project 1). While SouthCoast Wind has not yet selected a design for the other OSPs, it has stated that if HVDC converter is selected, which is its current preference, the same design parameters as identified in the NPDES permit application for the northern HVDC converter OSP would apply. Therefore, impacts from a second HVDC converter OSP are anticipated to be similar to the impacts described herein with the exception that the second OSP would be located in the southern portion of the Lease Area.

As reported in the NPDES permit application (TetraTech and Normandeau Associates, Inc. 2023), the CWIS is expected to withdraw cooling water from the ocean in the immediate vicinity of the HVDC converter OSP at rate of up to 9.9 million gallons per day (MGD) and maintain an intake velocity of 0.5 feet/second (0.15 meter/second) or less. USEPA considers intake velocities of 0.5 feet/second (0.15 meter/second) or less a suitable compliance option to minimize impingement impacts. With no other CWIS component causing potential impingement impacts, impingement is no longer included in subsequent discussions.

5.1.4.3.1 Heated Effluent

As part of the SouthCoast Wind Offshore Converter Station NPDES Permit Application (TetraTech and Normandeau Associates, Inc. 2023) for the northern OSP associated with Project 1, the spatial extent of the rise in temperatures of the receiving water at the discharge location of the CWIS in the HVDC converter OSP were modeled using a thermal mixing zone analysis in CORMIX v12.0GTD Advanced Tools based on the highest temperature differences between ambient (intake) and effluent (discharge) conditions in the fall (Scenario 1), winter (Scenario 2), spring (Scenario 3), and summer (Scenario 4). CORMIX is a recommended tool in the evaluation of point source discharges to receiving waters that also incorporates an analysis of mixing zone dynamics (Tetra Tech and Normandeau Associates, Inc. 2023). The plume dynamics were evaluated during four separate seasons to determine potential zones of initial dilution during those periods. According to the USEPA's Criterion Continuous Concentration for temperature-based water quality, the maximum acceptable increase in weekly average temperature resulting from artificial heat sources is 1.8°F (1°C) during all seasons of the year (USEPA 1986). Furthermore, the radius requirement for the 1.8°F (1°C) temperature increase caused by a discharge within the predicted zone of initial dilution should be less than 330 feet (100 meters) as described in the Ocean Discharge Criteria at §125.121(c) (Tetra Tech and Normandeau Associates, Inc. 2023).

The distance from the discharge point where the temperature delta reached 1°C (1.8°F) was 41.9 feet (12.8 meters) in the fall, 84.9 feet (25.9 meters) in the winter, 67.5 feet (20.6 meters) in the spring, and 46.6 feet (14.2 meters) in the summer (Table 5-7). The effluent plume area was highest in the winter at 792.1 square feet (73.6 square meters) and lowest in the fall at 407.0 square feet (37.8 square meters). These CORMIX results indicate that impacts to the ocean temperature are localized and minimal when the maximum temperature increases occur and that the water quality standard allowed for by the Ocean Discharge Criteria is expected to be met well within the 100-meter (330-foot) radius mixing zone for initial dilution of discharges (Tetra Tech and Normandeau Associates, Inc. 2023). Similar results would be anticipated if SouthCoast Wind selects a second HVDC converter OSP for the southern portion of the Lease Area.

Table 5-7. CORMIX results for maximum temperature delta scenarios for SouthCoast Wind

Parameter	Scenario 1: Fall	Scenario 2: Winter	Scenario 3: Spring	Scenario 4: Summer
Maximum discharge temperature, °F (°C)	86 (30)			
Minimum Ambient Atlantic Ocean temperature, lowest seasonal observed, °F (°C)	54.1 (12.3)	39.6 (4.2)	38.6 (3.7)	51.3 (10.7)
Maximum Temperature Delta, °F (°C)	31.9 (17.7)	46.4 (25.8)	47.4 (26.3)	34.7 (19.3)
Atlantic Ocean temperature at the edge of the plume, °F (°C)	55.9 (13.3)	41.4 (5.2)	40.4 (40.7)	53.1 (11.7)
Thermal Plume Length[1], ft (m)	41.9 (12.8)	84.9 (25.9)	67.5 (20.6)	46.6 (14.2)
Thermal Plume Width, ft (m)	11.8 (3.6)	11.1 (3.4)	12.8 (3.9)	28.7 (8.7)
Plume Area, ft^2 (m^2)	407.0 (37.8)	792.1 (73.6)	721.2 (67.0)	657.1 (61.0)

[1] Distance from the outfall, where the temperature delta reaches 1°C (1.8°F)
°C = degrees Celsius ; °F = degrees Fahrenheit; ft = feet; ft^2 = square feet; m = meters; m^2 = square meters
Source: TetraTech and Normandeau Associates, Inc. 2023

5.1.4.3.2 Entrainment of Eggs and Larvae

As site-specific studies on entrainment have yet to be conducted, data from the EFH mapper, MarMap/EcoMon ichthyoplankton surveys (1977–2019), and MA DMF trawl surveys were used to determine the species and life stages most susceptible to entrainment at the proposed location of the northern HVDC converter OSP and provide estimates of the entrainment impact (TetraTech and Normandeau Associates, Inc. 2023). Susceptible species included haddock (*Melanogrammus aeglefinus*) larvae, ocean pout (*Zoarces americanus*) eggs, Atlantic herring (*Clupea harengus*) larvae, Atlantic cod (*Gadus morhua*) eggs and larvae, silver hake (*Merluccius bilinearis*) eggs and larvae, red hake (*Urophycis chuss*) eggs and larvae, yellowtail flounder (*Pleuronectes ferruginea*) eggs and larvae, monkfish (*Lophius americanus*) eggs and larvae, windowpane flounder (*Scophthalmus aquosus*) larvae, witch flounder (*Glyptocephalus* cynoglossus) eggs and larvae, winter flounder (*Pseudopleuronectes americanus*) larvae, American plaice (*Hippoglossoides platessoides*) larvae, silver/offshore hake (*Merluccius bilinearis/albidus*) larvae, pollock (*Pollachius virens*) eggs and larvae, Atlantic mackerel (*Scomber scombrus*) eggs and larvae, butterfish (*Peprilus triacanthus*) eggs and larvae, and summer flounder (*Paralichthys dentatus*) eggs and larvae. Based on monthly mean larval densities of species observed within 10 miles (16 kilometers) of the CWIS location and assuming a water withdrawal rate of 9.9 MGD, the taxa with the highest estimated annual larval entrainment were hakes (3.9 million), Atlantic herring (3.9 million), sand lances (3.3 million), summer flounder (1.3 million), and silver hake (0.5 million). Atlantic cod were estimated to have relatively low annual larval entrainment of 85,353 individuals between January and April, with a peak of 40,734 individuals in March. While entrainment estimates were generated from the best available data, these estimates do not reflect the current species composition in the study area, seasonality, population dynamics, and natural variability. Furthermore, ichthyoplankton data used in this analysis were from various water column depths as opposed to the fixed depth of the CWIS intake at 74 feet (22.6 meters) below the surface and 81 feet (24.7 meters) above and perpendicular to the seafloor, thus, leading to a possible overestimation of larval entrainment as individuals settling in demersal habitats or floating on the surface may not be susceptible to the CWIS intake flow.

Entrainment mitigation measures that may be used at the converter station facility include single pump operation, dual pump operation at reduced capacity via three-way valve or variable frequency drives, and a fixed depth of water withdrawal (TetraTech and Normandeau Associates, Inc. 2023). With the extent of entrainment being directly proportional to the intake flow volume, utilizing a single pump instead of two pumps at full capacity or running two pumps at 50 percent capacity reduces the cooling intake flow volume leading to a proportional reduction in entrainment levels. Variable frequency drives may be used in the cooling water intake system to control flow and minimize the total flow volume required. This allows for the maintenance of safe operational parameters in the HVDC converter while reducing the water intake volume and entrainment impact. The CWIS is designed to withdraw water at a depth of 74 feet (22.6 meters) below the surface and 81 feet (24.7 meters) above the seafloor. This mid-water column intake depth minimizes entrainment impacts as it avoids the higher concentrations of buoyant ichthyoplankton that inhabit surface waters (Sundby and Kristiansen 2015) and those planktonic taxa associated with benthic habitats (Kendall and Naplin 1981). Similar results would be anticipated if SouthCoast Wind selects a second HVDC converter OSP for the southern portion of the Lease Area.

5.1.4.3.2.1 Direct Effects on EFH and EFH Species

- Permanent, negligible entrainment effects on early life stages of EFH species:
    - Pelagic

5.2 Project Surveys and Monitoring Activities

Geophysical surveys and biological monitoring activities will be conducted in the Project area prior to, during, and post-construction. Geophysical surveys will be used to collect data on features present on the seafloor and within the subsurface to inform installation and protection methods to be applied during construction, aid in avoiding potential seafloor and subsurface hazards, and identify any anomalies or changes from prior surveys. Biological project monitoring activities proposed by the applicant include monitoring of marine mammals, fisheries, and the benthos within the Project area. Further information and specifics will be available when the Post-Construction Monitoring Plan is developed.

5.2.1 HRG and Geotechnical Surveys

High-resolution geophysical (HRG) and geotechnical surveys may utilize equipment such as multi-beam echosounders, sidescan sonar, shallow penetration sub-bottom profilers (e.g., “Chirp”, parametric, and non-parametric sub-bottom profilers), medium penetration sub-bottom profilers (e.g., sparkers), ultra-short baseline positioning equipment, and marine magnetometers within the Lease Area and along the export cable routes. During the construction phase an estimated 2,485 miles (4,000 kilometers) may be surveyed within the Lease Area and 3,106 miles (5,000 kilometers) along the ECCs in water depths ranging from 6.5 feet (2 meters) to 204 feet (62 meters). A maximum of four total vessels will be used concurrently for surveying. On average, 50 miles (80-line kilometers) will be surveyed per vessel each day at approximately 3 knots (5.6 kilometers/hour). HRG survey operations will occur on a 24-hour basis, although some vessels may only operate during daylight hours (~12-hour survey vessels). While the final survey plans will not be completed until construction contracting commences, HRG surveys are anticipated to operate at any time of year for a maximum of 112.5 active sound source days. During the operations phase of construction, an estimated 1,740 miles (2,800 kilometers) may be surveyed in the Lease Area and 1,988 miles (3,200 kilometers) along the ECCs each year. Using the same estimate of 50 miles (80 kilometers) of survey completed each day per dedicated survey vessel, approximately 75 days of survey activity would occur each year. During the O&M phase years post-construction, periodic risk-based export cable surveys will be performed, but the frequency and scope of these surveys have yet to be developed.

Exposure to HRG survey noise above behavioral effects thresholds could result in behavioral disturbances including startling, avoidance, and disruption of feeding and spawning activity. As HRG survey equipment is towed during operation at a vessel speed of 3 knots (5.6 kilometers/hour), no individual area is continuously exposed to significant underwater noise (i.e., noise exceeding an established effect threshold). Underwater noise impacts from HRG survey activities are expected to be similar to those resulting from vessel engine noise which have been found to disrupt spawning behavior in fish species such as Atlantic cod and Atlantic herring (Vabø et al. 2002; Handegard et al. 2003; Dean et al. 2022). While HRG-related noise effects on habitat suitability are short-term in duration and the instantaneous area affected is relatively small, the resulting impacts on EFH species could vary in significance depending on the specific timing and location of survey activities. Current research suggests that noise exposure may not necessarily lead to adverse disruptive effects. McQueen et al. (2022) observed that Atlantic cod exposed to seismic airgun noise suspended spawning activity when the stressor was present but resumed spawning at the same location within an hour of its removal. Noise levels generated by seismic airguns are much higher in intensity than those produced by the HRG survey equipment suggesting that this stressor is unlikely to lead to substantial adverse effects on spawning and other biologically important activities.

5.2.2 Marine Mammal Monitoring

SouthCoast Wind will implement measures as identified in the Marine Mammal and Sea Turtle Monitoring and Mitigation Plan (SouthCoast Wind 2023, Appendix O), and the Marine Mammal Protection Act (MMPA) Incidental Take Authorization (ITA) application. Monitoring measures include visual monitoring and acoustic monitoring. Visual monitoring methods for marine mammals and sea turtles will be conducted by protected species observers aboard construction and/or support vessels during construction activity and vessel transit to provide an estimate of potential effects on marine mammals and sea turtles, implement mitigation measures, and ensure vessel strike avoidance. SouthCoast Wind will also use a real-time passive acoustic monitoring (PAM) system or mobile PAM platforms such as towed PAM, autonomous surface vehicles, or autonomous underwater vehicles to supplement visual monitoring during construction to detect all marine mammals potentially present in the Project area. PAM data will be used to characterize the presence marine mammals through passive detection of vocalizations, to record ambient noise and marine mammal vocalizations in the Project area before, during, and after construction, and to monitor impacts relating to project activities. In addition to the requirements for construction-related monitoring, periodic PAM deployments may also be done over the life of the Project for other scientific monitoring needs.

5.2.3 Fisheries

SouthCoast Wind will be working with University of Massachusetts Dartmouth’s School for Marine Science and Technology (SMAST) and the Anderson Cabot Center of Ocean Life at the New England Aquarium to conduct fisheries monitoring for the pre-construction, construction, operations, and decommissioning phases of the Project. Fisheries monitoring plans have been developed in coordination with SMAST, the Anderson Cabot Center, and federal and state agencies, and align with BOEM guidelines (BOEM, 2019b) with additional recommendations provided by the Responsible Offshore Science Alliance (ROSA) Fisheries Monitoring Working Group. SouthCoast Wind intends to provide financial and in-kind support to fund regional fisheries science and monitoring and will be committed to increasing the understanding of highly migratory fish species that transit in and around the Project area, as well as test and explore new technologies for the monitoring and detection of fish species. This funding will also support the collection of data related to movement ecology, biology, and population structure of fish species and other efforts to increase the understanding of how migratory species respond to the installation and operation of WTGs.

SMAST is proposing a comprehensive fisheries monitoring plan (SMAST 2024) to assess potential impacts of the proposed development on marine fish and invertebrate communities within the Lease Area. The faculty, staff, and project principal investigators are recognized experts in the field of fishing technology, fishing impacts, and ecological research. Additionally, the principal investigators have a long history of collaborative research in partnership with fishing industry, regulatory agencies, and the scientific community. The proposed fisheries monitoring plan incorporates multiple surveys utilizing a range of survey methods to assess different facets of regional ecology and fisheries and follows a Before-After-Control-Impact (BACI) design originally proposed by Green (1979), and recommended by BOEM (BOEM 2019b), with principals on environmental sampling as guidance (Underwood 1994, Christie et al 2020). These include a demersal otter trawl survey occurring on a seasonal basis (once per quarter), benthic optical drop camera survey occurring once in spring (Q2) and once in late summer (Q3), and a ventless lobster trap survey and neuston net survey occurring every two weeks from May through October. The incorporation of these surveys will provide a holistic assessment of the fisheries resources in the Lease Area and assess the potential impact of offshore wind energy development. All components of the fisheries monitoring plan (SMAST 2024) are planned to be conducted on board commercial fishing vessels piloted by experienced fishermen.

The demersal otter trawl, further referred to as a trawl, is a net that is towed behind a vessel along the seafloor expanded horizontally by a pair of otter boards or trawl doors. Trawls tend to be relatively indiscriminate in the fish and invertebrates they collect; hence trawls are a general tool for assessing fish communities along the seafloor and are widely used by institutions worldwide for fisheries and ecosystem monitoring. The trawl survey, employing a tow speed of 3.0 knots and a tow duration of 20 minutes, will be used to evaluate the impacts of development on demersal fish populations. The benthic optical drop camera survey uses the SMAST sampling pyramid that deploys three cameras (digital still and video) and estimates the substrate as well as 50 different invertebrate and fish species that associate with the sea floor. This survey is used in the NOAA stock assessment of the Atlantic sea scallop (*Placopecten magellanicus*) resource. A ventless trap survey will focus on assessing populations of American lobster, Jonah crab, and black sea bass in the SouthCoast Wind Lease Area. This work will be conducted in partnership with the Massachusetts Lobstermen's Association. This survey follows the same sampling design as the Massachusetts, Maine, and Rhode Island state ventless trap surveys to allow broader scale comparisons, however, ropeless fishing gear will be deployed during the ventless trap survey meaning there will be no vertical downlines. The primary method for retrieving trap strings will be grappling, though on-demand systems will continue to be tested and potentially phased into the survey as the technology progresses and becomes logistically feasible (SMAST 2024). In tandem with the ventless trap survey, SouthCoast Wind and its collaborators will plan, coordinate, and conduct a stratified random neuston tow survey to target neustonic American lobster larvae and other large ichthyoplankton in the SouthCoast Wind Lease Area and control areas during May through October.

Trawl surveys used to assess abundance and distribution of target fish and invertebrate species within the offshore Project area could affect a variety of fish and invertebrate species. The capture of fish species, including ESA-listed species like the Atlantic sturgeon, in trawl gear has the potential to result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations (Moser and Ross 1995; Collins et al. 2000; Moser et al. 2000). Capture of sturgeon in trawl gear could result in injury or death, however, the use of trawl gear is considered a safe and reliable method to capture sturgeon if tow and onboard handling times are limited (Beardsall et al. 2013). Drop camera surveys are non-intrusive sampling techniques which are not expected to cause any impacts to fish, invertebrate, or EFH. Bycatch of non-target species is possible during ventless trap surveys though bycaught organisms would be returned to the environment where practicable. The potential bycatch impact would be comparable to but limited in extent relative to the baseline level of impacts from commercial fisheries. Survey gear types placed on the seabed (e.g., traps) could also potentially disturb benthic habitats and epifauna (Schweitzer et al. 2018). However, any resulting disturbance would be minimal given the limited number or traps to be used and the small footprint of the survey gear.

A fisheries monitoring plan (INSPIRE 2023a) has been developed for the portion of the Brayton Point ECC in Rhode Island state waters in accordance with the Rhode Island Ocean Special Area Management Plan (OSAMP), the Baseline Assessment Requirements in state waters, and other applicable sections of the Rhode Island Code of Regulations to characterize abundance and size structure, as well as, presence, movement, and behavior of key fisheries species during the pre-construction, construction, and post-construction phases of the project. The species targeted by monitoring efforts will include the striped bass (*Morone saxatillis*), summer flounder (*Paralichthys dentatus*), tautog (*Tautoga onitis*), false albacore (*Euthynnus alletteratus*), channeled whelk (*Busycotypus canaliculatus*), and knobbed whelk (*Busycon carica*) with acoustic telemetry and trap surveys as the primary monitoring methodologies.

SouthCoast Wind will conduct acoustic telemetry monitoring along the Brayton Point ECC at the mouth of the Sakonnet River using a 12-receiver array of fixed station acoustic receivers to monitor the movements, presence, and persistence of several commercially and recreationally important species (e.g., striped bass, summer flounder, tautog, and false albacore). Receivers will be deployed in early spring (April) and retrieved in late fall (November) to ensure seasonal overlap with the target species with tagging efforts occurring regularly in between. Target fish species within the area in and around the receiver array will be captured via rod-and-reel, implanted with Vemco acoustic transmitters, and released back into the ocean. Acoustic telemetry methodologies have been used extensively in fisheries research (Hussey et al. 2015; Freiss et al. 2021) and mortality of tagged fish is expected to be low. SouthCoast Wind will also conduct a trap survey to monitor whelk relative abundance and size structure along commercially fished sections of the Brayton Point ECC in the Sakonnet River. The survey will identify potential impacts from the short-term disturbance of submarine cable installation on the localized channeled and knobbed whelk resources. Sampling will occur every two weeks from May to November to align with the commercial fishery for whelk within Narragansett Bay at four to six stations to be selected with input from the commercial fishing industry. In the absence of standardized whelk survey practices, SouthCoast Wind has consulted with the local whelk fleet regarding trap design and intends to deploy three six-trap strings that will be laid parallel to the export cable at each of the sampling locations using a Before-After Gradient (BAG) survey design. The use of traps could result in unavoidable impacts to habitat-forming invertebrates that comprise an important component of habitat for some EFH species. The extent of habitat disturbance and number of organisms affected could be comparable to and limited in extent relative to the baseline level of impacts from commercial fisheries.

5.2.4 Benthos/Benthic Habitat

SouthCoast Wind will conduct a benthic seafloor habitat and seafloor characterization assessment in the Lease Area and along the proposed ECCs (SouthCoast Wind 2023, Appendix M). This baseline seafloor survey will characterize benthic habitats within the Project area possibly affected by the proposed construction and operations to better inform siting decisions with the goal of avoiding or minimizing potential impacts on sensitive biological communities and EFH as required by BOEM 2019a and NMFS 2020 guidelines. Survey methodologies include benthic grab sampling for analysis of physical parameters and benthic community structure, SPI/PV imagery for determining the physical characteristics of surficial sediment and presence of epifauna and other surface-dwelling organisms, and real time video to support and inform reporting according to the CMECS format as required by BOEM guidelines.

SouthCoast Wind has also developed a benthic monitoring plan for benthic habitats within the Lease Area and the Brayton Point ECC to evaluate detectable post-construction changes (INSPIRE 2024). Benthic monitoring will focus on determining changes to the benthic ecosystem associated with the development of the wind farm. Specifically, the monitoring will focus on documenting potential adverse outcomes associated with the introduction of novel surfaces (foundations, scour protection, and cable protection layers) that act as artificial reefs, the artificial reef effect (epifaunal colonization) associated with the offshore wind structures that will lead to enrichment (fining and higher organic content) of surrounding soft bottom habitats resulting in shifts in benthic function (increased organic matter processing), and the physical disturbance of soft sediments during cable installation that will temporarily disrupt the function of the infaunal community, with sampling to occur in the late spring/early fall after construction. To assess the effect of the introduction of hard-bottom novel surfaces, a ROV stereo-camera system will be used to measure changes in benthic percent cover, identify key or dominant species, document non-native species, and compare findings across water depths in a stratified-random sampling design. To evaluate structure-oriented enrichment, sediment grab samples and SPI/PV will be used to measure changes in benthic function over time and with distance from foundations. For this objective, a stratified random selection of foundations within water depth contoured strata will be tested using a BAG design at each selected foundation. SPI/PV will again be used to measure benthic function over time and with distance from the cable centerline to assess cable-associated physical disturbance. A BAG design will be used to evaluate this objective within a stratified-random selection of cable segments.

