MAYFLOWER WIND

Appendix K. Seagrass and Macroalgae Report

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MAYFLOWER WIND

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Mayflower Wind Energy LLC

Final Seagrass and Macroalgae Report

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AECOM Imagine it. Delivered.

Quality Information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
0	02/04/2021	COP Submittal	Yes	Kristen Durocher	Deputy Project Manager
1	08/27/2021	Revised to include Brayton Point ECC and updated Falmouth Project Design Envelope, and in response to BOEM comments	Yes	Kristen Durocher	Deputy Project Manager

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Acronyms and Abbreviations

Abbreviation or Acronym	Definition
BMP	Best Management Practice
BOEM	Bureau of Ocean Energy Management
CMECS	Coastal and Marine Ecological Classification Standard
COP	Construction and Operations Plan
CR	CR Environmental, Inc.
CWA	Clean Water Act
EC	Export Cable
ECC	Export Cable Corridor
EFH	Essential Fish Habitat
EMF	electromagnetic fields
GPS	Global Positioning System
HDD	Horizontal Directional Drilling
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IISD	International Institute for Sustainable Development
IPF	Impact-Producing Factor
kHz	kilohertz
km	kilometer
kV	kilovolt
m	meter
Mayflower Wind	Mayflower Wind Energy LLC
MassDEP	Massachusetts Department of Environmental Protection
MLLW	Mean Lower Low Water
NAVD 88	North American Vertical Datum of 1988
NMFS	National Marine Fisheries Service
O&M	Operations & Maintenance
OCS	Outer Continental Shelf
OSP(s)	Offshore Substation Platform(s)
OSRP	Oil Spill Response Plan
POI	Point of Interconnection
PV	Plan View
SAV	Submerged Aquatic Vegetation
SPI	Sediment Profile Imaging
TVG	Time Varied Gain
VBES	Vertical Beam Echo Sounder
WTG	Wind Turbine Generator

1.0 Introduction

Mayflower Wind Energy LLC (Mayflower Wind) proposes an offshore wind renewable energy generation project (the Project) located in federal waters off the southern coast of Massachusetts in the Outer Continental Shelf (OCS) Lease Area OCS-A 0521 (Lease Area). The Project will deliver electricity to the regionally administered transmission system via export cables with sea-to-shore transitions in Falmouth, Massachusetts, Portsmouth, Rhode Island (for overland crossing of Aquidneck Island), and Somerset, Massachusetts and onshore transmission system extending to the respective points of interconnection (POIs) in Massachusetts.

The Bureau of Ocean Energy Management (BOEM) has produced regulations and guidelines for preparing a Construction and Operations Plan (COP) as well as conducting specific technical studies to support COP development. Specific guidelines applicable to this submerged aquatic vegetation (SAV) bed resource characterization include:

- Information Guidelines for a Renewable Energy Construction and Operation Plan (COP) (BOEM, 2020a);
- Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585 (BOEM, 2020b); and
- Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 (BOEM, 2019).

In 2020, the National Marine Fisheries Service (NMFS) published Recommendations for Mapping Fish Habitat (NMFS, 2020) to clarify and supplement the BOEM benthic habitat survey guidelines. These recommendations were updated in March 2021 (NMFS, 2021).

1.1 Assessment Objectives

Submerged aquatic vegetation (SAV) is defined by the U.S. Army Corps of Engineers New England Region (2018), New England Fishery Management Council (2017), Atlantic States Marine Fisheries Commission (2018) and the Commonwealth of Massachusetts Division of Marine Fisheries (2002) to include rooted vascular plants (i.e., seagrass). Seagrass, and therefore SAV species, present off the coast of Massachusetts are limited to eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*). Macroalgae are not flowering plants. Macroalgae have a distinctly different, less-specialized morphology with a holdfast that anchors them to a hard surface instead of roots and/or rhizomes that extend below the seafloor. For the purposes of this report, the following terminology is used:

- Eelgrass – a type of seagrass found in salt water off the coast of Massachusetts; this term will be used when referring to this particular plant species;
- Seagrass – flowering vascular plants with roots, stems and leaves which reproduce by producing flowers, fruits and seeds, similar to many terrestrial plants;
- Submerged aquatic vegetation bed – an area of submerged vegetation dominated by eelgrass, although macroalgae and bare, rocky, or sandy patches may be interspersed within the bed; and
- Macroalgae – a variety of multi-celled red, brown and green algae species visible to the human eye which may be detached or attached to a hard substrate, such as rock, by a holdfast. Although macroalgae is not considered a SAV species, it may occur within a SAV bed as well as outside of an SAV bed.

The objectives of this assessment are to document presence of seagrass and macroalgae which provide sediment and shoreline stabilization and will contribute toward understanding of essential fish habitat (EFH) as required by BOEM (2020) and NMFS (2020, 2021) guidelines. Results from the assessment will provide technical information to support the Mayflower Wind COP. Consistent with BOEM guidance, the specific objectives of this habitat assessment are to:

- Identify and confirm the presence and relative abundance of eelgrass and macroalgae communities along the export cable corridors (ECCs) from the Lease Area to landfalls in Falmouth and Somerset, Massachusetts, and Portsmouth, Rhode Island associated with development of the Project;
- Establish a pre-construction baseline that may be used to assess whether detectable changes occurred in post-construction eelgrass and macroalgae habitat associated with proposed operations;
- Collect information aimed at supporting spatial planning decisions;
- Inform development of an approach to quantify and mitigate substantial changes in the eelgrass and macroalgae communities associated with the proposed Project activities; and
- Provide data to inform the EFH assessment (COP Appendix N, Essential Fish Habitat and Protected Fish Species Assessment).