ROV stereo camera surveys will monitor novel hard bottom habitats within sub-areas of the Project area, at structures selected using a stratified random design. The selected WTG and OSP foundations will be surveyed from the air-sea interface down to the seafloor and away from the structure to the edge of the scour protection layer using underwater image collection. To evaluate cable-associated physical disturbance effects in hard bottom habitats, delineated complex habitat will be included as a stratum in the benthic monitoring program, including Glacial Moraine A and where boulder fields occur. The survey design will be consistent with the soft bottom export cable locations (BAG design), however, the spatial scale of data collection will cater to the patchiness and general heterogeneity of these hard bottom habitats. Video imagery will be collected along continuous transects perpendicular to and along the center line of where boulder relocation activities were conducted.

During physical sampling (e.g., grab sampling), organisms captured would be removed from the environment for scientific analysis. Other non-target fish and invertebrate species could also be impacted by sampling activities when survey equipment contacts the seafloor or when inadvertently captured as bycatch causing injury or death. Non-target organisms would be returned to the environment where practicable. While project monitoring activities would result in unavoidable impacts on EFH species through the intentional or incidental take of individual organisms, the extent of habitat disturbance and number of organisms affected would be small in comparison to the baseline level of impacts from commercial fisheries and would not have a measurable effect on the viability of any species at the population level or available EFH. Surveying activities will occur in the third quarter of each sampling year to align with peak biomass and diversity of benthic organisms. Any survey would use a random sampling design making repeated disturbance of the same habitat unlikely. As such, habitat impacts from survey implementation would likely be short term in duration. The intensity and duration of impacts anticipated from fisheries and benthic monitoring activities would constitute a minor adverse effect on EFH and associated species.

5.3 Decommissioning Concept

As described in Section 2.4, SouthCoast Wind will be required to remove and/or decommission all Project infrastructure and clear the seabed of all obstructions when these facilities reach the end of their 35-year designed service life. Decommissioning activities will involve removing WTG and OSP foundations and associated structures above the mudline. Interarray cables, ECCs, and associated scour protection will either be removed or retired in place, depending on the habitat value they provide. All Project components that are removed will be transported to an appropriate disposal and/or recycling facility.

Vessels involved in decommissioning would generate underwater noise, which may cause temporary behavioral effects on pelagic EFH species similar to those described in Section 5.1.1.1. Vessel noise may result in brief periods of exposure near the surface of the water column but is not expected to cause injury, hearing impairment or long-term masking of biologically relevant cues in fish and invertebrates. 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. Increased underwater noise during decommissioning would primarily be associated with structure removal activities that may include mechanical cutting, water jet cutting, or other industry standard practices. The noise produced by 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 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. Direct impacts on 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.

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 on 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.

If the cable protection is left in place, hard-bottom habitat would remain along parts of the cable corridors and would continue to support an assemblage of EFH species associated with complex benthic habitat. Removal of the cables would disturb soft-bottom habitat and would cause temporary impacts on EFH species with benthic or epibenthic life stages (e.g., crushing or burial, sediment suspension and deposition) similar to those described for cable emplacement in Section 5.1.2.3. Removal of the scour protection would convert hard-bottom habitat to soft-bottom habitat and would likely result in a recolonization by EFH species preferring soft-bottom sand and fine-sediment habitat and the loss of any EFH species associated with complex benthic habitat.

5.4 Cumulative and Synergistic Effects on EFH

BOEM has completed a study of IPFs on the North Atlantic OCS to consider in an offshore wind development cumulative impacts scenario (BOEM 2019a). That study is incorporated in this document by reference. The study identifies cause-and-effect relationships between renewable energy projects and resources potentially affected by such projects. It further classifies those relationships into a manageable number of IPFs through which renewable energy projects could affect resources. It also identifies the types of actions and activities to be considered in a cumulative impact’s scenario. The study identifies actions and activities that may affect the same biological resources (e.g., EFH) as renewable energy projects and states that such actions and activities may have the same IPFs as offshore wind projects. Potential impact-producing factors from current and future offshore wind energy projects are expected to result from the same or similar components as the SouthCoast Wind project: wind turbines, offshore and onshore cable systems, offshore substations, onshore O&M facilities, and onshore interconnection facilities. It is further assumed that other potential offshore wind projects will employ the same or similar construction and installation, operations and maintenance, and decommissioning activities as the proposed project. However, future offshore wind projects would be subject to evolving economic, environmental, and regulatory conditions. Lease areas may be split into multiple projects, expanded, or removed, and development within a particular lease area may occur in phases over long periods of time. Research currently being conducted in combination with data gathered regarding physical, biological, socioeconomic, and cultural resources during development of initial offshore wind projects in the United States could affect the design and implementation of future projects, as could advancements in technology.

The primary impacts of the Proposed Action on EFH would result from the presence of structures, including 147 WTG and 2 OSP foundations, 376 acres of habitat alteration of foundations/scour protection when using monopile foundations (403 acres when using piled jacket foundations and 598 acres when using a combination of suction-bucket jackets for up to 85 WTG/OSP positions and piled-jacket foundations for up to 64 WTG/OSP positions), and 122 acres of cable protection for the interarray and ECC cables. Planned and existing offshore wind activities across all of the U.S. East Coast OCS, including the Proposed Action, would include up to 3,163 new foundations, 4,665 acres of foundation scour protection, and 2,542 acres of cable hard protection (BOEM 2023, Appendix D). BOEM anticipates that structures would be added intermittently over an assumed 5-year period and that they would remain until decommissioning of each facility is complete.

These structures would be constructed in mostly sandy seafloor and would therefore convert soft-bottom habitat to hard-bottom habitat. The installation of these structures would result in a permanent loss of EFH for epibenthic and benthic finfish and invertebrates that associate with soft-bottom habitat (e.g., clams, flounders, skates). The added structures could affect migration through the area of species that prefer complex habitat by providing unique, complex features (relative to the primarily sandy seafloor). This could lead to retention of those species and possibly impact spawning opportunities. Complex habitat and its associated faunal communities are limited in the Lease Area; however, complex habitats are present in some locations along the two ECCs. The structures would create an “artificial reef effect,” whereby more sessile attached organisms (e.g., sponges, algae, mussels, shellfish, sea anemones) would likely colonize over time. 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 species that are typically associated with soft-bottom habitat. Potential benefits of added complex habitat may be offset if the colonizable habitats act as steppingstones for non-native species. Similar effects would be expected from the use of concrete mattresses for cable protection at cable crossing locations. SouthCoast Wind anticipates a maximum of 16 cable crossing locations along the Brayton Point ECC potentially requiring up to nine concrete mattresses each. Interarray cable crossings may also require cable protection, however, cable crossing locations along the interarray cable layout have not yet been identified. Colonization of concrete mattresses used for cable protection by epifouling taxa, mobile invertebrates, and benthic fishes has been found to occur in European wind farms. A recent study on artificial hard substrate colonization at the Hywind Scotland Pilot Park floating offshore wind farm (Karlsson et al. 2022) found species of hydroids, sea stars, crab, lobster, flatfish, and ling inhabiting concrete mattresses used for cable protection three years post construction. It is expected that epifaunal colonization, species succession, and reef effects will also occur on concrete mattresses used within the SouthCoast Wind Project area, however, the magnitude of effects may vary by location and season.

NMFS has defined the area within 20 kilometers of the 30-meter isobath west of the Nantucket Shoals as an Area of Concern (Figure 5-6). Nantucket Shoals is a highly productive area and is EFH for many fish species. While direct physical impacts to the seafloor are unlikely to extend into this area, there is potential for construction noise to impact species that use this area for foraging and spawning. Of particular concern, is Atlantic cod. Van Hoeck et al. (2023) recently published a study identifying peak cod spawning based on temporal patterns in cod grunting in late November and early December in Southern New England. The impact of pile-driving noise would depend on the time of year it occurs and could potentially cause reduced reproductive success in one or more spawning seasons resulting in long-term impacts on populations if one or more cohorts suffer suppressed recruitment. For the SouthCoast

Wind project, no pile driving is to occur in this area of concern from October 15 to May 31. This seasonal restriction would benefit Atlantic cod spawning in this area as it temporally overlaps peak Atlantic cod spawning.

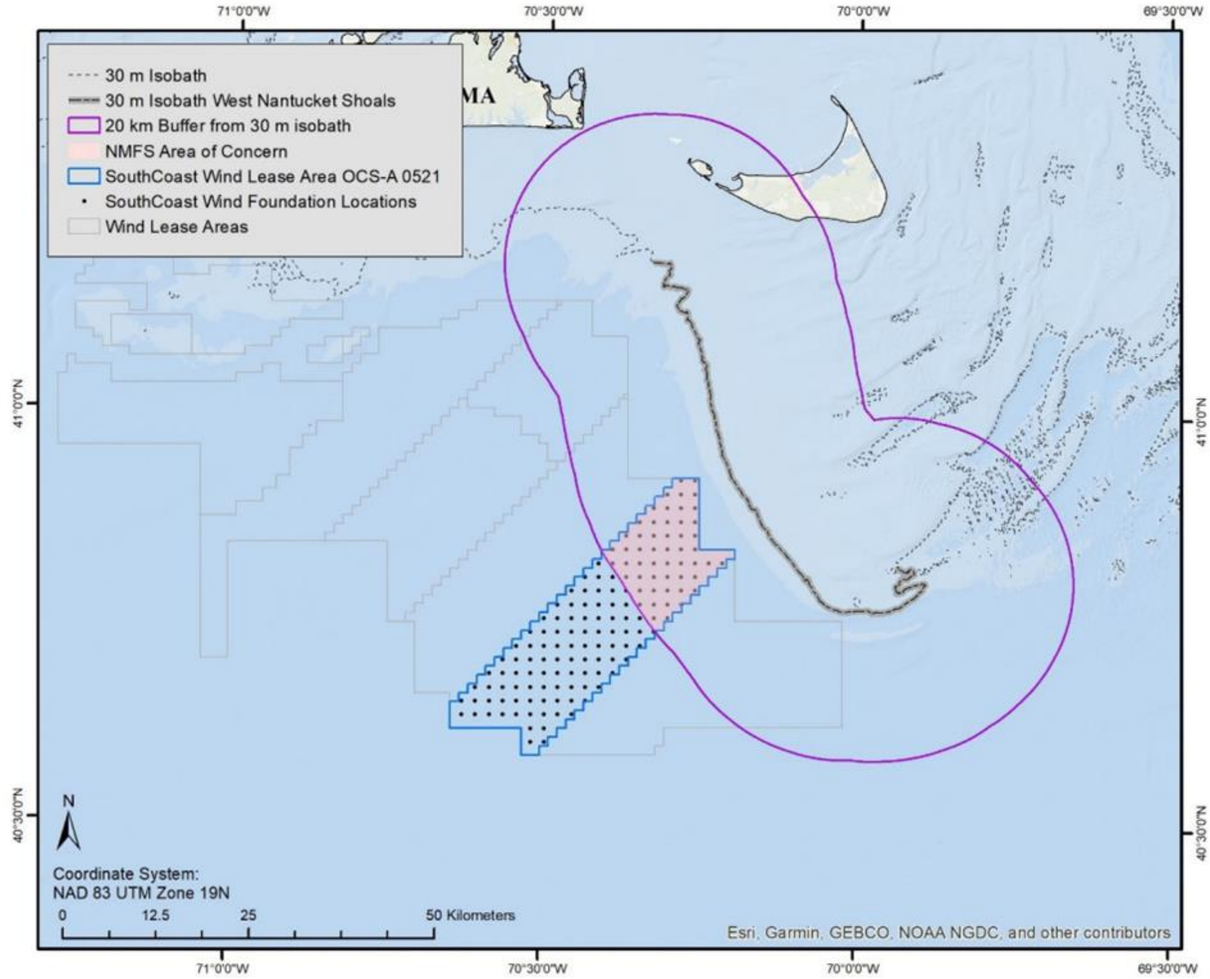


Figure 5-6. NMFS Area of Concern

In the Southern New England region, there is one existing offshore wind facility, the Block Island Wind Farm, and two offshore wind projects that are under construction in the region, South Fork Wind and Vineyard Wind 1, which will likely be operational in 2024. Additionally, there are two offshore wind projects in the Southern New England region that are scheduled to begin offshore construction in 2024, Sunrise Wind and Revolution Wind (Sunrise Wind 2023, Revolution Wind 2023a). Collectively, the construction and operation of these facilities would impact EFH and EFH species primarily through seafloor disturbance during cable emplacement, pile driving noise, and habitat conversion.

Construction of the Sunrise Wind and Revolution Wind projects would include placement of 540 miles of buried and armored cable along transmission corridors and interarray connections, disturbing 2,091 acres (846 hectares) of benthic habitat. Cable emplacement for each of these two projects is scheduled to begin in 2024 and would disturb, displace, and injure or kill finfish and invertebrates, release sediment into the water column, and cause habitat alterations. Mobile finfish and invertebrates are likely to move away from cable-laying equipment, but immobile or slow-moving demersal species and life stages (e.g., eggs, larvae) may be injured or killed by this construction activity. Some types of equipment that are used to prepare the seabed prior to cable emplacement (e.g., hydraulic dredges) use water withdrawals, which can entrain planktonic eggs and larvae with assumed 100-percent mortality of entrained individuals. Suspended sediment and sediment deposition associated with cable emplacement may cause impacts on EFH and EFH species out to several hundred meters, including behavioral changes in fish and invertebrates and burial of sessile species and life stages. Seabed preparation prior to cable emplacement would cause short-term disturbances of soft-bottom habitat and long-term disturbances of complex habitat, which may require several years to recover.

Construction of the Sunrise Wind and Revolution Wind projects would also generate pile driving noise during the installation of up to 194 WTG and 3 OSP foundations. Pile driving noise may cause behavioral or injurious effects over distances of up to several kilometers from each foundation installation site and would temporarily render the surrounding habitat less suitable for some fish and invertebrate species. Pile driving is anticipated to cause adverse impacts to EFH for both pelagic and demersal life stages; however, this impact will be short-term, as EFH is expected to return to pre-pile driving conditions at the completion of foundation installation.

The Southern New England region is known to support cod spawning aggregations (Clucas et al. 2019) during the winter months, 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 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) and cod in this region have shown a tendency to be distributed over larger areas (Loehrke 2014). Existing data also indicate that cod spawning occurs throughout the Southern New England region (DeCelles et al. 2017; INSPIRE 2020). While juvenile and adult Atlantic cod are highly mobile, the spawning Atlantic cod life stage is considered sensitive and vulnerable due to a demonstrated high fidelity to specific spawning sites (Dean et al. 2022).

Atlantic cod exhibit courtship and spawning behavior, including vocalizations, primarily at night (Dean et al. 2014, Zemeckis et al. 2019), with peak spawning communication occurring approximately 4 to 6 hours after sunset (Zemeckis et al. 2019). Monitoring surveys to document cod spawning activity within and around the Revolution Wind Farm lease area found that Atlantic cod spawning was concentrated in the months of November and December within the central portion of their lease area based on grunt detections that were recorded (Revolution Wind 2023b). Noise from pile driving could potentially have an impact on cod reproduction by reducing the efficiency of these vocalizations (Stanley et al. 2017). If pile driving is suspended during the winter months to avoid impacts to North Atlantic right whales, this will also mitigate potential noise impacts on spawning Atlantic cod. Seafloor-disturbing activities could also impact spawning habitat for Atlantic cod (e.g., large-grained and complex habitats; medium- and low-density boulder fields) though mitigation measures during project construction may minimize such disturbances.

BOEM anticipates that the installation of offshore wind structures for offshore wind projects in the Southern New England region would occur intermittently over a three-year period and would remain until decommissioning of each facility is complete. The presence of offshore wind structures and turbine arrays may alter the hydrodynamic environment around an offshore wind farm. Such structures can reduce the wind-driven mixing of surface waters (depending on proximity of the hub height to the water’s surface) and increase vertical mixing as water flows around the structure. Changes in hydrodynamics have the potential to impact larval distribution, primary productivity, and cause thermal dynamic shifts in the water column. Some hydrodynamic effects will be localized to the foundations, as the influence of the structure on the hydrodynamic system decreases with range and the area experiences strong regional forcing from the Gulf Stream. Other hydrodynamic effects may extend up to tens of kilometers as a result of the cumulative wind energy extraction of multiple wind farm arrays and the resulting atmospheric wakes. However, the magnitude of impact on specific marine ecosystems and biogeochemistry remains uncertain though hydrodynamic changes are not expected to substantially impact EFH and associated species.

6. Avoidance, Minimization, and Mitigation

6.1 Avoidance, Minimization, and Mitigation Measures

This section outlines AMMs proposed by SouthCoast Wind and additional agency-proposed AMMs that are intended to avoid and/or minimize potential impacts on EFH-designated species and EFH. Relevant AMMs and mitigation measures, contributions to avoiding and/or minimizing adverse effects on EFH, and supporting rationale are summarized in Table 6-1 (applicant AMMs) and Table 6-2 (agency-proposed AMMs).

Table 6-1. AMMs for avoidance, minimization, and mitigation

Project Phase	Impact Producing Factors Potential Effect or Category	Description	Expected Effects on EFH and NOAA Trust Resources	Anticipated Enforcing Agency
Construction	Seabed or Ground Disturbance Seabed preparation, offshore component installation, and vessel anchoring/ spudding	• SouthCoast Wind will use BMPs to minimize sediment mobilization during offshore component installation • SouthCoast Wind, when feasible, will use technologies that minimize sediment mobilization and seabed sediment alteration for cable burial operations • SouthCoast Wind, where practical and safe, will utilize DP vessels • SouthCoast Wind will utilize HDD for sea-to-shore transition	Limits impacts on benthic EFH, EFH species, and NOAA Trust Resources by reducing the extent of direct habitat impacts and by reducing suspended sediment and sediment redeposition impacts. Use of HDD for sea-to-shore transition minimizes impacts on summer flounder HAPC at the Falmouth ECC landing.	Best practice - not an enforceable measure
Construction, O&M, Decommissioning	Seabed or Ground Disturbance Scour Development Routine offshore operation and maintenance	• SouthCoast Wind will utilize scour protection methods to avoid developing scour holes at the base of structures • SouthCoast Wind will bury submarine cables at depths to guard against exposure from seabed mobility	Minimizes the extent of direct habitat impacts and EMF impacts on benthic EFH, EFH species, and NOAA Trust Resources.	BSEE
Decommissioning	Seabed or Ground Disturbance Offshore component decommissioning	• SouthCoast Wind will use BMPs to minimize sediment mobilization during decommissioning	Limits impacts on benthic EFH, EFH species, and NOAA Trust Resources by reducing suspended sediment and sediment redeposition impacts.	Best practice - not an enforceable measure
Construction, O&M, Decommissioning	Seabed or Ground Disturbance Offshore component installation, routine offshore O&M, vessel anchoring, and decommissioning	• SouthCoast Wind will select and use BMPs including the use of a SWPPP to minimize sediment mobilization during offshore construction of WTGs and OSPs, scour protection placement, and HDD operations • SouthCoast Wind, when feasible, will use technologies that minimize sediment mobilization and seabed sediment alteration for cable burial operations	Limits impacts on benthic EFH, EFH species, and NOAA Trust Resources by reducing the extent of direct habitat impacts and by reducing suspended sediment and sediment redeposition impacts.	Best practice – not an enforceable measure
Construction, O&M,	Seabed or Ground	• SouthCoast Wind will follow BMPs, including the use of a SWPPP, during onshore construction	Minimizes potential adverse effects on EFH and NOAA	BSEE, USCG,

Project Phase	Impact Producing Factors Potential Effect or Category	Description	Expected Effects on EFH and NOAA Trust Resources	Anticipated Enforcing Agency
Decommissioning	Disturbance Onshore component installation and decommissioning	activities to control sedimentation and erosion	Trust Resources from impacts on water quality.	USEPA, MassDEP and RIDEM
Construction, O&M, Decommissioning	Planned Discharges Stormwater runoff, routine releases, and duct bank installation	• SouthCoast Wind will follow USCG requirements at 33 CFR Part 151 and 46 CFR Part 162 regarding bilge and ballast water • SouthCoast Wind will require all Project vessels to comply with regulatory requirements related to the prevention and control of discharges and accidental spills including USEPA requirements under the USEPA 2013 Vessel General Permit and state and local government requirements	Minimizes the potential for the discharge of ballast or bilge water contaminated with invasive species. Minimizes potential adverse effects on EFH and NOAA Trust Resources from impacts on water quality.	BOEM, BSEE and USCG
Construction, O&M, Decommissioning	Accidental Events/ Natural Hazards Unplanned releases	• SouthCoast Wind will comply with the regulatory requirements related to the prevention and control of discharges and accidental spills as documented in the proposed Project's OSRP • SouthCoast Wind's SWPPP will include a Project-specific SPCC plan to prevent inadvertent releases of oils and other hazardous materials to the environment to the extent practicable • SouthCoast Wind will have an HDD Contingency Plan in place to mitigate, control, and avoid unplanned discharges related to HDD activities	Minimizes potential adverse effects on EFH and NOAA Trust Resources from impacts on water quality.	BOEM, BSEE and USCG
Construction, O&M	Seabed or Ground Disturbance Planned Discharges/ Accidental Events Project installation and vessel O&M	• SouthCoast Wind will select sites for construction that avoid areas of sensitive seafloor and benthic habitat to the extent practicable • SouthCoast Wind will utilize HDD for nearshore export cable installation • SouthCoast Wind will minimize trench and sidecasting widths for export cable installation and anchor outside of eelgrass beds where possible • To the extent possible, SouthCoast Wind will avoid use of anchored vessels near known eelgrass beds	Minimizes impacts on summer flounder HAPC. Minimizes impacts on sensitive and slow to recover habitats utilized by EFH species and NOAA Trust Resources.	BOEM and NMFS

Project Phase	Impact Producing Factors Potential Effect or Category	Description	Expected Effects on EFH and NOAA Trust Resources	Anticipated Enforcing Agency
Construction	Change in Ambient Lighting	• Any effects of changes to ambient lighting will be limited to proposed landfall locations where eelgrass beds or clusters of macroalgae were identified along the northern portions of the proposed ECCs	Minimizes potential impact of lighting on summer flounder HAPC and SAV and macroalgae habitat.	BOEM and NMFS
Construction	Actions that May Displace Biological Resources (Eelgrass and Macroalgae) Actions that May Cause Direct Injury or Death	• Offshore export cable installation and the location of the HDD exit pit are planned for outside the mapped eelgrass extents at the cable landing locations	Avoids direct impacts on summer flounder HAPC and sensitive eelgrass habitat.	BOEM and NMFS
O&M	Change in Ambient EMF	• SouthCoast Wind will utilize HDD for nearshore export cable installation.	EMF modeling conducted for the proposed Project indicates that the use of HDD in nearshore areas will reduce magnetic field impacts on summer flounder HAPC and EFH associated with SAV habitat.	Best practice - not an enforceable measure
Decommissioning	Seabed or Ground Disturbance	• The proposed Project's offshore export cables may be left in place to minimize environmental effects.	Minimizes direct habitat impacts on benthic EFH, EFH species, and NOAA Trust Resources.	Best practice - not an enforceable measure
Decommissioning	Displacement of Eelgrass and Macroalgae Actions that May Cause Direct Injury or Death of Biological Resources	• The offshore export cables may be left in place to minimize environmental effects.	Minimizes direct impacts on benthic EFH, EFH species, and NOAA Trust Resources. Avoids displacement of SAV and macroalgae that may have become established in the cable corridor during the Project's lifetime.	Best practice - not an enforceable measure

Project Phase	Impact Producing Factors Potential Effect or Category	Description	Expected Effects on EFH and NOAA Trust Resources	Anticipated Enforcing Agency
Construction, O&M, Decommissioning	Seabed or Ground Disturbance/ Harassment/mortality Vessel Anchoring	• SouthCoast Wind will design the scour protection system to reduce and minimize scour and sedimentation to the extent practicable • SouthCoast Wind, where practical and safe, will utilize DP vessels	Minimizes direct impacts on benthic EFH, EFH species, NOAA Trust Resources, and sensitive habitats used by EFH species.	Best practice - not an enforceable measure
Construction, O&M, Decommissioning	Planned Discharges/ Accidental Events	• SouthCoast Wind will comply with the regulatory requirements related to the prevention and control of discharges and accidental spills as documented in the proposed Project's OSRP	Minimizes potential adverse effects on EFH and NOAA Trust Resources from impacts on water quality.	BOEM, BSEE and USCG
Construction, Decommissioning	Actions that May Displace Biological or Cultural Resources, or Human Uses Habitat Loss	• SouthCoast Wind will use HDD at landings to avoid disturbance to nearshore productive shellfish beds to the extent practicable • SouthCoast Wind will select lower impact construction methods, where possible • SouthCoast Wind will select corridor and micro-route cables within selected corridor to avoid complex habitats, where possible • SouthCoast Wind's Project cable burial layout was designed to minimize length of cable needed • SouthCoast Wind will bury cables, where possible, to allow for benthic recolonization after construction is complete • SouthCoast Wind will re-locate large boulders, when necessary, to areas of similar habitat	Limits impacts on benthic EFH, sensitive habitats, and associated EFH species and NOAA Trust Resources by reducing the extent of direct habitat impacts. Re-locating boulders to areas of similar habitat would reduce the impacts of boulder relocation on EFH species associated with this habitat.	BOEM and NMFS
O&M	Actions that May Displace Biological or Cultural Resources, or Human Uses Habitat Loss	• Presence of Project foundation areas, scour protection, and cable burial would allow for benthic recolonization	Minimizes the long-term impacts of the Project on benthic EFH, EFH species, and NOAA Trust Resources.	Best practice – not an enforceable measure
O&M	Change in Ambient EMF Displacement/ harassment	• SouthCoast Wind will employ industry standard cable burial and cable shielding methods to reduce potential effects • SouthCoast Wind's Project cable burial layout was designed to minimize length of cable needed to reduce potential effects	Minimizes impacts on benthic EFH, EFH species, and NOAA Trust Resources from EMF.	BSEE

Project Phase	Impact Producing Factors Potential Effect or Category	Description	Expected Effects on EFH and NOAA Trust Resources	Anticipated Enforcing Agency
Construction, O&M, Decommissioning	Habitat Disturbance and Modification Habitat Loss and artificial reef effect	• SouthCoast Wind will design the sea-to-shore transition to reduce the dredging footprint and effects on benthic organisms (e.g., cofferdam and/ or gravity cell) • SouthCoast Wind will incorporate use of HDD at landing(s) and avoid disturbance to finfish and invertebrate EFH to the extent practicable • SouthCoast Wind will incorporate use of HDD of subsea cables, as appropriate, to minimize spatial and temporal effects on benthic organisms • SouthCoast Wind will avoid seafloor disturbance to complex habitats when practical	Limits impacts on summer flounder HAPC, benthic EFH, sensitive habitats, and associated EFH species by reducing the extent of direct habitat impacts.	Best practice - not an enforceable measure
Construction, Decommissioning	Change in Ambient Lighting/ Displacement, harassment, and mortality	• SouthCoast Wind will incorporate use of HDD at landings and avoid disturbance to finfish and invertebrate EFH to the extent practicable	Limits impacts on benthic EFH, EFH species, and NOAA Trust Resources by reducing the extent of direct habitat impacts. Use of HDD for sea-to-shore transition minimizes impacts on summer flounder HAPC at the Falmouth ECC landing.	Best practice - not an enforceable measure
O&M	Change in Ambient Lighting/ Displacement, harassment, and mortality	• SouthCoast Wind will install offshore export cables and interarray cables to target burial depths and use cable shielding materials to minimize effects of EMFs	Minimizes impacts on benthic EFH, EFH species, and NOAA Trust Resources from EMF.	BSEE

Project Phase	Impact Producing Factors Potential Effect or Category	Description	Expected Effects on EFH and NOAA Trust Resources	Anticipated Enforcing Agency
Construction, O&M, Decommissioning	Introduced Sound into the Environment (In-air or Underwater) Behavioral disturbance Planned Discharges/ Accidental Events	• SouthCoast Wind will incorporate lower-impact construction methods, where possible • SouthCoast Wind will incorporate soft start methods, to the extent practicable, during initial pile driving activities to allow mobile finfish and invertebrates to migrate away from the area • SouthCoast Wind will employ sound-attenuation measures (e.g., bubble curtains, insulated piles) • SouthCoast Wind will limit duration of pile driving activities to reduce sound propagation/sound exposure • SouthCoast Wind will comply with the regulatory requirements related to the prevention and control of discharges and accidental spills as documented in the proposed Project's OSRP • SouthCoast Wind will establish protocols to minimize releases of marine trash and debris, and when practical and safe will collect marine trash and debris for later disposal	Minimizes potential impacts on EFH species and NOAA Trust Resources from underwater sound produced during construction and decommissioning activities. Minimizes potential adverse effects on EFH and NOAA Trust Resources from impacts on water quality.	BOEM, NMFS, BOEM, BSEE

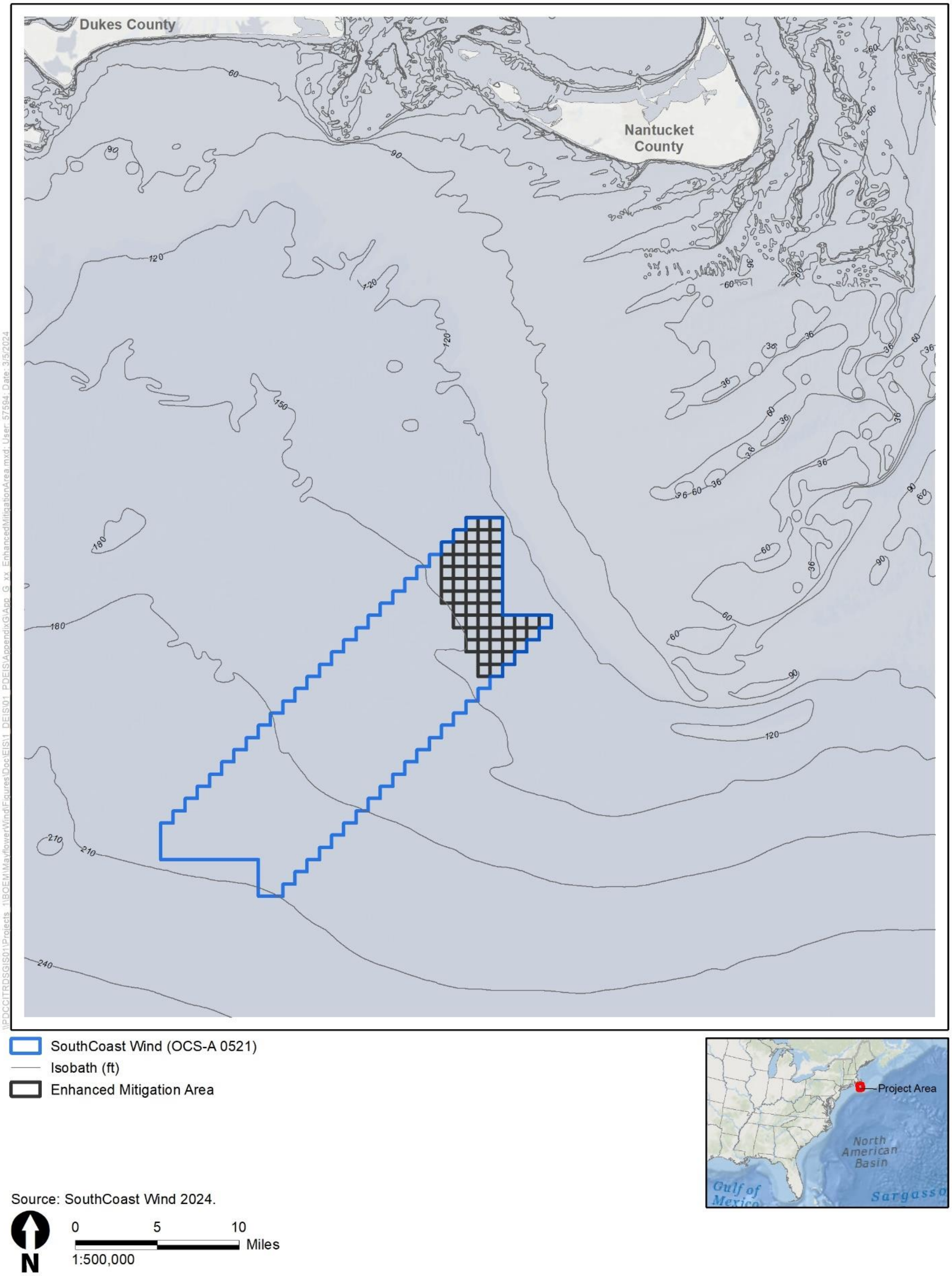
Source: modified from COP Volume 2, Table 16-1; SouthCoast Wind 2023

Table 6-2. Agency-proposed mitigation measures (AMMs) for avoidance, minimization, and mitigation

Project Phase	AMM	Description	Expected Effects on EFH and NOAA Trust Resources
O&M	NS-1 HVDC open-loop cooling system avoidance area	To minimize potential impacts on zooplankton from impingement and entrainment in offshore wind HVDC converter station open-loop cooling systems, no open-loop cooling systems will be permitted in the enhanced mitigation area of the Lease Area (Figure 6-1). No geographic restrictions on the offshore ECC, nor the installation of an HVAC OSP are included in this mitigation measure. Nantucket Shoals supports dense aggregations of zooplankton such as gammarid shrimp and copepods, which in turn, support higher tropic levels of wildlife. While the SouthCoast Wind Project would not overlap with the highest modeled densities of zooplankton in the Nantucket Shoals region, BOEM is requiring a precautionary measure to reduce the magnitude of potential mortality from entrainment of zooplankton in an HVDC open-loop cooling system. This measure is anticipated to result in less mortality to prey species for higher trophic level fish than compared with project design envelope which could include HVDC OSP locations closer to Nantucket Shoals and thus closer to higher densities of zooplankton.	Minimizes entrainment impacts on egg and larval stages of EFH species, NOAA Trust Resources, and prey species.
Construction, O&M	NS-2 Pile-driven foundations only	Only monopile or piled jacket foundations may be used in the enhanced mitigation area, which would minimize the overall structure impact on benthic prey species.	Minimizes direct habitat impacts on benthic EFH, benthic NOAA Trust Resources and benthic prey species in the enhanced mitigation area.
Construction	NS-4 Pile-driving time-of-year restriction in enhanced mitigation area	SouthCoast Wind must drive piles in the enhanced mitigation area (Figure 6-1) only between June 1 to October 31 when North Atlantic right whale (NARW) density is at its lowest. This time frame also falls outside of the spawning season of fish species in Nantucket Shoals such as Atlantic cod (Fall to Winter; Weiss et al., 2005).	While this mitigation measure was proposed to ensure that no NARW are exposed to injurious levels of noise from pile driving activity, it also protects EFH species and NOAA Trust Resources that occur in the area during the winter and spring, including spawning Atlantic cod.
Construction	MA-1 Sand wave leveling and boulder clearance	Sand wave leveling and boulder clearance should be limited to the extent practicable. Best efforts should be made to microsite to avoid these areas.	Minimizes direct habitat impacts on EFH, EFH species, and NOAA Trust Resources associated with boulder habitat.

Project Phase	AMM	Description	Expected Effects on EFH and NOAA Trust Resources
Pre-Construction, Construction, O&M, Decommissioning	BA-13 Detected or Impacted Dead Non-ESA-Listed Fish	Any occurrence of at least 10 dead non-ESA-listed fish within established shutdown or monitoring zones must also be reported to BOEM (at renewable_reporting@boem.gov) as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours after the sighting.	Reporting will inform on unusual mortality events for fish species and measure potentially unforeseen impacts.
Construction	BA-14 Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Pile-Driving Time-of-Year Restriction	The Lessee must not conduct any foundation pile-driving activities between December 1 and April 30. Pile driving must not occur in December unless unanticipated delays due to weather or technical problems arise that necessitate extending pile driving through December, and the pile driving is allowed by BOEM in accordance with the following procedures. The Lessee must notify BOEM in writing by September 1 that the Lessee believes that circumstances necessitate pile driving in December. The Lessee must submit to BOEM (at renewable_reporting@boem.gov) for written concurrence an enhanced survey plan for December 1 through December 31 to minimize the risk of exposure of NARWs to pile-driving noise, including noise from daily pre-construction geophysical surveys. BOEM will review the enhanced survey plan and provide comments, if any, on the plan within 30 calendar days of its submittal. The Lessee must resolve all comments on the enhanced survey plan to BOEM's satisfaction and receive BOEM's written concurrence before any pile driving occurs. However, the Lessee may conclusively presume BOEM's concurrence with the enhanced survey plan if BOEM provides no comments on the plan within 90 calendar days of its submittal. The Lessee must also follow the time-of-year enhanced mitigation measures specified in the applicable Biological Opinion. The Lessee must confirm adherence to time-of-year restrictions on pile driving in the pile-driving reports submitted with the FIR.	While this mitigation measure was proposed to ensure that no NARW are exposed to injurious levels of noise from pile driving activity, it also protects EFH species and NOAA Trust Resources that may occur in the Lease Area during the winter and spring.
Construction	BA-18 Wind Turbine Foundations Pile Driving/Impact Hammer Activity: Soft Start for Pile Driving	The Lessee must implement soft start techniques for all impact pile-driving, both at the beginning of a monopile installation and at any time following the cessation of impact pile-driving of 30 minutes or longer. The soft start procedure must include a minimum of 20 minutes of 4-6 strikes/minute at 10-20 percent of the maximum hammer energy.	Increases effectiveness of mitigations to avoid or minimize impacts on EFH species and NOAA Trust Resources from underwater noise.
Construction	BA-24 Wind Turbine Foundations Pile Driving/Impact	The Lessee must apply noise reduction technologies during all impact pile driving to minimize marine species noise exposure. The range measured to the Level B harassment threshold when noise mitigation devices are in use must be consistent with or less than the range modeled assuming 10 dB	Increases effectiveness of mitigations to avoid or minimize impacts on EFH species and NOAA Trust Resources from

Project Phase	AMM	Description	Expected Effects on EFH and NOAA Trust Resources
	Hammer Activity: Noise Mitigation for Impact Pile Driving	attenuation, determined via sound field verification of the modeled isopleth distances (e.g., Level B harassment distances). If a bubble curtain is used, the following requirements apply: 1. Bubble curtains must distribute air bubbles around 100 percent of the piling perimeter for the full depth of the water column. 2. The lowest bubble ring must be in contact with the seafloor for the full circumference of the ring, and the weights attached to the bottom ring must ensure 100 percent seafloor contact. 3. No parts of the ring or other objects may prevent full seafloor contact of the lowest bubble ring. The Lessee must train personnel in the proper balancing of air flow to the bubblers. The Lessee must submit an inspection and performance report to DOI within 72 hours following the performance test. Any modifications to attenuation devices to meet the performance standards must occur before impact driving occurs and maintenance or modifications completed must be included in the report. The Lessee must ensure PSOs follow all pile driving reporting instructions and requirements.	underwater noise.



Source: SouthCoast Wind 2024.

Figure 6-1. SouthCoast Wind Project enhanced mitigation area

6.2 Environmental Monitoring

SouthCoast Wind is actively engaged in outreach and two-way communication with the fishing community and with organizations that work on the overlap of fishing and offshore wind. Fisheries monitoring studies conducted in collaboration with the local fishing industry are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. Results from these monitoring studies can aid in avoiding and minimizing adverse effects on EFH from construction, installation, and operations-related impacts. Fisheries monitoring survey methodologies are discussed in Section 5.2.3. SouthCoast Wind has developed a benthic habitat monitoring plan (Section 5.2.4) in accordance with recommendations set forth in the Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf (BOEM 2019b). The benthic habitat monitoring plan will provide baseline information about the condition and use of benthic habitats within the Lease Area and ECCs. This information will support the assessment of ecological impacts from project construction, installation, and operations, and inform future management of EFH and associated species.

Submerged aquatic vegetation beds have been identified at the Falmouth landfall areas from a review of eelgrass field surveys completed in August 2020 (SouthCoast Wind 2023, Appendix K), through benthic habitat surveys completed in the Spring and Summer 2020 (SouthCoast Wind 2023, Appendix M), and from the Massachusetts Department of Environmental Protection (MassDEP, 2020) eelgrass mapping program data. A series of seasonal benthic surveys have been conducted along the Falmouth export cable corridor (extending 1.0 km to either side of the route centerline) to identify and characterize macrofauna and SAV in the survey area. Additional surveys may be conducted along the Brayton Point export cable corridor to further determine the presence of macrofauna and SAV. Data from these surveys will be used to refine the Project design to avoid impacts to SAV to the greatest extent practicable and minimize adverse effects on EFH from construction, installation, and operations-related impacts.

A detailed sound source verification plan will be developed and submitted to NMFS prior to the planned start of pile driving and UXO detonations. Sound source verification involves the measurement of underwater sounds produced by pile driving or UXO detonations at various distances from the sound source. Measurement results will be used to empirically determine and modify, if necessary, distances to threshold criteria used for mitigation purposes and estimation of effects. SouthCoast Wind will also develop and implement a post-construction monitoring plan, where operational noise will be monitored.

Table 6-3. Agency-proposed mitigation measures (AMMs) for environmental monitoring

Project Phase	Mitigation Measure	Description	Resource Area Mitigated
Construction, O&M	MA-2 Long-term passive acoustic monitoring	The Lessee must conduct long-term monitoring of ambient noise, marine mammal and commercially-important fish vocalizations in the Lease Area before, during, and following construction. The Lessee must conduct continuous recording at least 1 year before construction, during construction, initial operation, and for at least 3 but no more than 10 full calendar years of operation to monitor for potential noise impacts. The Lessee must meet with BOEM and BSEE at least 60 days prior to conclusion of the third full calendar year of operation monitoring (and at least 60 days prior to the conclusion of each subsequent year until monitoring is concluded) to discuss: 1) monitoring conducted to-date, 2) the need for continued monitoring, and 3) if monitoring is continued, whether adjustments to the monitoring are warranted. The instrument(s) must be configured to ensure that the specific locations of vocalizing NARW anywhere within the lease area could be identified, based on the assumption of a 10 km detection range for their calls. The lessee may execute the implementation of this condition through Option 1 or Option 2, as below. The timing requirement (i.e., monitoring for at least 3 but no more than 10 full calendar years of operation) will be reevaluated by BOEM and BSEE at the end of the third year and each year subsequently thereafter at the request of the Lessee (at a maximum frequency of requests of once per year). A. Option 1 - Lessee Conducts Long-term Passive Acoustic Monitoring. The Lessee must conduct PAM, including data processing and archiving following the Regional Wildlife Science Collaborative (RWSC) best practices to ensure data comparability and transparency. PAM instrumentation must be deployed to allow for identification of any NARW that vocalize anywhere within the lease area. The sampling rate (minimum 10 kHz) of the recorders must prioritize baleen whale detections, but must also have a minimum capability to record noise from vessels, pile-driving, and WTG operation in the lease area. The system must be configured for continuous recording over the entire year. If temporal gaps in recording are expected, the Lessee must ensure that additional recorders can be deployed to fill gaps. The Lessee must use trawl-resistant moorings to ensure that instruments are not lost, and must replace any lost instruments as soon as possible. The Lessee must also notify BOEM if this occurs. The Lessee must follow the best practices outlined in the RWSC best practices document, unless otherwise required through conditions of COP approval. The best practices include engaging with the RWSC, calibrating the instruments, running QA/QC on the raw data, following the templates for reporting species vocalizations, and preparing the data for archiving at National Centers for Ecological Information (NCEI). Although section III of the RWSC best practices document specifies steps for Section 106 compliance, the Lessee must instead follow the conditions outlined in the Section 106 Memorandum of Agreement. In terms of data processing, the Lessee must document the occurrence of whale vocalizations (calls of NARW, humpback, sei, fin, and minke whales, as well as odontocete clicks, as available based on sample rate) using automatic or manual detection methods. In addition, data must be processed with either manual or automatic detection software to detect vocalizations of spawning cod. The Lessee must submit a log of these detections as well as the detection methodology to BOEM (at renewable_reporting@boem.gov), BSEE (at protectedspecies@bsee.gov) and NMFS (at nmfs.pacmdata@noaa.gov) within 120 days following each recorder retrieval. All raw data must be sent to the NCEI Passive Acoustic Data archive on an annual basis and	Finfish

Project Phase	Mitigation Measure	Description	Resource Area Mitigated
		the Lessee must follow NCEI guidance for packaging the data and pay the fee. a. Long-term Passive Acoustic Monitoring Plan. The Lessee must prepare and implement a Long-term PAM Plan under this option. No later than 120 days prior to instrument deployment and before any construction begins, the Lessee must submit to BOEM and BSEE (renewable_reporting@boem.gov and OSWsubmittals@bsee.gov) the Long-term PAM Plan that describes all proposed equipment (including number and configuration of instruments), deployment locations, mooring design, detection review methodology, and other procedures and protocols related to the required use of PAM. As the Lessee prepares the Long-term PAM Plan, it must coordinate with the RWSC. BOEM and BSEE will review the Long-term PAM Plan and provide comments, if any, on the plan within 45 days of its submittal. The Lessee may be required to submit a modified Long-term PAM Plan based on feedback from BOEM and BSEE. The Lessee must address all outstanding comments to BOEM's and BSEE's satisfaction and will need to receive written concurrence from BOEM and BSEE. If BOEM or BSEE do not provide comments on the Long-term PAM Plan within 45 days of its submittal, the Lessee may conclusively presume BOEM's and BSEE's 's concurrence with the Long-term PAM Plan. B. Option 2 – Economic and Other Contributions to BOEM's Environmental Studies Program. As an alternative to conducting long-term PAM in the Lease Area, the Lessee may opt to make an economic contribution to BOEM's Environmental Studies Partnership for an Offshore Wind Energy Regional Observation Network (POWERON) initiative on an annual basis and cooperate with the POWERON team to allow access to the Lease Area for deployment, regular servicing, and retrieval of instruments. The Lessee's economic contribution will provide for all activities necessary to conduct PAM within the Lease Area, such as vessel and staff time for regular servicing of instruments, QA/QC on data, data processing to obtain vocalizations of sound-producing species and ambient noise metrics, as well as long-term archiving of data at NCEI. At the Lessee's request, the amount of the economic contribution will be estimated by BOEM's Environmental Studies Program. The Lessee will also be invited to contribute to discussions about the scientific approach of the POWERON initiative via the RWSC. The Lessee may request temporary withholding of the public release (placement into the NCEI public data archive) of raw acoustic data collected within the Lease Area for up to 180 days after it is collected. During this temporary hold, the Lessee may be provided a copy of the raw PAM data that was collected in the Lease Area or ROW after it has been cleared for any national security concerns under the RWSC best practices document.	
Pre-Construction, Construction, O&M	BA-3 Fisheries and Benthic Habitat Monitoring Surveys	The Lessee must develop monitoring plans and conduct fisheries research and monitoring surveys, including the benthic survey. The Lessee must conduct these surveys for durations of, at a minimum, 1 year during pre-construction, 1 year during construction, and 2 years post-construction. The Lessee must submit an annual report within 90 days of the completion of each survey season to DOI (renewable_reporting@boem.gov) that includes results and analyses as described in the monitoring plans. The Lessee must share data in accordance with their data sharing plan.	Benthic Resources, Commercial fisheries

Project Phase	Mitigation Measure	Description	Resource Area Mitigated
Pre-Construction, Construction, O&M	BA-34 Sea Turtle / Atlantic Sturgeon Identification and Data Collection	Any sea turtles or Atlantic sturgeon caught or retrieved in any fisheries survey gear must first be identified to species or species group. Each ESA-listed species caught or retrieved must then be documented using appropriate equipment and data collection forms. Biological data collection, sample collection, and tagging activities must be conducted as outlined below. Live, uninjured animals must be returned to the water as quickly as possible after completing the required handling and documentation. A. The Sturgeon and Sea Turtle Take Standard Operating Procedures must be followed (https://media.fisheries.noaa.gov/2021-11/Sturgeon%20%26%20Sea%20Turtle%20Take%20SOPs_external_11032021.pdf). B. Survey vessels must have a passive integrated transponder (PIT) tag reader onboard capable of reading 134.2 kHz and 125 kHz encrypted tags (e.g., Biomark GPR Plus Handheld PIT Tag Reader). This reader must be used to scan any captured sea turtles and sturgeon for tags, and any tags found must be recorded on the take reporting form (see below). C. Genetic samples must be taken from all captured Atlantic sturgeon (alive or dead) to allow for identification of the DPS of origin of captured individuals and tracking of the amount of incidental take. This must be done in accordance with the Procedures for Obtaining Sturgeon Fin Clips (https://media.fisheries.noaa.gov/dam-migration/sturgeon_genetics_sampling_revised_june_2019.pdf). i. Fin clips must be sent to a NMFS-approved laboratory capable of performing genetic analysis and assignment to DPS of origin. SouthCoast Wind must cover all reasonable costs of the genetic analysis. Arrangements for shipping and analysis must be made before samples are submitted and confirmed in writing to NMFS within 60 days of the receipt of the Project BiOp with ITS. Results of genetic analyses, including assigned DPS of origin must be submitted to NMFS within 6 months of the sample collection. ii. Subsamples of all fin clips and accompanying metadata forms must be held and submitted to a tissue repository (e.g., the Atlantic Coast Sturgeon Tissue Research Repository) on a quarterly basis. The Sturgeon Genetic Sample Submission Form is available for download at: https://media.fisheries.noaa.gov/2021-02/Sturgeon%20Genetic%20Sample%20Submission%20sheet%20for%20S7_v1.1_Form%20to%20Use.xlsx?nullhttps://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic. D. All captured sea turtles and Atlantic sturgeon must be documented with required measurements and photographs. The animal's condition and any marks or injuries must be described. This information must be entered as part of the record for each incidental take. Particularly, a NMFS Take Report Form must be filled out for each individual sturgeon and sea turtle (download at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null) and submitted to NMFS as described in the take notification measure below.	ESA-listed Atlantic Sturgeon

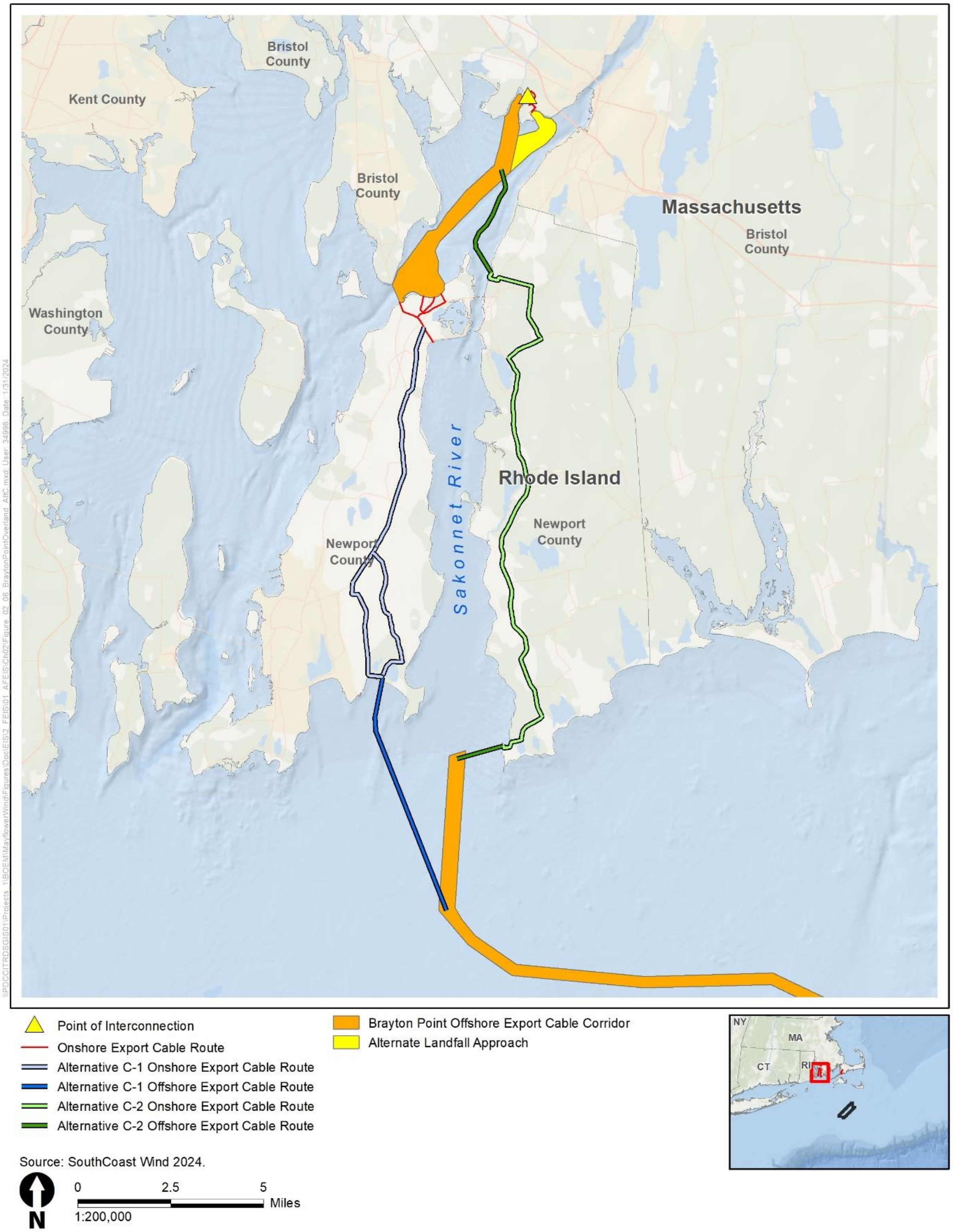
Project Phase	Mitigation Measure	Description	Resource Area Mitigated
Pre-Construction, Construction, O&M	BA-35 Sea Turtle / Atlantic Sturgeon Handling and Resuscitation Guidelines	Any sea turtles or Atlantic sturgeon caught and retrieved in gear used in fisheries surveys must be handled and resuscitated (if unresponsive) according to established protocols provided at-sea conditions are safe for those handling and resuscitating the animal(s) to do so. Specifically: a. Priority must be given to the handling and resuscitation of any sea turtles or sturgeon that are captured in the gear being used. Handling times for these species must be minimized, and if possible, kept to 15 minutes or less to limit the amount of stress placed on the animals. b. All survey vessels must have onboard copies of the sea turtle handling and resuscitation requirements (found at 50 CFR 223.206(d)(1)) before begging any on-water activity (download at: https://media.fisheries.noaa.gov/dam-migration/sea_turtle_handling_and_resuscitation_measures.pdf). These handling and resuscitation procedures must be carried out any time a sea turtle is incidentally captured and brought onboard the vessel during survey activities. c. If any sea turtles that appear injured, sick, or distressed, are caught and retrieved in fisheries survey gear, survey staff must immediately contact the Greater Atlantic Region Marine Animal Hotline at 866-755-6622 for further instructions and guidance on handling the animal, and potential coordination of transfer to a rehabilitation facility. If survey staff are unable to contact the hotline (e.g., due to distance from shore or lack of ability to communicate via phone), the USCG must be contacted via VHF marine radio on Channel 16. If required, hard-shelled sea turtles (i.e., non-leatherbacks) may be held on board for up to 24 hours and managed in accordance with handling instructions provided by the Hotline before transfer to a rehabilitation facility. d. Survey staff must attempt resuscitate any Atlantic sturgeon that are unresponsive or comatose by providing a running source of water over the gills as described in the Sturgeon Resuscitation Guidelines (https://media.fisheries.noaa.gov/dam-migration/sturgeon_resuscitation_card_06122020_508.pdf). e. If appropriate cold storage facilities are available on the survey vessel, any dead sea turtle or Atlantic sturgeon must be retained on board the survey vessel for transfer to an appropriately permitted partner or facility on shore unless NMFS indicates that storage is unnecessary, or storage is not safe. f. Any live sea turtles or Atlantic sturgeon caught and retrieved in gear used in any fisheries survey must ultimately be released according to established protocols including safety considerations.	ESA-listed Atlantic Sturgeon
Pre-Construction, Construction, O&M	BA-36 Lost Survey Gear	If any survey gear is lost, all reasonable efforts that do not compromise human safety would be undertaken to recover the gear. All lost gear would be reported to NMFS (nmfs.gar.incidental-take@noaa.gov) and BSEE (OSWsubmittals@bsee.gov) within 24 hours of the documented time of missing or lost gear. This report would include information on any markings on the gear and any efforts undertaken or planned to recover the gear.	Benthic Resources, Commercial fisheries

6.3 Alternative Project Designs that Could Avoid/Minimize Impacts

BOEM considered a reasonable range of alternatives to the No Action (Alternative A) and Proposed Action (Alternative B) during the EIS development process, and a summary of each alternative is described in this section.

6.3.1 Alternative C – Fisheries Habitat Minimization

Under Alternative C, the construction, operations and maintenance, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters outlined in the SouthCoast Wind COP (SouthCoast Wind 2023), subject to applicable mitigation measures. However, this alternative identifies two Onshore Export Cable routes that would avoid placing the Offshore Export Cable in the Sakonnet River, thereby avoiding impacts on associated fisheries, EFH, and HAPC (Figure 6-2). The two proposed routes are the Aquidneck Island, Rhode Island Route (Alternative C-1) and the Little Compton/Tiverton, Rhode Island Route (Alternative C-2). Alternative C-1 would reduce the total offshore export cable route by 9 miles (14 kilometers) and Alternative C-2 would reduce the total offshore export cable route by 12 miles (19 kilometers). The reductions in offshore export cable length would eliminate the construction, O&M, and decommissioning impacts from cable emplacement and anchoring in the Sakonnet River compared to the Proposed Action.



Source: SouthCoast Wind 2024.

Figure 6-2. Alternatives C-1 and C-2 avoiding the Sakonnet River

The Alternative C-1 route diverges from the proposed Brayton Point ECC approximately 5 miles (8 kilometers) offshore of the entrance to the Sakonnet River. Here, the route diverges to the northwest for approximately 4 miles (6.4 kilometers), crossing charted obstructions and entering the first of two managed Fish Trap Areas encountered along the route, where uncharted stakes and fishing structures, some submerged, may exist and may cause impacts to the stakeholders utilizing the fish traps. Within the 6-mile portion of the Alternative C-1 route towards the Aquidneck Island landfall, all of the over 20 USGS benthic grab samples consisted of Muddy Sand and Sand, except for one Gravel sample near the landfall location at Sachuest Beach (INSPIRE 2023b). However, the Alternative C-1 route would pass through Elbow Ledge, a high relief bathymetric feature to the south of Sachuest Bay that attracts fish from surrounding areas (Figure 6-3). This shoal likely provides hard substrate for attached fauna to grow and complex habitat that supports benthic and demersal species (INSPIRE 2023b). By passing through Elbow Ledge, Alternative C-1 could present more challenges during cable installation and may potentially create a greater impact to EFH compared to the similar offshore portion of the Proposed Action cable route.

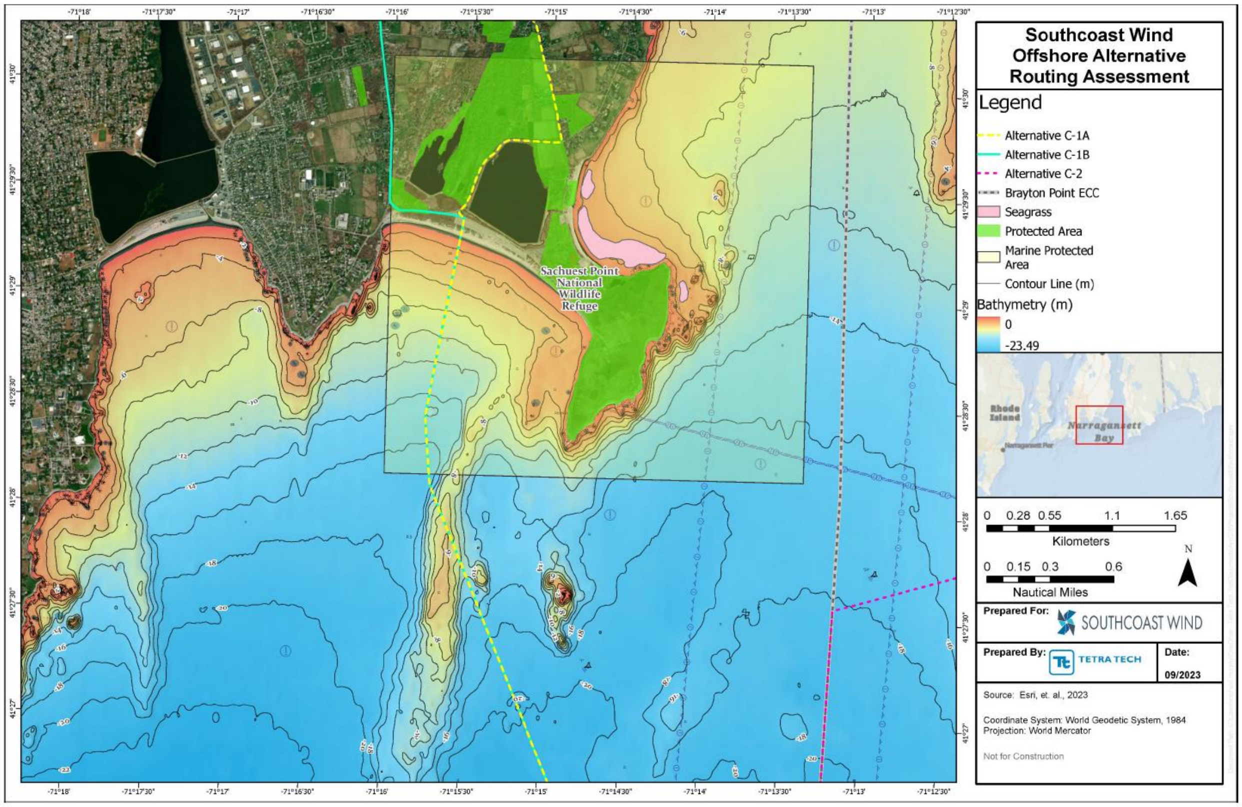


Figure 6-3. Landfall site at southeast end of Aquidneck Island at Sachuest Beach, RI (Alternative C-1) (Tetratech 2023)

The Alternative C-2 route diverges from the proposed Brayton Point ECC approximately 1.2 miles (2 kilometers) offshore of the entrance of the Sakonnet River. Here, the route diverges east-northeast for approximately 1.2 miles (2 kilometers) on approach to Little Compton (Figure 6-4). The Alternative C-2 route impacts a charted Fish Trap Area where there will potentially be time of year restrictions (TOYRs) for construction, though this requires further research. While specific TOYRs for certain species and habitats may not be in place, implementation of TOYRs may be recommended and/or required by managing agencies should development of Alternative C-2 continue. TOYRs are likely to be imposed on development activities with respect to these areas. TOYRs limit when disturbance activities can occur in areas when species are most likely to occur or when sensitive life-history stages are most common. This may have a direct, negative impact on cable installation activities depending on when TOYRs for in-water work would be implemented (e.g., if installation operations were restricted to a limited window during the winter, adverse weather conditions would likely impede production and impact overall Project schedule and costs). TOYRs may also cause increased impacts to other stakeholders where construction activities may overlap with periods of high recreational boating or recreational fishing activities.

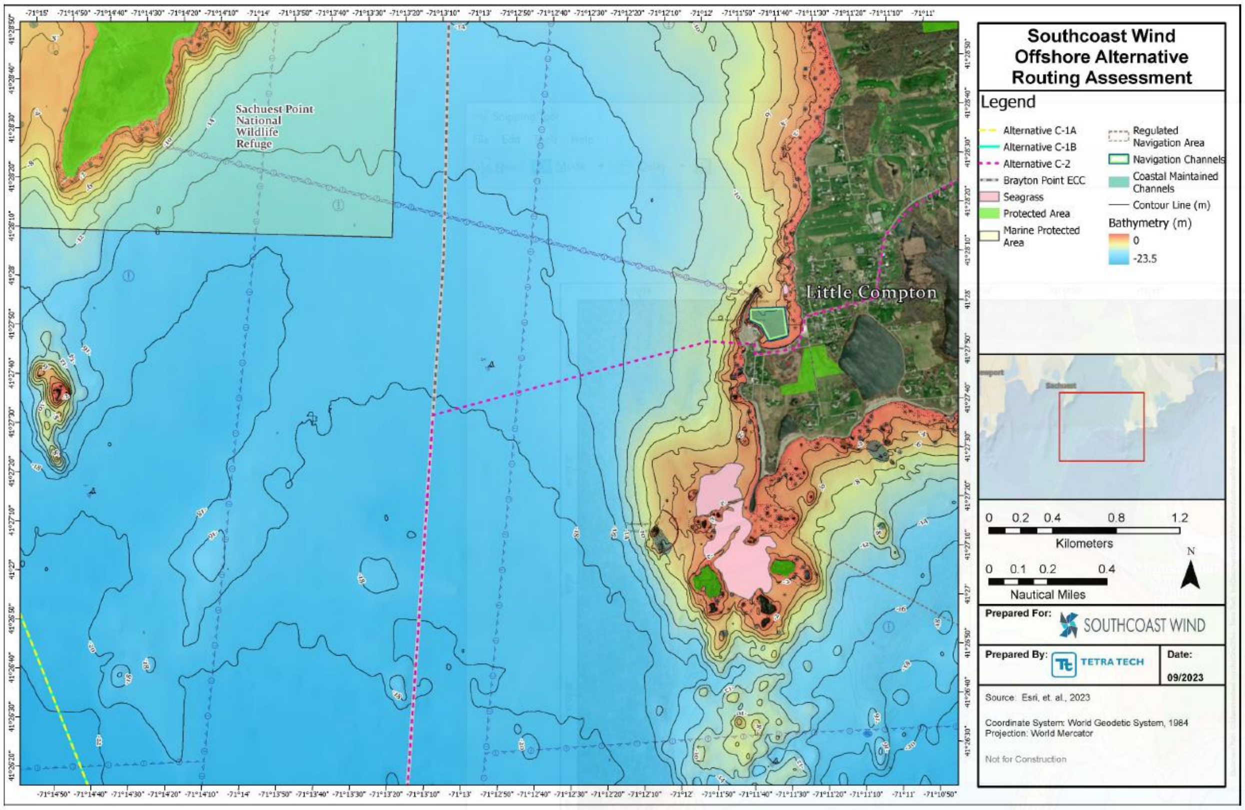


Figure 6-4. Marine approach at Little Compton, RI (Alternative C-2) (Tetratech 2023)

For both Alternatives C-1 and C-2 HDD would be used for the sea-to-shore transition similar to the methodology described in Section 2.2.2.3.2. HDD is expected to avoid any sensitive habitat areas.

Alternative C would reduce the length of the Brayton Point offshore export cable route, thereby reducing total seabed disturbance and associated benthic habitat disturbance. Avoiding cable installation in the Sakonnet River would reduce impacts on the EFH and HAPC for juvenile Atlantic cod from cable laying activity and long-term O&M impacts from presence of cable protection. While impacts would be reduced in the Sakonnet River, overall impact levels would be the same as the Proposed Action. Impacts of Alternative C when combined with impacts from ongoing and planned activities including offshore wind activities would be the same as the Proposed Action.

6.3.2 Alternative D – Nantucket Shoals

Under Alternative D, the construction, operations and maintenance, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters outlined in the SouthCoast Wind COP (SouthCoast Wind 2023), subject to applicable mitigation measures. However, up to six WTG positions (AZ-47, BA-47, BB-47, BC-47, BC-48, and BF-49) would be eliminated in the northeastern portion of the Lease Area to reduce potential impacts on foraging habitat and potential displacement of wildlife from this habitat adjacent to Nantucket Shoals. In addition, mitigation measures relevant to Nantucket Shoals were also proposed by the agencies and described in Table 6-2.

Alternative D would install six fewer WTGs than the Proposed Action, which would lessen total long-term seabed disturbance and benthic habitat impacts. Nantucket Shoals provides important habitat for fish species and removing WTGs near this area may reduce impacts on finfish, invertebrates, and EFH by increasing the distance from the boundary of construction activities to the boundary of Nantucket Shoals. Species that have EFH designations within the Lease Area for all life stages, including Atlantic cod, Atlantic sea scallop, windowpane flounder, winter flounder, and yellowtail flounder would experience reduced impacts associated with the construction and O&M of the Project with the elimination of six WTGs. While impacts would be reduced locally near the sites of the six removed turbine positions, impacts from the remaining 143 WTG/OSP foundations would still occur. Therefore, Alternative D is not expected to change the overall impact magnitude of the Project compared to the Proposed Action.

6.3.3 Alternative E – Foundation Structures

Alternative E addresses the possibility for one or more foundation types to be utilized for WTGs and OSPs and includes three sub-alternatives which detail the different foundation structures. This alternative includes three foundation options, which assume the maximum use of piled (monopile and piled jacket), suction bucket, and gravity-based foundation structures to assess the extent of potential impacts from each foundation type.

- Alternative E-1: Piled Foundations (monopile and piled jacket) only
- Alternative E-2: Suction-bucket Jacket Foundations only
- Alternative E-3: Gravity-based Foundations only

Alternative E-1 would result in the same impacts as the Proposed Action from installing only piled foundations where pile-driving activity would occur between June 1 to October 15 within 20 kilometers of the 30-meter isobath on the west side of Nantucket Shoals and between May 15 to December 31 in the remaining Lease Area. Alternatives E-2 and E-3 would avoid pile-driving noise impacts on finfish and invertebrates but would result in increased habitat conversion from larger foundations (Table 6-4) and increased artificial reef effects. Alternative E-1, having the smallest foundation and scour protection footprint would benefit existing benthic, surficial, and infaunal fish and invertebrate communities as less soft-bottom habitat would be affected and O&M impacts due to the presence of structures would be reduced. As site preparation is a critical component for gravity-based foundations under Alternative E-3, associated impacts from the dredging of up to 111,973,203 cubic feet (3,170,728 cubic meters) for all 149 foundation locations would occur. SouthCoast Wind has removed gravity-based foundations from its PDE, and they are no longer being considered for the Proposed Action as indicated in Section 2.2.1. However, BOEM has retained the analysis of this alternative in the EIS.

Table 6-4. Acreage of impacts on benthic resources from Alternatives E compared to the Proposed Action

Alternative	Difference in Area of Benthic Disturbance from Proposed Action
Alternative E-1: All Piled Foundation Structures	Same as Proposed Action
Alternative E-2: Suction-bucket Jacket Foundations only	336 acres more
Alternative E-3: Gravity-based Foundations only	1,317 acres more

Source: SouthCoast Wind DEIS, Table 3.5.2-2; BOEM 2023

6.3.4 Alternative F – Muskeget Channel Cable Modification

Under Alternative F, the construction, operations and maintenance, and eventual decommissioning of the Project on the OCS offshore Massachusetts would occur within the range of the design parameters outlined in the SouthCoast Wind COP (SouthCoast Wind 2023), subject to applicable mitigation measures. However, to minimize seabed disturbance in the Muskeget Channel, the Falmouth offshore export cable route would use ± 525 kilovolts HVDC cables connected to one HVDC converter OSP (if Falmouth is selected as the POI for Project 2), instead of HVAC cables connected to one or more HVAC OSPs as proposed under the Proposed Action. The OSP design for the offshore export cables connecting to Brayton Point would remain unchanged from the Proposed Action. As a result, there would be two HVDC converter OSPs under Alternative F – one HVDC converter OSP for Brayton Point and one HVDC converter OSP for Falmouth. In addition, Alternative F would use up to three offshore export cables to Falmouth, instead of up to five offshore export cables under the Proposed Action.

Alternative F, which would reduce the number of Falmouth offshore export cables from five to three, was developed to minimize impacts on complex benthic habitats, seabed disturbance, and EMF effects in the Muskeget Channel east of Martha’s Vineyard. This alternative would decrease the area of benthic habitat disturbance by approximately 700 acres or 40 percent, thereby reducing impacts on complex habitats found in the channel. While the amplitude of EMF generated by DC cables can be up to three times greater than that of AC cables (Hutchison et al. 2020b), AC and DC EMFs differ in the way they interact with organisms and direct comparisons cannot be made (CSA Ocean Sciences, Inc. and Exponent 2019). However, previous studies on DC undersea cables showed only temporary alterations in mobility and behavior of some fish and invertebrate species with no appreciable effects on overall movement or population health (Hutchison et al. 2018; Wyman et al. 2018; Klimley et al. 2017). Because cable installation would still occur in the same corridor, the same overall impacts are expected. Impacts of Alternative F when combined with impacts from ongoing and planned activities including offshore wind activities would be the same as the Proposed Action.

6.4 Adaptive Management Plans

No adaptive management plans have been proposed by the applicant.

7. NOAA Trust Resources

Twenty species of NOAA Trust Resources have been identified within the general vicinity of the Lease Area and ECC. Table 7-1 discusses species and life stages 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 that are likely to occur and utilize habitat within the Project area:

- Alewife (*Alosa pseudoharengus*)
- American eel (*Anguilla rostrata*)
- American lobster (*Homarus americanus*)
- American shad (*Alosa sapidissima*)
- Atlantic croaker (*Micropogonias undulatus*)
- Atlantic menhaden (*Brevoortia tyrannus*)
- Blueback herring (*Alosa aestivalis*)
- Blue crab (*Callinectes sapidus*)
- Blue mussel (*Mytilus edulis*)
- Eastern oyster (*Crassostrea virginica*)
- Gulf stream flounder (*Citharichthys arctifrons*)
- Horseshoe crab (*Limulus polyphemus*)
- Jonah crab (*Cancer borealis*)
- Northern sand lance (*Ammodytes dubius*)
- Northern sea robin (*Prionotus carolinus*)
- Quahog (Mercenaria mercenaria)
- Soft-shell clams (*Mya arenaria*)
- Spotted hake (*Urophycis regia*)
- Striped bass (*Morone saxatilis*)
- Tautog (*Tautoga onitis*)
- Weakfish (*Cynoscion regalis*)

Table 7-1. Determination for NOAA trust resources by species or species group

Species	Life Stages within Project Area	Impact Determination	Rationale for Determination
Alewife	Juvenile, Adult	Negligible, short-term, long-term, and permanent impacts	Short-term effects from disturbance during Project construction (i.e., entrainment, crushing and burial, sediment suspension and deposition, noise) would occur. Behavioral effects of suspended sediment from cable emplacement and pile-driving noise would have the greatest areal extent, respectively occurring over estimated areas of up to 72,052 acres and up to 99,785 acres of benthic and pelagic habitat; however, these impacts would occur intermittently at various locations within the Project area and not throughout the entire area for the entire duration of construction. Soft bottom habitat is expected to recover within 1.5 to 2 years following cessation of disturbance. Approximately 498 acres of soft-bottom benthic habitat would be permanently displaced or altered by placement of the WTG and OSP foundations, scour protection, and cable protection. The affected area represents a small portion of suitable habitat for these species within the Project area. Once scour protection is colonized it would provide habitat features for species associated with hard substrates. Operational noise and EMF effects would occur throughout the operational lifespan of the Proposed Action but are below established thresholds for injury effects for fish. Collectively, areas affected by short-term construction related impacts are expected to return to baseline conditions within minutes to 2 years after the project is completed. Permanent habitat alterations and operational effects on habitat would be negligible because: • Impacts are limited in intensity and extent; • Species occurrence is limited; • Long-term impacts may produce new potentially suitable habitats; and/or • The area affected is small relative to available habitat in the Project area.
American eel	Larvae, Juvenile, Adult		
American lobster	All		
Atlantic croaker	All		
Atlantic menhaden	All		
Blue crab	All		
Blueback herring	Juvenile, Adult		
Gulf stream flounder	All		
Horseshoe crab	All		
Jonah crab	All		
Northern sand lance	All		
Northern sea robin	All		
Spotted hake	All		
Striped bass	Juvenile, Adult		
Tautog	All		
Weakfish	All		
American shad	Juvenile, Adult		
Bivalves (blue mussel, eastern oyster, quahog, soft-shell clam)	All	Minor, short-term, and permanent impacts	Short-term effects from disturbance during Project construction (i.e., entrainment, crushing and burial, sediment suspension and deposition, noise) would occur for bivalves. Effects of suspended sediment and sediment deposition from cable emplacement would occur over estimated areas of up to 19,138 acres and up to 38,277 acres of benthic habitat, respectively. Soft bottom habitat is expected to recover within 1.5 to 2 years following cessation of disturbance. Approximately 498 acres of soft-bottom benthic habitat would be permanently displaced or altered by placement of the monopile and OSP foundations, scour protection, and cable protection. The Lease Area and ECC have been sited to avoid and minimize overlap of structures with known shellfish habitats in designated EFH. Based on the small area affected relative to the extent of designated EFH in the Project area and vicinity, the Project would have a negligible effect on habitat for these species. The benthic community structure would adapt and recover rapidly after the project is completed

8. Conclusions/Determinations

The Proposed Action includes construction, operations, maintenance, and decommissioning of the Project components at the end of the planned lifespan of the Project. These activities may have short-term (i.e., less than 2 years) and permanent (i.e., the Project lifespan) adverse effects on EFH, EFH-designated species, and NOAA Trust Resources in the Project area. There are 46 species of finfish, elasmobranchs, and invertebrates with designated EFH within the Lease Area and ECCs. EFH-designated species with one or more demersal life stage are more likely to experience adverse effects than species with only pelagic life stages, primarily resulting from the permanent conversion of benthic habitat following the installation of the WTG and OSP foundations, scour protection, and cable protection.

Project construction is expected to cause short-term adverse effects on the environment that could affect habitat suitability for EFH and EFH-designated species. Short-term adverse effects would include those from construction-related underwater noise, crushing and burial, entrainment, and increased turbidity and sedimentation caused by the disturbance of bottom substrates. These effects would occur intermittently at varying locations in the Project area during the construction period but are not expected to cause permanent impacts on EFH or population-level effects.

Project operations and maintenance are expected to cause permanent adverse effects on EFH for some life stages of EFH-designated species. Permanent adverse effects would include loss of soft-bottom benthic habitat resulting from the presence of WTG and OSP foundations, scour and cable protection, operational noise, EMF and heat effects, hydrodynamic changes, and food web changes. Conversion of benthic habitat resulting from the presence of scour and cable protection and conversion of pelagic habitat resulting from the presence of the WTG and OSP foundations may also cause long-term (i.e., greater than 2 years but less than the Project lifespan) beneficial effects on EFH-designated species that would be associated with complex habitat.

Table 8-1 details short-term and permanent adverse effects on habitat suitability by impact mechanism described in Section 5 and overall EFH effect determinations by managed species and life stage. Long-term impacts are not included in this table of adverse impacts because the only impacts that are expected to have this duration are beneficial impacts associated with the presence of structures. The Proposed Action is expected to adversely affect EFH for a species and life stage if (1) EFH for the designated species and life stage occurs in the Project area; and (2) one or more of the impact mechanisms described in Section 5 is expected to have an adverse effect on the species and life stage.

Table 8-1. Effects of the Proposed Action on EFH by impact mechanism and EFH effect determinations for managed species and life stages

EFH Species Group	EFH Species	Life Stage	Habitat Association	Short-Term Adverse Effects on EFH				Permanent Adverse Effects on EFH				EFH Effect Determination
				Construction Noise	Crushing and Burial	Entrainment	Water Quality	Habitat Conversion	Operational Noise	EMF & Heat	Hydrodynamic	
Gadids	Atlantic cod	Eggs	Surface	Yes	--	--	--	--	No	--	No	Yes
		Larvae	Pelagic	Yes	--	Yes	No	--	No	No	No	Yes
		Juvenile	Benthic complex	Yes	Yes	--	--	--	Yes	No	No	Yes
		Adult	Benthic complex	Yes	Yes	--	Yes	No	Yes	No	No	Yes
	Haddock	Eggs	Surface	Yes	--	--	--	--	No	--	No	Yes
		Larvae	Surface	Yes	--	--	--	--	No	--	No	Yes
		Juvenile	Benthic complex	Yes	Yes	--	Yes	No	Yes	No	No	Yes
		Adult	Benthic complex	Yes	Yes	--	Yes	No	Yes	No	No	Yes
	Pollock	Eggs	Surface	No	--	--	--	--	No	--	--	No
		Larvae	Pelagic	Yes	--	Yes	No	--	No	No	No	Yes
		Juvenile	Benthic complex/non-complex	No	Yes	--	Yes	Yes	--	No	--	Yes
		Adult	Benthic complex	--	--	--	--	--	--	--	--	No
	Red hake	Eggs	Surface	Yes	--	--	--	--	No	--	No	Yes
		Larvae	Surface	Yes	--	--	--	--	No	--	No	Yes
		Juvenile	Benthic non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Adult	Benthic non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
	Silver hake	Eggs	Surface	Yes	--	--	--	--	No	--	No	Yes
		Larvae	Surface	Yes	--	--	--	--	No	--	No	Yes
		Juvenile	Benthic complex/non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Adult	Benthic complex/non-complex	No	Yes	--	Yes	Yes	--	No	--	Yes
	Offshore hake	Eggs	Pelagic	--	--	--	--	--	--	--	--	No
		Larvae	Pelagic	Yes	Yes	Yes	No	--	No	No	No	Yes
		Juvenile	Benthic non-complex	--	--	--	--	--	--	--	--	No
		Adult	Benthic non-complex	--	--	--	--	--	--	--	--	No
	White hake	Eggs	Surface	--	--	--	--	--	--	--	--	No

				Short-Term Adverse Effects on EFH				Permanent Adverse Effects on EFH				
EFH Species Group	**EFH Species**	**Life Stage**	**Habitat Association**	**Construction Noise**	**Crushing and Burial**	**Entrainment**	**Water Quality**	**Habitat Conversion**	**Operational Noise**	**EMF & Heat**	**Hydrodynamic**	**EFH Effect Determination**
		Larvae	Surface	Yes	Yes	Yes	No	--	No	No	No	Yes
		Juvenile	Pelagic/benthic non-complex	No	Yes	No	Yes	Yes	No	No	No	Yes
		Adult	Benthic non-complex	No	Yes	No	Yes	Yes	No	No	No	Yes
Other finfish	Atlantic butterfish	Eggs	Pelagic	Yes	--	Yes	No	--	No	No	No	Yes
		Larvae	Pelagic	Yes	--	Yes	No	--	No	No	No	Yes
		Juvenile	Pelagic/benthic non-complex	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes
		Adult	Pelagic/benthic non-complex	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes
	Atlantic sea herring	Eggs	Benthic complex	Yes	Yes	--	Yes	No	No	No	No	Yes
		Larvae	Pelagic	Yes	--	Yes	No	--	No	No	No	Yes
		Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
	Black sea bass	Eggs	Surface	Yes	--	--	--	--	No	--	No	Yes
		Larvae	Benthic complex	Yes	Yes	--	Yes	No	No	No	No	Yes
		Juvenile	Benthic complex	Yes	Yes	--	Yes	No	Yes	No	No	Yes
		Adult	Benthic complex	Yes	Yes	--	Yes	No	Yes	No	No	Yes
	Bluefish	Eggs	Pelagic	--	--	--	--	--	--	--	--	No
		Larvae	Pelagic	--	--	--	--	--	--	--	--	No
		Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
	Monkfish	Eggs	Surface	Yes	--	--	--	--	No	--	No	Yes
		Larvae	Pelagic	Yes	--	Yes	No	--	No	No	No	Yes
		Juvenile	Benthic complex	Yes	Yes	--	Yes	No	Yes	No	No	Yes
		Adult	Benthic complex	Yes	Yes	--	Yes	No	Yes	No	No	Yes
	Ocean pout	Eggs	Benthic complex	Yes	Yes	--	Yes	No	No	No	No	Yes
		Juvenile	Benthic non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Adult	Benthic non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
	Scup	Eggs	Pelagic	No	--	Yes	No	--	--	No	--	Yes

				Short-Term Adverse Effects on EFH				Permanent Adverse Effects on EFH				
EFH Species Group	**EFH Species**	**Life Stage**	**Habitat Association**	**Construction Noise**	**Crushing and Burial**	**Entrainment**	**Water Quality**	**Habitat Conversion**	**Operational Noise**	**EMF & Heat**	**Hydrodynamic**	**EFH Effect Determination**
		Larvae	Pelagic	No	--	Yes	No	--	--	No	--	Yes
		Juvenile	Benthic non-complex/complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Adult	Benthic non-complex/complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
	Atlantic wolffish	Eggs	Benthic complex	Yes	Yes	--	Yes	No	No	No	No	Yes
		Larvae	Benthic non-complex/complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Juvenile	Benthic non-complex/complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Adult	Benthic non-complex/complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
Flatfish	Windowpane flounder	Eggs	Surface	Yes	--	--	--	--	No	--	No	Yes
		Larvae	Pelagic	Yes	--	Yes	No	--	No	No	No	Yes
		Juvenile	Benthic non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Adult	Benthic non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
	Winter flounder	Eggs	Benthic non-complex	No	Yes	--	Yes	Yes	--	No	--	Yes
		Larvae	Pelagic/benthic non-complex	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
		Juvenile	Benthic non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Adult	Benthic non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
	Witch flounder	Eggs	Surface	Yes	--	--	--	--	No	--	No	Yes
		Larvae	Surface	Yes	--	--	--	--	No	--	No	Yes
		Juvenile	Benthic non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Adult	Benthic non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
	Yellowtail flounder	Eggs	Surface	Yes	--	--	--	--	No	--	No	Yes
		Larvae	Surface	Yes	--	--	--	--	No	--	No	Yes
		Juvenile	Benthic non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Adult	Benthic non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
	Summer flounder	Eggs	Pelagic	Yes	--	Yes	No	--	No	No	No	Yes
		Larvae	Pelagic	Yes	--	Yes	No	--	No	No	No	Yes
		Juvenile	Benthic non-complex/complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Adult	Benthic non-complex/complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes

EFH Species Group	EFH Species	Life Stage	Habitat Association	Short-Term Adverse Effects on EFH				Permanent Adverse Effects on EFH				EFH Effect Determination
				Construction Noise	Crushing and Burial	Entrainment	Water Quality	Habitat Conversion	Operational Noise	EMF & Heat	Hydrodynamic	
	American plaice	Eggs	Pelagic	--	--	--	--	--	--	--	--	No
		Larvae	Pelagic	Yes	--	Yes	No	--	No	No	No	Yes
		Juvenile	Benthic non-complex/complex	--	--	--	--	--	--	--	--	No
		Adult	Benthic non-complex/complex	--	--	--	--	--	--	--	--	No
Highly migratory species	Atlantic mackerel	Eggs	Pelagic	Yes	--	Yes	No	--	No	No	No	Yes
		Larvae	Pelagic	Yes	--	Yes	No	--	No	No	No	Yes
		Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
	Albacore tuna	Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
	Atlantic bluefin tuna	Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
	Atlantic skipjack tuna	Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
	Atlantic yellowfin tuna	Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
Sharks	Blue shark	Neonate/YOY	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Subadult	Pelagic	--	--	--	--	--	--	--	--	No
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
	Basking shark	Neonate/YOY	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Subadult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
	Common thresher shark	Neonate/YOY	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Subadult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes

EFH Species Group	EFH Species	Life Stage	Habitat Association	Short-Term Adverse Effects on EFH				Permanent Adverse Effects on EFH				EFH Effect Determination
				Construction Noise	Crushing and Burial	Entrainment	Water Quality	Habitat Conversion	Operational Noise	EMF & Heat	Hydrodynamic	
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
	Dusky shark	Neonate/YOY	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Subadult	Pelagic	--	--	--	--	--	--	--	--	No
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
	Sand tiger shark	Neonate/YOY	Benthic complex/non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Juvenile	Benthic complex/non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Subadult	Benthic complex/non-complex	--	--	--	--	--	--	--	--	No
		Adult	Benthic complex/non-complex	--	--	--	--	--	--	--	--	No
	Sandbar shark	Neonate/YOY	Benthic non-complex	--	--	--	--	--	--	--	--	No
		Juvenile	Benthic non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Subadult	Benthic non-complex	--	--	--	--	--	--	--	--	No
		Adult	Benthic non-complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
	Shortfin mako shark	Neonate/YOY	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Subadult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
	Tiger shark	Neonate/YOY	Pelagic	--	--	--	--	--	--	--	--	No
		Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Subadult	Pelagic	--	--	--	--	--	--	--	--	No
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
	White shark	Neonate/YOY	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Subadult	Pelagic	--	--	No	--	--	--	--	--	No
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes

EFH Species Group	EFH Species	Life Stage	Habitat Association	Short-Term Adverse Effects on EFH				Permanent Adverse Effects on EFH				EFH Effect Determination
				Construction Noise	Crushing and Burial	Entrainment	Water Quality	Habitat Conversion	Operational Noise	EMF & Heat	Hydrodynamic	
Sharks (cont.)	Smooth dogfish	Neonate/YOY	Pelagic	--	--	--	--	--	--	--	--	No
		Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Subadult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
	Spiny dogfish	Neonate/YOY	Pelagic	--	--	--	--	--	--	--	--	No
		Juvenile	Pelagic	--	--	--	--	--	--	--	--	No
		Subadult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
	Porbeagle	Neonate/YOY	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Juvenile	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Subadult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	No	No	--	Yes	No	No	Yes
Skates	Little Skate	Juvenile	Benthic non-complex/complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Adult	Benthic non-complex/complex	No	Yes	--	Yes	Yes	Yes	No	No	Yes
	Winter skate	Juvenile	Benthic non-complex/complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Adult	Benthic non-complex/complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
	Barndoor skate	Juvenile	Benthic non-complex/complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
		Adult	Benthic non-complex/complex	Yes	Yes	--	Yes	Yes	Yes	No	No	Yes
Invertebrates	Atlantic sea scallop	Eggs	Benthic complex	Yes	Yes	--	Yes	No	No	No	No	Yes
		Larvae	Pelagic/benthic complex	Yes	Yes	Yes	Yes	No	No	No	No	Yes
		Juvenile	Benthic complex	Yes	Yes	--	Yes	No	No	Yes	No	Yes
		Adult	Benthic complex	Yes	Yes	--	Yes	No	No	Yes	No	Yes
	Atlantic surf clam	Juvenile	Benthic non-complex	Yes	Yes	--	Yes	Yes	No	Yes	No	Yes
		Adult	Benthic non-complex	Yes	Yes	--	Yes	Yes	No	Yes	No	Yes
	Ocean quahog	Juvenile	Benthic non-complex	Yes	Yes	--	Yes	Yes	No	Yes	No	Yes
		Adult	Benthic non-complex	Yes	Yes	--	Yes	Yes	No	Yes	No	Yes
	Northern	Eggs	Pelagic	--	--	--	--	--	--	--	--	No

EFH Species Group	EFH Species	Life Stage	Habitat Association	Short-Term Adverse Effects on EFH				Permanent Adverse Effects on EFH				EFH Effect Determination
				Construction Noise	Crushing and Burial	Entrainment	Water Quality	Habitat Conversion	Operational Noise	EMF & Heat	Hydrodynamic	
	shortfin squid	Juvenile	Pelagic	--	--	--	--	--	--	--	--	No
		Adult	Pelagic	Yes	--	No	No	--	No	No	No	Yes
	Longfin inshore squid	Eggs	Benthic complex	Yes	Yes	--	Yes	No	No	No	No	Yes
		Juvenile	Pelagic	Yes	--	No	No	--	No	No	No	Yes
		Adult	Pelagic	Yes	--	No	No	--	No	No	No	Yes

Notes: ‘Yes’ = adverse effect on habitat suitability; ‘No’ = insignificant effect on habitat suitability; ‘--’ = no life stage EFH exposure to this impact mechanism.

9. References

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Appendix A – Benthic Habitat Mapping Methods

Input and Data Approach

Multiple sources of geophysical and ground-truth data were used as input for mapping benthic habitats within the Study Area by INSPIRE Environmental. 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* (COP Appendix E; SouthCoast Wind 2023) and benthic assessment reports (COP Appendices M, M.2, and M.3, Benthic Resources) appended to the COP.

Geophysical Data and Derived Data Products

Geophysical data surveys of the Study Area were conducted in 2020 and 2021 by Fugro USA Marine, Inc. (Fugro). High-resolution geophysical surveys included collection of high-resolution multibeam echosounder (MBES) and side-scan sonar (SSS) data (COP Appendix E; SouthCoast Wind 2023). MBES and SSS are collected using different instruments deployed from the same survey vessel. The MBES was installed on Fugro's Hydrodynamic Acoustic System pole, which provides a high 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 1.6 feet (0.5 meter; COP Appendix E; SouthCoast Wind 2023). Bathymetric data provide information on depth and seafloor topography. Bathymetric data were also used to create a model of seafloor slope for the Study Area with a cell size of 9.8 feet (3 meters). Backscatter data were derived from the MBES and processed to a resolution of 9.8 inches (25 centimeters; COP Appendix E; SouthCoast Wind 2023). 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. Backscatter returns are relative (see below) and referred to in terms of low, medium, and high reflectance rather than absolute decibel values. In general, softer, fine-grained sediments absorb more of the acoustic signal and a weaker signal is returned to the MBES. However, backscatter strength is disproportionately affected by the coarse sediment fraction (e.g., Goff et al. 2000), so fine sediment with small amounts of shell hash can generate higher backscatter reflectance than coarser sediment. 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 et al. 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 et al., 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 et al., 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 (Brown et al. 2011, Table 1).

SSS data were generated from a towed instrument 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). 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 3.9 inches (10 centimeters); this resolution permits detection of medium to large boulders but does not permit the reliable detection of individual cobbles 2.5 to 10.1 inches (6.4 to 25.6 centimeters). Although individual small boulders and cobbles cannot be detected in 10-cm resolution SSS, textures and patterns in the data can indicate the presence or absence of higher densities of these features, which can be confirmed by ground-truth data.

Boulders greater than or equal to one foot (0.3 meter) in diameter were identified from the MBES and SSS data; boulder fields and individual boulder “picks” outside boulder fields were mapped by Fugro and used as input data for benthic habitat mapping. No boulders were identified in the geophysical data collected within the Lease Area. Boulder identification methods differed between the Brayton Point ECC and Falmouth ECC (COP Appendix E, Section 3.3.4; SouthCoast Wind 2023). Boulders and boulder fields were manually identified and mapped at the Falmouth ECC. At the Brayton Point ECC, detection via Fugro’s proprietary machine learning algorithm was followed with manual review and classification of boulders and anthropogenic features (e.g., lobster traps). Boulder fields are defined as a geoform by the federal CMECS (FGDC 2012).

Seabed sediment types were classified by Fugro using a simplified version of the CMECS Substrate classification hierarchy, which is based on the Folk classification scheme (Folk 1954) (COP Appendix E; SouthCoast Wind 2023). Seabed sediment types within this simplified scheme are Mud to Muddy Sand, Sand, Gravelly Mud, Gravelly Sand, and Gravel. All but Gravelly Sand were delineated in the study area (COP Appendix E; SouthCoast Wind 2023). This CMECS scheme applies only to geological sediments; Shell, Construction Materials, and Anthropogenic Rock Rubble were also used in mapping seabed sediment types. In areas of Gravel with unconsolidated stratified glacial deposits, a geoform morphological unit of Glacial Moraine/Till was delineated. Bathymetry and SSS were used as the primary data sets to delineate these seabed sediment types, and backscatter was utilized as a secondary data set, due to its relative nature, as discussed above in this section and in COP Appendix E (SouthCoast Wind 2023). Grain size distribution results from laboratory analysis of grab samples were used to ground-truth the sediment types indicated by the geophysical data (COP Appendix E; SouthCoast Wind 2023).

A combination of backscatter over hillshaded bathymetry and SSS data was used to detect large- and small-scale bedforms, such as mega-ripples and ripples and ripple scour depressions (RSDs) (COP Appendix E; SouthCoast Wind 2023). An additional bedform detected in SSS data and GrabCam imagery in soft bottom habitats was identified as biogenic mounds composed of tube-building fauna; these were noted in data products derived from geophysical data as “well developed” and “poorly developed” mounds (COP Appendix E; SouthCoast Wind 2023). These features were recorded as most distinct in data collected in 2020 along portions of the Falmouth ECC route options. Survey data collected in 2021 indicated that these mounds are not stable features of the seafloor that persist across seasons or years

(COP Appendix E; SouthCoast Wind 2023). Review of available imagery indicates that both polychaete and amphipod tube-builder taxa, known to be ephemeral, comprised these mound features.

Ground-Truth Data

Ground-truth data were collected at a total of 768 stations in the Study Area using a variety of benthic sampling techniques, with some stations sampled during multiple surveys and using multiple techniques. These benthic data (SPI/PV, grab samples, GrabCam) were analyzed for a suite of parameters on sediment types, bedform dynamics, and biogeochemical processes, as well as to characterize infaunal and epifaunal biological communities. Detailed descriptions of each variable analyzed and full data analysis results for each benthic survey can be found in the Benthic and Shellfish Resources Characterization Report and Addendum #2 (COP Appendices M and M.2; SouthCoast Wind 2023). All benthic data results prepared for SouthCoast Wind by Fugro, Integral, and AECOM, were provided to INSPIRE for the purpose of mapping benthic habitats in support of EFH consultation. These data were inventoried and summarized as detailed below to provide a single summarized set of key variables at each station for ground-truthing geophysical data and mapping benthic habitats to support EFH consultation.

CMECS Substrate and Biotic classifications were consistently evaluated across all surveys from SPI/PV (including Transect SPI/PV), grab samples, and GrabCam. These variables serve as ground-truth for assessing and calibrating geophysical data signatures and characterizing the physical and biological characteristics of benthic habitats. Primary CMECS Substrate and Biotic classifiers were selected for the summary data set: Substrate Group and Subgroup, Biotic Subclass and Co-occurring Biotic Subclass. Substrate Group and Subgroup parameters provide categorical values describing sediment composition (e.g., Sandy Gravel, 30 to 80 percent gravel cover on sand). CMECS Biotic Subclasses describe dominant biota (by percent cover) at a coarse level. Within the Benthic/Attached Biota Biotic Setting, there are eight classes, of which the Faunal Bed class is of most relevance to the U.S. Atlantic outer continental shelf. Three subclasses fall under the Faunal Bed hierarchy: Attached Fauna, Soft Sediment Fauna, and Inferred Fauna (e.g., tracks and trails, egg masses). Although Biotic Subclass is not directly based on sediment grain size distributions, it reflects them at the scale of relevance to the dominant fauna present, thus serving as an integrator of physical and biological characteristics of the seafloor. The CMECS definition expressly states that “substrate type is such a defining aspect of the Faunal Bed class that CMECS Faunal Bed subclasses are assigned as physical-biological associations involving both biota and substrate” (FGDC 2012).

Because the presence of Attached Fauna can be an important component of benthic habitat utilization by benthic taxa and demersal fish (NMFS 2021) and may be present at sparse to patchy levels and, therefore, not classified as the Biotic Subclass, INSPIRE summarized Attached Fauna presence into a single variable. Attached Fauna were noted as present if Attached Fauna types were noted at the level of the Biotic Subclass or Co-occurring Biotic Subclass, or, where available, the Biotic Group or Co-occurring Biotic Group across all available replicate-level sampling data (i.e., a replicate is a single SPI/PV image pair, single grab, or a single GrabCam video).

The presence of sensitive and non-native taxa were evaluated from PV images by INSPIRE. Sensitive seafloor habitats include corals, SAV beds, and valuable cobble and boulder habitat (BOEM 2019a). Cobble and boulder habitat can serve as structure for hard and soft corals, nursery grounds for juvenile lobster, and as preferable benthic habitat for squid to deposit their eggs. The benthic data collected serve as baseline presence/absence data for marine non-native species within the Study Area. The colonial tunicate *Didemnum vexillum* is known to have widespread presence on Georges Bank and other areas of New England (Stefaniak et al. 2009), and dense colonies of this tunicate can smother native species (Bullard et al. 2007). Because species-level identification cannot be confirmed without a physical sample, presence observed in the PV images was noted as Didemnum spp.

The summarized data set includes predominant values across all available replicate data for Substrate Group, Substrate Subgroup, Biotic Subclass, and Co-occurring Biotic Subclass, presence/absence values for Attached Fauna, and types of sensitive taxa and non-native taxa. Predominance was determined across all analyzed samples and surveys with the predominant category having the maximum number of analyzed replicates. If multiple categories occurred with equal frequency, then the predominant category was classified as “Varies.” Sample type and replicate count are also provided.

In addition, variability across replicate level data was examined for Substrate Subgroup and Biotic Subclass. This examination evaluated variation of the result in a scalar, quantitative format. Calculations to compare the variable categories, as well as the predominant results while accounting for overall sampling effort, are described below.

Two measures to assess variable heterogeneity within a station were computed:

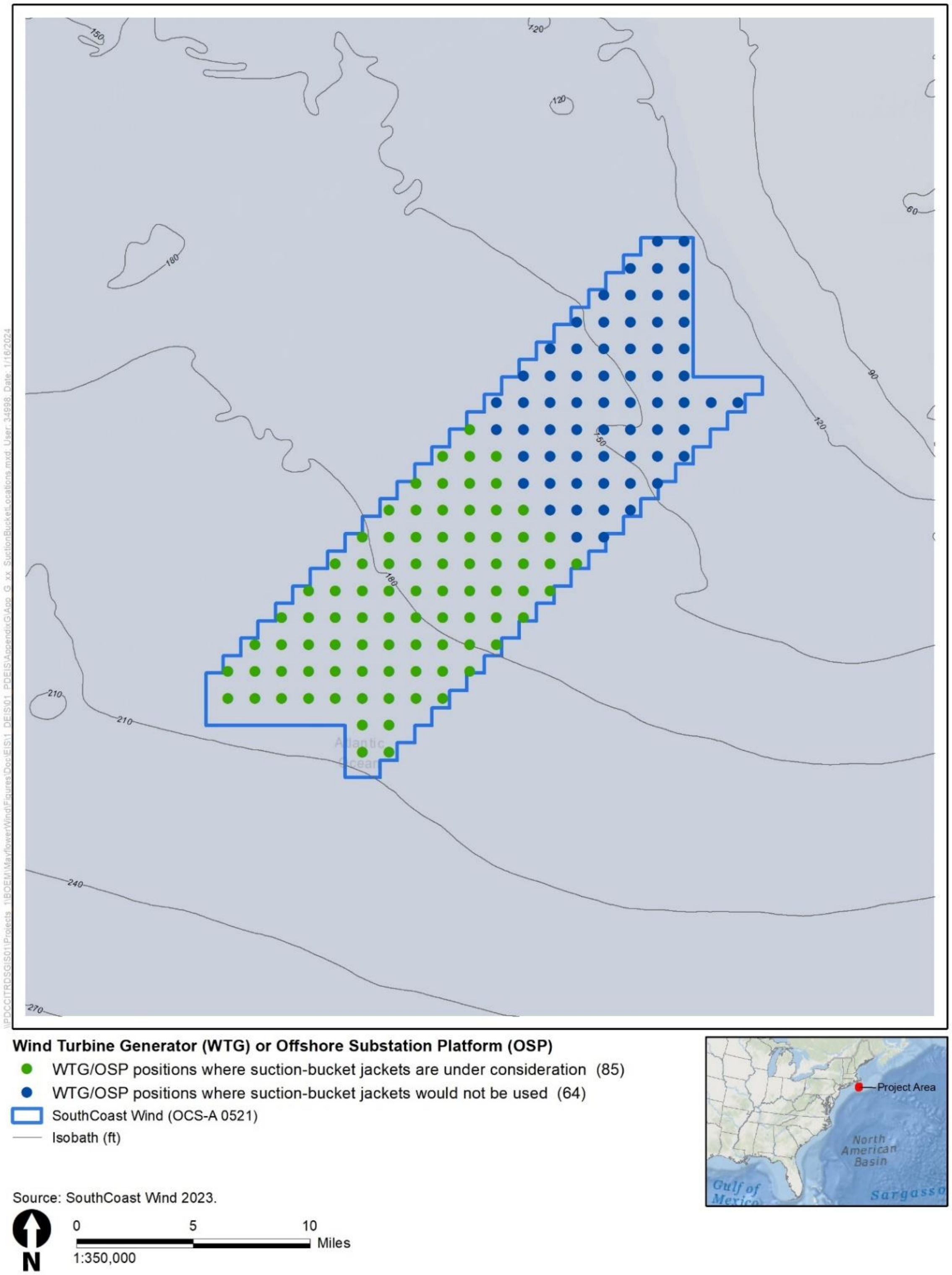
- Categorical Variability: variability of relevant categorical variables across all surveys and sample types was calculated by dividing unique number of categories by the number of analyzed replicates. Numerical results ranged from 0 to 1, with 1 indicating high variability and heterogeneity.
- Percentage of Predominance: quantitative measure (percent) of a category’s dominance at a station across time and over sample types was calculated by dividing the number of replicates in the predominant category at a station by the total number of analyzed replicates. Numerical results ranged from 0 percent to 100 percent, with 100 percent indicating the category at that station was fully dominant (all replicates were categorized the same way).

Stations without a quantitative value designated as N/A indicates a “Varies” result for predominant category, as percentage of predominance could not be calculated; stations designated as Not Analyzed indicates the station was not analyzed for the variable being examined. Because variability cannot be measured with a sample size of one, results that are designated as N/A for categorical variability indicate there was only one analyzed replicate for the station.

Appendix B – Suction-Bucket Jacket Installation Entrainment Assessment

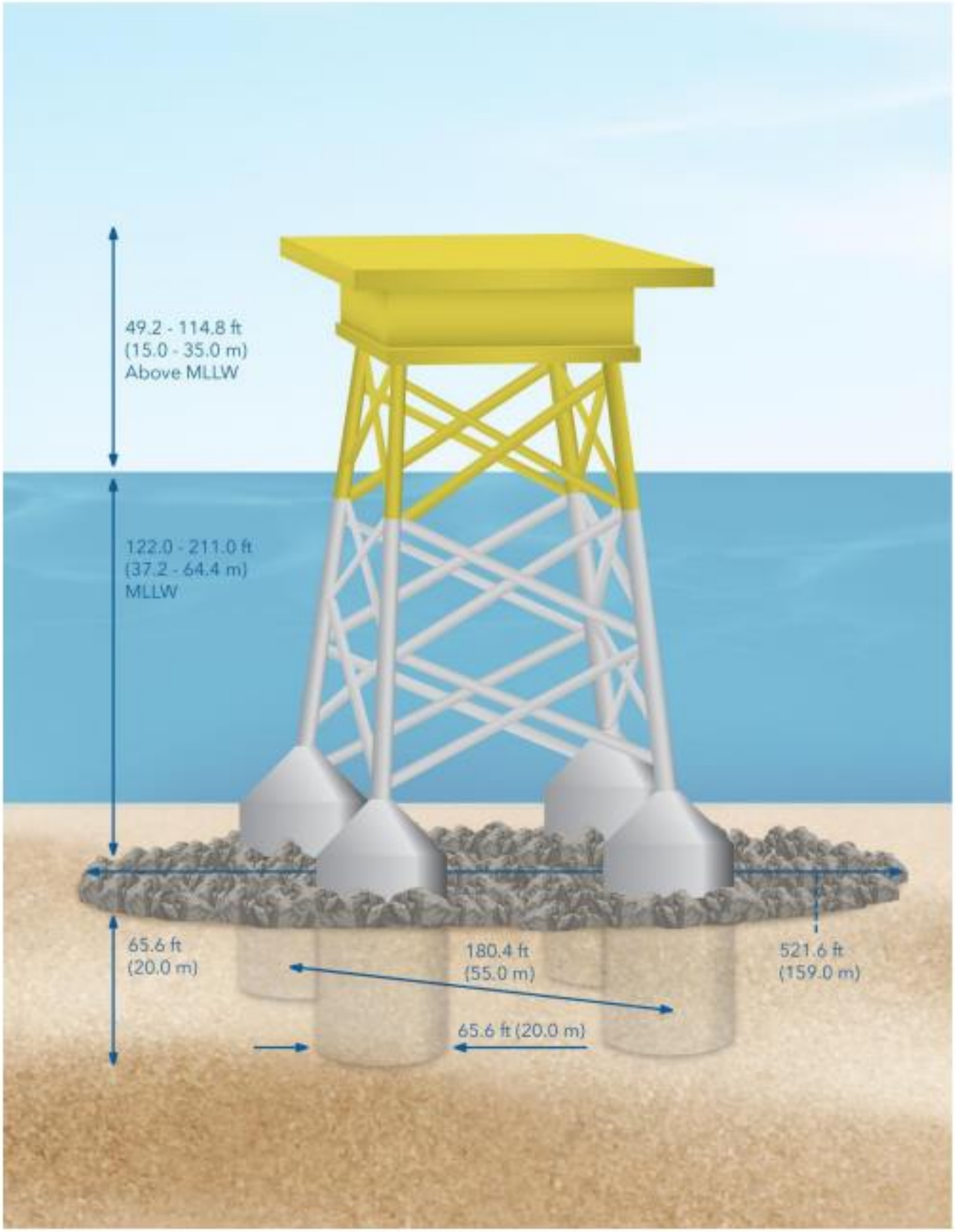
Introduction

SouthCoast Wind Energy LLC (SouthCoast Wind) may use suction-bucket jacket foundations for up to 85 wind turbine generators (WTG)/offshore substation platforms (OSPs) in the southern portion of Lease Area OCS-A 0521 (Figure 1). Suction-bucket jackets have a similar steel lattice design to piled jackets but diverge at the connection to the seafloor. These substructures use suction buckets instead of piles to secure the structure to the seabed (Figure 2). Each suction-bucket jacket foundation will be made up of four buckets (one per leg) with each bucket having a diameter of up to 20 meters, a penetration depth of up to 20 meters, and a volume of approximately 6,800 cubic meters. During installation, the suction-bucket jacket is lowered to the seabed with the open bottom of the buckets being embedded into the substrate on the weight of the jacket substructure. To complete the installation and secure the foundation, water and air are pumped out of the buckets, at a typical flow rate of 300 cubic meters per hour, creating negative pressure within the buckets which then embeds the foundation buckets into the seabed. The jacket can also be leveled at this stage by varying the applied pressure. The pumps will be released from the suction buckets once the jacket reaches its designed penetration depth. The connection of the required suction hoses is typically completed using a remotely operated vehicle (ROV). A typical duration for suction bucket jacket installation is 15 to 20 hours per foundation and is scheduled to occur over a 16-month period between the start of Q2 2030 (April 2030) to the start of Q3 2031 (July 2031) (Figure 3). Further details on suction-bucket jacket foundations can be found in the SouthCoast Wind Construction and Operations Plan Volume 1 (SouthCoast Wind 2023). During installation of suction-bucket jacket foundations, planktonic organisms may become entrained as water is pumped out of the buckets during the embedding process. This assessment estimates the potential plankton entrainment impact that may occur as a result of the installation of 85 suction-bucket jacket foundations in the southern portion of SouthCoast Wind Lease Area over a 16-month period.



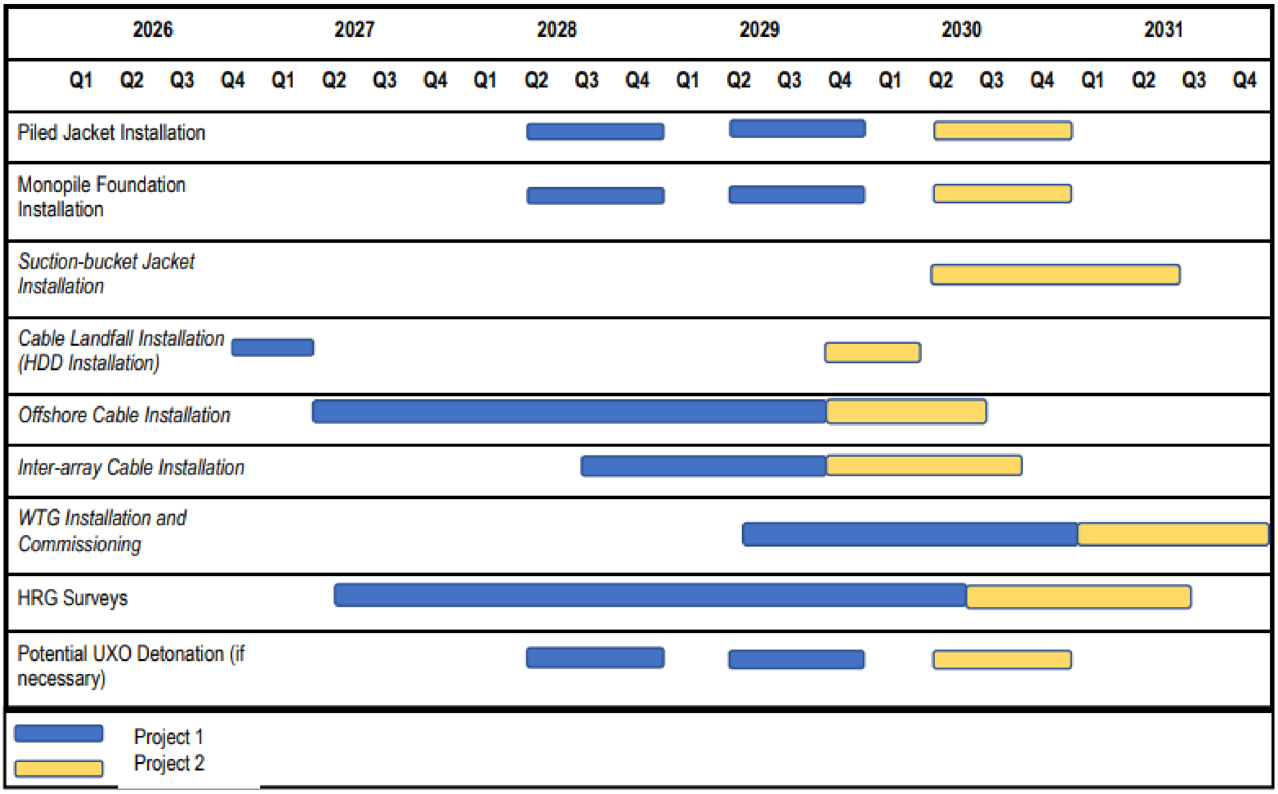
Source: SouthCoast Wind 2023.

Figure 1. WTG positions where suction-bucket jacket foundations are under consideration



Source: COP Volume 1, Figure 3-9; SouthCoast Wind 2023

Figure 2. Indicative WTG suction-bucket jacket substructure diagram

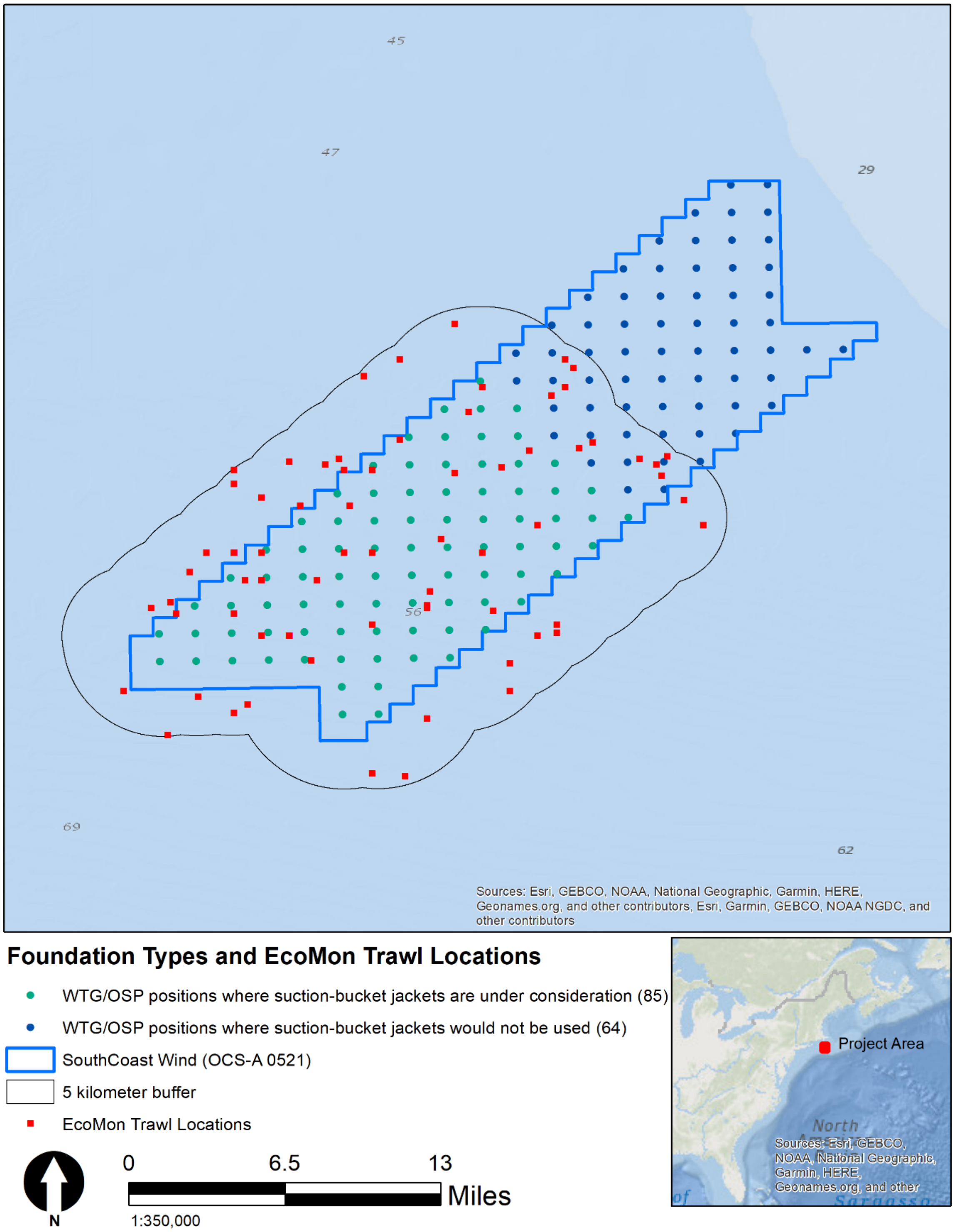


Source: SouthCoast Wind Construction ITR Application (LGL 2024)

Figure 3. Nominal installation periods for major SouthCoast Wind project components

Technical Approach

To determine the presence and abundance of plankton species in the SouthCoast Wind suction-bucket jacket installation area, data on ichthyoplankton and zooplankton densities from the National Oceanic and Atmospheric Administration (NOAA) Northeast Fisheries Science Center (NEFSC) Ecosystem Monitoring (EcoMon) survey program (NOAA NEFSC 2019) was used. The EcoMon dataset includes catch extrapolated plankton densities per 100 cubic meters for 45 ichthyoplankton and 92 zooplankton taxa from EcoMon plankton trawl surveys between 1977 to 2021. EcoMon surveys are conducted six to seven times per year covering approximately 120 randomly selected stations on the continental shelf between North Carolina and Nova Scotia using twin 60-centimeter Bongo nets with a 333-micron mesh. The EcoMon data set used in this assessment includes plankton tows conducted between 1977 and 2021 (EcoMon Plankton Data Version 3.8) and is available online from the NOAA National Centers for Environmental Information (NCEI). For assessing potential entrainment impacts from the installation of suction-bucket jacket foundations, plankton data was limited to EcoMon trawl samples collected within 5-kilometers of the suction-bucket jacket installation area in the southern portion of Lease Area OCS-A 0521 (Figure 4). This analysis area was used on the assumption that foundation installation is a one-time localized action with short-term entrainment impacts.



Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors, Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other

Figure 4. EcoMon plankton trawl survey locations within 5-kilometers of the potential suction-bucket jacket foundation installation area in the SouthCoast Wind Lease Area

Plankton density data (number of individuals per 100 m^3) for each fish and invertebrate taxa in the EcoMon data set were pooled and averaged by month for all samples that occurred within the entrainment assessment area (127 total trawls; Table 1). Ichthyoplankton eggs are not recorded in the EcoMon database and are excluded from this analysis. Monthly entrainment estimates for suction-bucket foundation installations were calculated using a per foundation one-time total seawater displacement volume of 27,200 cubic meters (6,800 m^3 per bucket x 4 buckets per foundation) and the assumption that the installation of 85 suction-bucket jacket foundations would occur evenly over a 16-month period from April 2030 to July 2031. Given this construction schedule, 5 to 6 suction-bucket jacket foundations can be installed per month with double the installations occurring in the months of April, May, June, and July due to installations occurring in those months in both 2030 and 2031 (Table 2). To calculate entrainment estimates (EE) for suction-bucket jacket foundation installations, mean monthly plankton densities were multiplied by the total volume of seawater displaced by a single foundation then multiplied by the number of suction-bucket foundation installations in each month (Equation 1). While this equation uses parameters specific to SouthCoast Wind, it follows the basic entrainment calculation presented in the Sunrise Wind Farm Project Construction and Operations Plan Appendix N2 – Ichthyoplankton Entrainment Assessment (TRC 2022).

Equation 1:

Suction Bucket EE = Mean plankton density for a given month (number/100 m^3) x total volume of seawater displaced by a single suction-bucket jacket foundation (27,200 m^3) x number of foundations installed in a given month (5, 6, 10, or 11)

Table 1. Number of EcoMon plankton trawls by month within the suction-bucket jacket installation entrainment analysis area

	Number of trawls
January	13
February	8
March	13
April	6
May	14
June	6
July	6
August	7
September	10
October	15
November	21
December	8
Total	127

Table 2. Hypothetical number of suction-bucket jacket installations by month from April 2030 to July 2031

	Number of installations
Apr 2030/31	11
May 2030/31	10
Jun 2030/31	11
Jul 2030/31	10
Aug 2030	6
Sep 2030	5
Oct 2030	6
Nov 2030	5
Dec 2030	6
Jan 2031	5
Feb 2031	5
Mar 2031	5
Total	85

Results

A total of 91 plankton taxa were found to occur in the suction-bucket jacket entrainment analysis area of which 36 were ichthyoplankton and 55 were zooplankton (Table 3). Excluding unidentified fish (Pisces), the most abundant ichthyoplankton species were the sand lance (*Ammodytes* spp.), gulf stream flounder (*Citharichthys arctifrons*), Atlantic mackerel (*Scomber scombrus*), and hake (*Urophycis* spp.). Sand lances showed peak abundance in January with a mean density of 290.39 individuals per 100 cubic meters while gulf stream flounder, Atlantic mackerel, and hake had peak mean monthly densities of 182.80 (September), 315.67 (June), and 158.74 (August) individuals per 100 cubic meters, respectively (Table 3). Calanoid copepods were the most abundant of the zooplankton taxa present in the entrainment analysis area. *Centropages typicus*, *Calanus finmarchicus*, *Pseudocalanus* spp., and *Temora longicornis* had the highest mean monthly densities at 132,995.40 (October), 125,988.43 (May), 56,569.62 (May), and 76,906.81(June) individuals per 100 cubic meters, respectively (Table 3).

The highest estimated total entrainment for all ichthyoplankton and zooplankton taxa combined occurred in the months of May and June (Table 4) which coincided with peak abundance for Calanoid copepods and the months where the most suction-bucket jacket foundation installations occurred. Entrainment estimates generally followed monthly plankton density trends given that these calculations are density dependent with the exception of April, May, June, and July where foundation installations were double that of the other months. Among zooplankton species, *C. finmarchicus* had the highest estimated entrainment at 342,688,524 individuals in the month of May. For ichthyoplankton species identified to at least genus, Atlantic mackerel had the highest estimated entrainment in the month of June at 944,475 individuals. Total estimated entrainment (number of individuals) by taxa from start to completion of suction-bucket jacket foundation installation was highest for *C. finmarchicus* (874,641,271), *C. typicus* (820,148,482), *Pseudocalanus* spp. (609,183,491) and *T. longicornis* (308,384,062) among zooplankton taxa and Atlantic mackerel (954,383), sand lance (869,447), gulf stream flounder (507,854), and hake (488,465) among ichthyoplankton taxa. For other taxa-specific entrainment estimates refer to Table 4.

Table 3. Mean monthly density of plankton by taxa (#/100m^3) within the suction-bucket jacket installation analysis area

		April	May	June	July	August	September	October	November	December	January	February	March
calanoid copepod	*Centropages typicus*	960.04	17,219.52	6,583.09	26,394.34	58,359.04	59,522.90	132,955.40	103,738.76	33,639.95	39,446.72	18,344.62	8,229.49
calanoid copepod	*Calanus finmarchicus*	18,977.66	125,988.43	61,121.25	53,624.81	27,823.89	16,855.19	993.51	953.42	2,120.70	1,276.83	1,939.75	49,523.60
calanoid copepod	*Pseudocalanus* spp.	41,051.38	56,569.62	48,441.45	18,686.48	6,416.94	1,503.92	4,486.57	1,847.69	12,561.41	14,012.92	14,780.25	40,229.93
calanoid copepod	*Temora longicornis*	178.51	14,926.68	76,906.81	1,577.32	3,472.86	822.55	2,663.72	1,103.12	2,126.76	1,441.06	903.03	9,971.50
larvacean	Appendicularia	4,887.41	36,534.07	59.12	2,375.23	13,222.16	6,606.19	4,705.71	1,128.14	258.13	403.05	1,604.70	15,823.45
calanoid copepod	*Paracalanus parvus*	0.00	981.84	4,849.94	1,622.32	3,448.91	19,932.68	17,877.69	13,566.08	1,887.55	1,127.51	2,071.01	163.81
calanoid copepod	*Acartia* spp.	10.53	1,291.82	2,506.78	375.22	382.60	16,843.97	1,490.05	9,667.00	16,122.50	2,140.72	704.84	498.44
arrow worm	*Chaetognatha*	781.02	5,865.14	4,919.49	5,826.61	17,493.24	2,682.07	1,844.02	4,451.56	3,119.88	1,535.35	786.16	1,594.30
podonid copepod	*Evadne* spp.	8.23	30,619.52	158.14	972.59	8,319.57	4,942.87	119.56	0.00	0.00	13.76	0.00	3,292.70
salp	Salpa	8.23	153.16	0.00	2,100.13	9,385.53	7,615.23	27,562.04	1,389.24	0.00	0.00	0.00	0.00
gastropod	Gastropoda	249.19	2,385.42	11,074.11	1,496.48	10,168.08	1,657.72	5,310.98	1,559.69	1,037.31	270.41	1,750.53	1,448.51
amphipod	Hyperiidea	487.77	1,032.40	14,699.90	1,091.58	9,594.60	1,937.23	2,802.23	2,136.92	1,807.19	120.61	329.83	325.86
oithonid copepod	*Oithona* spp.	378.51	1,717.03	764.31	3,314.09	7,331.41	1,727.93	1,862.37	866.60	994.86	588.24	12,349.05	3,653.19
calanoid copepod	*Centropages hamatus*	317.87	2,548.40	2,141.62	2,551.73	3,562.74	5,441.05	1,723.42	2,525.27	1,963.61	2,649.18	1,526.41	1,736.96
coelenterate	Coelenterata	21.06	17,466.09	5,170.18	2,073.64	212.12	422.85	341.00	85.03	0.00	0.00	1,191.66	119.60
echinoderm	Echinodermata	936.54	4,160.74	0.00	0.00	412.26	4,339.76	14,295.25	576.80	166.06	0.00	82.83	90.65
barncale	Cirripedia	7,730.44	993.89	162.11	85.79	0.00	0.00	0.00	0.00	0.00	66.54	2,349.90	10,315.52
calanoid copepod	*Metridia lucens*	287.16	1,303.22	7,785.20	1,417.34	1,128.51	636.97	982.71	1,060.09	1,435.65	1,295.25	2,497.05	397.17
ctenopod	*Penilia* spp.	0.00	0.00	0.00	1,677.33	9,162.86	7,936.60	832.40	202.38	0.00	0.00	0.00	0.00
pelagic shelled snail	Thecosomata	238.67	1,262.05	2,071.34	472.58	2,891.09	418.71	4,101.72	192.25	213.16	78.20	826.48	1,361.10
calanoid copepod	*Calanus minor*	0.00	0.00	20.20	39.81	3,975.36	4,151.44	3,299.26	1,546.48	205.19	90.18	0.00	0.00
copepod	Copepoda	0.00	20.71	0.00	0.00	48.25	0.00	47.24	8.61	0.00	0.00	13,170.13	0.00
pteropod	*Spiratella* spp.	0.00	1,104.15	6,979.76	278.95	0.00	503.90	260.07	979.18	753.28	192.21	559.01	31.58
onychopod	*Evadne nordmanni*	0.00	793.29	6,717.83	3,260.00	0.00	0.00	95.53	39.57	63.75	0.00	0.00	0.00
decapod	Decapoda	104.45	648.30	1,282.55	4,787.49	850.23	205.42	1,167.33	187.29	81.75	94.37	150.64	33.13
amphipod	Gammaridea	219.96	145.12	5,959.28	0.00	0.00	153.47	81.74	1,542.22	253.60	303.54	666.78	106.70
unidentified fish	Pisces	0.00	253.24	965.51	1,399.27	3,144.64	1,594.56	238.15	60.38	39.24	436.94	207.64	110.67
calanoid copepod	*Clausocalanus furcatus*	0.00	0.00	0.00	42.89	1,783.94	3,433.65	1,410.62	1,221.15	0.00	0.00	0.00	0.00
cyclopoid copepod	*Oncaea* spp.	0.00	0.00	0.00	0.00	2,884.93	2,196.01	1,436.30	443.04	15.88	10.40	0.00	0.00
siphonophore	Siphonophorae	41.15	205.25	0.00	0.00	3,485.72	1,891.49	663.26	246.69	0.00	124.76	31.67	36.80
calanoid copepod	*Acartia longiremis*	247.08	2,264.87	300.98	1,684.45	932.79	126.26	0.00	17.42	0.00	27.67	0.00	171.45
calanoid copepod	*Temora stylifera*	0.00	0.00	43.98	119.44	1,694.15	878.12	1,566.23	206.75	0.00	0.00	0.00	0.00
krill	Euphausiacea	0.00	685.72	587.29	180.77	286.83	591.61	435.78	560.63	14.54	14.50	1.73	741.06
calanoid copepod	*Clausocalanus arcuicornis*	0.00	255.46	527.03	21.26	397.58	503.98	940.63	774.52	109.55	127.01	308.18	64.00
cyclopoid copepod	Corycaeidae	0.00	0.00	0.00	0.00	424.66	1,595.80	1,020.42	202.71	31.12	167.09	56.26	0.00
pteropod	*Spiratella retroversa*	0.00	0.00	2,023.00	557.67	0.00	0.00	0.00	0.00	0.00	0.00	82.88	15.54
annelid worm	Polychaeta	69.63	589.94	43.98	59.07	269.22	263.95	192.71	206.28	68.36	37.92	79.84	408.41
cyclopoid copepod	*Oithona spinirostris*	0.00	0.00	206.08	0.00	1,144.87	0.00	585.64	113.03	158.44	0.00	0.00	24.65

		April	May	June	July	August	September	October	November	December	January	February	March
onychopod	*Podon* spp.	0.00	0.00	0.00	106.32	606.10	477.98	25.41	0.00	7.27	0.00	0.00	0.00
protozoan	Protozoa	0.00	0.00	0.00	0.00	145.13	180.64	151.32	558.79	37.69	18.96	22.21	0.00
mysid shrimp	Mysidacea	0.00	0.00	43.98	39.88	39.48	15.79	0.00	140.23	129.02	127.63	396.64	50.03
calanoid copepod	*Temora* spp.	0.00	0.00	0.00	0.00	0.00	379.30	170.32	213.59	0.00	69.68	70.65	0.00
calanoid copepod	*Tortanus discaudatus*	0.00	445.13	172.61	0.00	0.00	0.00	0.00	73.75	7.76	20.56	8.10	65.49
ostracod	Ostracoda	0.00	0.00	39.41	0.00	0.00	43.52	210.07	204.37	155.59	68.85	6.37	0.00
bivalve	Pelecypoda	0.00	0.00	0.00	0.00	0.00	32.82	49.56	521.13	7.76	86.33	0.00	0.00
bryozoan	Bryozoa	0.00	0.00	0.00	0.00	0.00	80.80	51.60	163.67	55.13	200.08	88.88	40.77
calanoid copepod	*Paracalanus* spp.	0.00	0.00	0.00	0.00	72.57	96.97	29.70	170.53	0.00	272.33	0.00	0.00
sand lance	*Ammodytes* spp.	38.20	2.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	290.39	169.53	90.79
gulf stream flounder	*Citharichthys arctifrons*	0.00	0.00	0.00	3.67	141.86	182.80	10.60	0.19	0.13	0.00	0.00	0.00
calanoid copepod	*Calanus* spp.	0.00	0.00	324.21	0.00	0.00	0.00	8.11	0.00	0.00	0.00	0.00	0.00
Atlantic mackerel	*Scomber scombrus*	0.00	3.64	315.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
hake	*Urophycis* spp.	0.00	0.00	0.00	12.03	158.74	85.56	45.65	3.60	0.56	0.00	0.00	0.00
calanoid copepod	*Eucalanus* spp.	0.00	0.00	0.00	0.00	71.62	0.00	64.40	49.78	0.00	0.00	0.00	0.00
krill	*Euphausia krohnii*	0.00	0.00	0.00	0.00	0.00	52.30	110.20	5.67	0.00	0.00	0.00	0.00
Atlantic herring	*Clupea harengus*	0.00	0.00	0.00	0.00	0.00	0.00	21.69	52.20	73.52	12.83	1.51	0.30
silver hake	*Merluccius bilinearis*	0.00	0.00	4.17	18.50	70.00	20.20	17.27	5.05	1.50	0.00	0.00	0.00
pteropod	*Creseis* spp.	0.00	0.00	0.00	0.00	0.00	0.00	93.13	0.00	0.00	0.00	0.00	0.00
Northern krill	*Meganyctiphanes norvegica*	0.00	41.79	0.00	0.00	39.43	0.00	0.00	5.86	0.00	4.08	0.00	0.00
pelagic sea slug	Gymnosomata	0.00	0.00	0.00	42.83	0.00	0.00	15.87	0.00	0.00	0.00	0.00	0.00
ctenophore	Ctenophora	0.00	0.00	0.00	0.00	0.00	42.10	7.33	5.67	0.00	0.00	0.00	0.00
fourspot flounder	*Hippoglossina oblonga*	0.00	0.00	0.00	4.33	24.29	7.90	1.53	0.00	0.00	0.00	0.00	0.00
krill	*Thysanoessa longicaudata*	0.00	0.00	0.00	0.00	0.00	0.00	31.73	0.00	0.00	0.00	0.00	0.00
Arctic krill	*Thysanoessa raschii*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.43	0.00	0.00	0.00	0.00
yellowtail flounder	*Limanda ferruginea*	0.00	10.92	15.09	1.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26
summer flounder	*Paralichthys dentatus*	0.00	0.00	0.00	0.00	0.00	0.91	10.18	10.51	3.08	0.17	0.00	0.08
butterfish	*Peprilus* spp.	0.00	0.00	0.00	9.49	12.49	2.19	0.21	0.00	0.00	0.00	0.00	0.00
cunner	*Tautogolabrus adspersus*	0.00	0.00	0.00	11.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic cod	*Gadus morhua*	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.84	1.79	2.88	1.74
witch flounder	*Glyptocephalus cynoglossus*	0.00	1.40	3.12	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
windowpane flounder	*Scophthalmus aquosus*	0.00	0.21	0.00	0.00	1.00	0.90	1.47	0.81	0.00	0.00	0.00	0.00
offshore hake	*Merluccius albidus*	0.00	0.07	3.67	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00
Madeira lanternfish	*Ceratoscopelus maderensis*	0.00	0.00	0.08	0.00	0.00	2.20	1.31	0.13	0.00	0.00	0.00	0.00
pollock	*Pollachius virens*	0.46	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	1.58	0.70
flounder	*Etropus* spp.	0.00	0.00	0.00	0.00	0.00	2.30	0.20	0.05	0.00	0.00	0.00	0.00
haddock	*Melanogrammus aeglefinus*	0.00	0.97	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.19
Atlantic menhaden	*Brevoortia tyrannus*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.55	0.12	0.00	0.00	0.00
American plaice	*Hippoglossoides platessoides*	0.00	0.66	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
winter flounder	*Pseudopleuronectes americanus*	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10

		April	May	June	July	August	September	October	November	December	January	February	March
sea robin	*Prionotus* spp.	0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00
frigate tuna	*Auxis* spp.	0.00	0.00	0.00	0.00	0.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00
flounder	*Bothus* spp.	0.00	0.00	0.00	0.17	0.00	0.30	0.33	0.05	0.00	0.00	0.00	0.00
fourbeard rockling	*Enchelyopus cimbrius*	0.00	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.08	0.00	0.00
longhorn sculpin	*Myoxocephalus octodecemspinosus*	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45
bluefish	*Pomatomus saltatrix*	0.00	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00
rock gunnel	*Pholis gunnellus*	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
monkfish	*Lophius americanus*	0.00	0.00	0.00	0.00	0.15	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker	*Micropogonias undulatus*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.13	0.00	0.00	0.00
rockfish	*Sebastes* spp.	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
wolffish	*Anarhichas* spp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
lanternfish	*Benthosema* spp.	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
bristlemouth	*Cyclothone* spp.	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00

Table 4. Estimated monthly entrainment of plankton by taxa from suction-bucket jacket foundation installations

		Apr 2030/31	May 2030/31	Jun 2030/31	Jul 2030/31	Aug 2030	Sep 2030	Oct 2030	Nov 2030	Dec 2030	Jan 2031	Feb 2031	Mar 2031	Total
calanoid copepod	*Centropages typicus*	2,872,445	46,837,087	19,696,610	71,792,596	95,241,956	80,951,140	216,983,211	141,084,712	54,900,396	53,647,543	24,948,683	11,192,104	820,148,482
calanoid copepod	*Calanus finmarchicus*	56,781,159	342,688,524	182,874,780	145,859,479	45,408,581	22,923,061	1,621,403	1,296,654	3,460,980	1,736,489	2,638,060	67,352,101	874,641,271
calanoid copepod	*Pseudocalanus* spp.	122,825,734	153,869,374	144,936,818	50,827,226	10,472,448	2,045,331	7,322,075	2,512,853	20,500,221	19,057,573	20,101,133	54,712,705	609,183,491
calanoid copepod	*Temora longicornis*	534,112	40,600,570	230,105,176	4,290,310	5,667,715	1,118,663	4,347,199	1,500,246	3,470,876	1,959,843	1,228,117	13,561,236	308,384,062
larvacean	Appendicularia	14,623,136	99,372,661	176,877	6,460,617	21,578,565	8,984,424	7,679,720	1,534,268	421,272	548,148	2,182,394	21,519,890	185,081,971
calanoid copepod	*Paracalanus parvus*	0	2,670,599	14,511,015	4,412,719	5,628,628	27,108,438	29,176,392	18,449,862	3,080,488	1,533,409	2,816,572	222,788	109,610,912
calanoid copepod	*Acartia* spp.	31,496	3,513,739	7,500,276	1,020,594	624,396	22,907,805	2,431,754	13,147,119	26,311,912	2,911,375	958,576	677,882	82,036,922
arrow worm	Chaetognatha	2,336,807	15,953,173	14,719,109	15,848,379	28,548,975	3,647,615	3,009,444	6,054,125	5,091,638	2,088,070	1,069,174	2,168,248	100,534,757
podonid copepod	*Evadne* spp.	24,624	83,285,092	473,140	2,645,431	13,577,538	6,722,298	195,121	0	0	18,717	0	4,478,071	111,420,032
salp	Salpa	24,624	416,601	0	5,712,358	15,317,192	10,356,713	44,981,249	1,889,361	0	0	0	0	78,698,098
gastropod	Gastropoda	745,581	6,488,352	33,133,742	4,070,421	16,594,309	2,254,494	8,667,514	2,121,173	1,692,896	367,751	2,380,716	1,969,975	80,486,924
amphipod	Hyperiidea	1,459,398	2,808,132	43,982,091	2,969,089	15,658,387	2,634,638	4,573,238	2,906,211	2,949,340	164,034	448,564	443,163	80,996,284
oithonid copepod	*Oithona* spp.	1,132,512	4,670,318	2,286,821	9,014,334	11,964,856	2,349,988	3,039,395	1,178,570	1,623,616	800,002	16,794,708	4,968,336	59,823,455
calanoid copepod	*Centropages hamatus*	951,057	6,931,642	6,407,717	6,940,697	5,814,385	7,399,823	2,812,628	3,434,366	3,204,616	3,602,888	2,075,916	2,362,262	51,937,996
coelenterate	Coelenterata	62,997	47,507,755	15,469,164	5,640,292	346,182	575,073	556,519	115,645	0	0	1,620,653	162,661	72,056,939
echinoderm	Echinodermata	2,802,138	11,317,203	0	0	672,813	5,902,075	23,329,847	784,442	271,006	0	112,644	123,286	45,315,453
barncale	Cirripedia	23,129,467	2,703,371	485,018	233,344	0	0	0	0	0	90,494	3,195,864	14,029,102	43,866,660
calanoid copepod	*Metridia lucens*	859,183	3,544,753	23,293,308	3,855,151	1,841,735	866,283	1,603,778	1,441,729	2,342,981	1,761,541	3,395,981	540,148	45,346,572
ctenopod	*Penilia* spp.	0	0	0	4,562,347	14,953,783	10,793,776	1,358,477	275,238	0	0	0	0	31,943,620
pelagic shelled snail	Thecosomata	714,086	3,432,786	6,197,459	1,285,404	4,718,252	569,439	6,694,001	261,457	347,873	106,348	1,124,011	1,851,095	27,302,210
calanoid copepod	*Calanus minor*	0	0	60,428	108,288	6,487,792	5,645,954	5,384,391	2,103,216	334,864	122,641	0	0	20,247,575
copepod	Copepoda	0	56,323	0	0	78,746	0	77,101	11,713	0	0	17,911,370	0	18,135,254
pteropod	*Spiratella* spp.	0	3,003,292	20,883,427	758,730	0	685,299	424,440	1,331,680	1,229,359	261,404	760,252	42,948	29,380,829
onychopod	*Evadne nordmanni*	0	2,157,737	20,099,757	8,867,200	0	0	155,910	53,817	104,040	0	0	0	31,438,462
decapod	Decapoda	312,499	1,763,388	3,837,380	13,021,977	1,387,575	279,367	1,905,087	254,709	133,418	128,348	204,869	45,061	23,273,678
amphipod	Gammaridea	658,120	394,738	17,830,171	0	0	208,721	133,406	2,097,418	413,873	412,813	906,823	145,113	23,201,196
unidentified fish	Pisces	0	688,801	2,888,806	3,806,014	5,132,052	2,168,598	388,659	82,110	64,034	594,238	282,396	150,516	16,246,224
calanoid copepod	*Clausocalanus furcatus*	0	0	0	116,670	2,911,390	4,669,765	2,302,133	1,660,763	0	0	0	0	11,660,721
cyclopoid copepod	*Oncaea* spp.	0	0	0	0	4,708,201	2,986,578	2,344,042	602,530	25,914	14,140	0	0	10,681,404
siphonophore	Siphonophorae	123,116	558,280	0	0	5,688,695	2,572,429	1,082,433	335,498	0	169,672	43,070	50,048	10,623,240
calanoid copepod	*Acartia longiremis*	739,258	6,160,433	900,527	4,581,713	1,522,306	171,715	0	23,685	0	37,625	0	233,176	14,370,438
calanoid copepod	*Temora stylifera*	0	0	131,583	324,863	2,764,850	1,194,242	2,556,087	281,178	0	0	0	0	7,252,804
krill	Euphausiacea	0	1,865,147	1,757,182	491,703	468,114	804,584	711,189	762,459	23,733	19,717	2,348	1,007,845	7,914,020
calanoid copepod	*Clausocalanus arcuicornis*	0	694,855	1,576,884	57,836	648,853	685,410	1,535,104	1,053,350	178,784	172,736	419,125	87,036	7,109,972
cyclopoid copepod	Corycaeidae	0	0	0	0	693,040	2,170,288	1,665,333	275,688	50,784	227,236	76,507	0	5,158,876
pteropod	*Spiratella retroversa*	0	0	6,052,816	1,516,853	0	0	0	0	0	0	112,710	21,132	7,703,512
annelid worm	Polychaeta	208,333	1,604,631	131,583	160,675	439,369	358,965	314,496	280,543	111,564	51,574	108,586	555,431	4,325,751
cyclopoid copepod	*Oithona spinirostris*	0	0	616,601	0	1,868,426	0	955,770	153,723	258,568	0	0	33,530	3,886,618
onychopod	*Podon* spp.	0	0	0	289,186	989,151	650,053	41,465	0	11,867	0	0	0	1,981,721
protozoan	Protozoa	0	0	0	0	236,859	245,673	246,961	759,952	61,504	25,787	30,201	0	1,606,936

		Apr 2030/31	May 2030/31	Jun 2030/31	Jul 2030/31	Aug 2030	Sep 2030	Oct 2030	Nov 2030	Dec 2030	Jan 2031	Feb 2031	Mar 2031	Total
mysid shrimp	Mysidacea	0	0	131,583	108,469	64,429	21,468	0	190,715	210,561	173,574	539,436	68,043	1,508,276
calanoid copepod	*Temora* spp.	0	0	0	0	0	515,845	277,963	290,477	0	94,768	96,077	0	1,275,131
calanoid copepod	*Tortanus discaudatus*	0	1,210,759	516,454	0	0	0	0	100,303	12,664	27,957	11,013	89,063	1,968,214
ostracod	Ostracoda	0	0	117,920	0	0	59,186	342,840	277,937	253,923	93,639	8,665	0	1,154,110
bivalve	Pelecypoda	0	0	0	0	0	44,631	80,885	708,736	12,664	117,415	0	0	964,332
bryozoan	Bryozoa	0	0	0	0	0	109,888	84,211	222,587	89,964	272,105	120,870	55,446	955,071
calanoid copepod	*Paracalanus* spp.	0	0	0	0	118,430	131,874	48,478	231,925	0	370,375	0	0	901,081
sand lance	*Ammodytes* spp.	114,294	6,194	0	0	0	0	0	0	0	394,937	230,554	123,468	869,447
gulf stream flounder	*Citharichthys arctifrons*	0	0	0	9,973	231,511	248,608	17,299	259	204	0	0	0	507,854
calanoid copepod	*Calanus* spp.	0	0	970,031	0	0	0	13,233	0	0	0	0	0	983,265
Atlantic mackerel	*Scomber scombrus*	0	9,909	944,475	0	0	0	0	0	0	0	0	0	954,383
hake	*Urophycis* spp.	0	0	0	32,717	259,068	116,360	74,502	4,901	916	0	0	0	488,465
calanoid copepod	*Eucalanus* spp.	0	0	0	0	116,882	0	105,103	67,696	0	0	0	0	289,680
krill	*Euphausia krohnii*	0	0	0	0	0	71,128	179,846	7,707	0	0	0	0	258,681
Atlantic herring	*Clupea harengus*	0	0	0	0	0	0	35,398	70,988	119,979	17,450	2,059	410	246,283
silver hake	*Merluccius bilinearis*	0	0	12,467	50,320	114,240	27,472	28,179	6,865	2,448	0	0	0	241,991
pteropod	*Creseis* spp.	0	0	0	0	0	0	151,994	0	0	0	0	0	151,994
Northern krill	*Meganyctiphanes norvegica*	0	113,657	0	0	64,347	0	0	7,966	0	5,545	0	0	191,515
pelagic sea slug	Gymnosomata	0	0	0	116,507	0	0	25,894	0	0	0	0	0	142,401
ctenophore	Ctenophora	0	0	0	0	0	57,256	11,968	7,707	0	0	0	0	76,931
fourspot flounder	*Hippoglossina oblonga*	0	0	0	11,787	39,634	10,744	2,502	0	0	0	0	0	64,667
krill	*Thysanoessa longicaudata*	0	0	0	0	0	0	51,789	0	0	0	0	0	51,789
Arctic krill	*Thysanoessa raschii*	0	0	0	0	0	0	0	41,383	0	0	0	0	41,383
yellowtail flounder	*Limanda ferruginea*	0	29,706	45,144	3,949	0	0	0	0	0	0	0	347	79,146
summer flounder	*Paralichthys dentatus*	0	0	0	0	0	1,239	16,614	14,297	5,020	232	0	103	37,505
butterfish	*Peprilus* spp.	0	0	0	25,817	20,386	2,973	338	0	0	0	0	0	49,515
cunner	*Tautogolabrus adspersus*	0	0	0	31,280	0	0	0	0	0	0	0	0	31,280
Atlantic cod	*Gadus morhua*	0	0	494	0	0	0	0	0	1,371	2,428	3,920	2,360	10,573
witch flounder	*Glyptocephalus cynoglossus*	0	3,810	9,340	2,616	0	0	0	0	0	0	0	0	15,766
windowpane flounder	*Scophthalmus aquosus*	0	583	0	0	1,632	1,224	2,394	1,101	0	0	0	0	6,933
offshore hake	*Merluccius albidus*	0	194	10,971	0	0	0	979	0	0	0	0	0	12,144
Madeira lanternfish	*Ceratoscopelus maderensis*	0	0	224	0	0	2,995	2,134	179	0	0	0	0	5,531
pollock	*Pollachius virens*	1,371	385	0	0	0	0	0	0	0	658	2,149	956	5,519
flounder	*Etropus* spp.	0	0	0	0	0	3,128	326	65	0	0	0	0	3,519
haddock	*Melanogrammus aeglefinus*	0	2,631	1,526	0	0	0	0	0	0	0	410	260	4,827
Atlantic menhaden	*Brevoortia tyrannus*	0	0	0	0	0	0	0	2,114	188	0	0	0	2,302
American plaice	*Hippoglossoides platessoides*	0	1,791	1,551	0	0	0	0	0	0	0	0	0	3,342
winter flounder	*Pseudopleuronectes americanus*	0	2,322	0	0	0	0	0	0	0	0	0	138	2,460
sea robin	*Prionotus* spp.	0	0	0	0	1,518	0	0	0	0	0	0	0	1,518
frigate tuna	*Auxis* spp.	0	0	0	0	1,399	0	0	0	0	0	0	0	1,399
flounder	*Bothus* spp.	0	0	0	453	0	408	544	65	0	0	0	0	1,470
fourbeard rockling	*Enchelyopus cimbrius*	0	1,166	0	0	0	0	0	0	408	105	0	0	1,678

		Apr 2030/31	May 2030/31	Jun 2030/31	Jul 2030/31	Aug 2030	Sep 2030	Oct 2030	Nov 2030	Dec 2030	Jan 2031	Feb 2031	Mar 2031	Total
longhorn sculpin	*Myoxocephalus octodecemspinosus*	519	0	0	0	0	0	0	0	0	0	0	617	1,136
bluefish	*Pomatomus saltatrix*	0	0	0	0	933	0	0	0	0	0	0	0	933
rock gunnel	*Pholis gunnellus*	1,042	0	0	0	0	0	0	0	0	0	0	0	1,042
monkfish	*Lophius americanus*	0	0	0	0	240	151	0	0	0	0	0	0	391
Atlantic croaker	*Micropogonias undulatus*	0	0	0	0	0	0	0	95	212	0	0	0	307
rockfish	*Sebastes* spp.	0	0	0	0	233	0	0	0	0	0	0	0	233
wolffish	*Anarhichas* spp.	0	0	0	0	0	0	0	0	0	0	0	105	105
lanternfish	*Benthosema* spp.	0	0	224	0	0	0	0	0	0	0	0	0	224
bristlemouth	*Cyclothone* spp.	0	0	0	0	0	79	0	0	0	0	0	0	79
	Total	**234,069,107**	**898,942,462**	**825,778,671**	**381,936,384**	**351,690,999**	**247,035,372**	**394,162,384**	**214,368,128**	**133,382,938**	**94,203,343**	**108,965,170**	**205,048,207**	

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