1.2 Report Organization

This report includes a general Project overview (Section 2.0), a description of the assessment approach (Section 3.0), a characterization of existing conditions (Section 4.0), and a characterization of effects (Section 5.0). Conclusions are provided in Section 6.0 and references are listed in Section 7.0. The Eelgrass Survey Report from August 2020 (CR Environmental, Inc. [CR], 2020) is attached.

2.0 Project Overview

2.1 Project Overview

The Mayflower Wind Project includes a Lease Area located in federal waters south of Martha's Vineyard and Nantucket (Figure 2-1). Wind turbine generators (WTGs) constructed within the Lease Area will deliver power via inter-array cables to the offshore substation platforms (OSPs). The WTG/OSP positions have been established based on a 1 x 1 nautical mile (nm) (1.9 x 1.9 kilometer [km]) grid oriented along the cardinal directions to maintain a uniform spacing of WTGs across all the lease areas within the Massachusetts/Rhode Island Wind Energy Area. Submarine offshore export cables will be installed within offshore export cable corridors (ECCs) to carry the electricity from the OSPs within the Lease Area to the onshore transmission systems via two different ECCs. One ECC will make landfall in Falmouth, Massachusetts and the other will make landfall at Brayton Point, in Somerset, Massachusetts.

The proposed Falmouth ECC will extend from the Lease Area and enter Massachusetts state waters south of Nantucket Island and Martha's Vineyard, and pass through Muskeget Channel into Nantucket Sound. The offshore export cables will make landfall via horizontal directional drilling (HDD). Potential landing location(s) for the Falmouth ECC include Shore Street, Central Park, or Worcester Avenue in Falmouth, Massachusetts. The proposed Brayton Point ECC will run north and west from the Lease Area through Rhode Island Sound to the Sakonnet River. It will then run north up the Sakonnet River, cross land at Aquidneck Island to Mount Hope Bay, and then north into Massachusetts state waters to Brayton Point. Landfall will be made via HDD at one of two potential landing locations in Somerset on the western side of Brayton Point from the Lee River (preferred) or the eastern side from the Taunton River (alternate).

The Offshore Project Area includes the Lease Area, Falmouth and Brayton Point ECCs, and the HDD at the landfall locations.

2.2 Specific Project Details

Each primary offshore Project component is briefly described below in Table 2-1. Additional details may be found in the Construction and Operations Plan (COP) Section 3 –Description of Proposed Activities.

Table 2-1. Key Project Details

Project Attribute	Description
Lease Area Size	127,388 acres (51,552 hectares [ha])
Layout and Project Size	Up to 149 WTG/OSP positions Up to 147 WTGs Up to 5 OSPs
WTGs	Rotor diameter: 721.7 – 918.6 feet (ft) (220.0 – 280.0 meters [m]) Blade length of 351.0 – 452.8 ft (107.0 – 138.0 m) Hub height above Mean Lower Low Water (MLLW): 418.7 – 605.1 ft (127.6 – 184.4 m)
OSP(s)	Top of topside height above MLLW: 160.8 – 344.5 ft (49.0 – 105.0 m)
WTG/OSP Substructures	Monopile, piled jacket, suction-bucket jacket, and/or gravity-based structure Seabed penetration: 0 – 295.3 ft (0 – 90.0 m) Scour protection for up to all positions
Inter-Array Cables	Nominal inter-array cable voltage: 60 kilovolts (kV) to 72.5 kV Length of inter-array cables beneath seafloor: 124.3 – 497.1 miles (mi) (200 – 800 km) Target burial depth (below level seabed): 3.2 – 8.2 ft (1 – 2.5 m)

Project Attribute	Description
Landfall Location(s)	Falmouth, MA Three locations under consideration: Worcester Avenue (preferred), Shore Street, and Central Park Somerset, MA Two locations under consideration: the western (preferred) and eastern (alternate) shorelines of Brayton Point Aquidneck Island, Portsmouth, RI Several locations under consideration for intermediate landfall across the island
Offshore Export Cables	Falmouth ECC Anticipated Cable Type: high voltage alternating current (HVAC) Number of export cables: up to 5 Nominal export cable voltage: 200 – 345 kV Length per export cable beneath seabed: 51.6 – 87.0 mi (83 – 140 km) Cable crossings: up to 9 Target burial depth (below level seabed): 3.2 – 13.1 ft (1 – 4 m) Brayton Point ECC Cable Type: high voltage direct current (HVDC) Number of export cables: up to 6 Up to 4 export power cables and up to 2 communication cables Nominal export cable voltage: ±320 kV Length per export cable beneath seabed: 97 – 124 mi (156 – 200 km) Cable/pipeline crossings: up to 16 (total) Target burial depth (below level seabed): 3.2 – 13.1 ft (1 – 4 m)

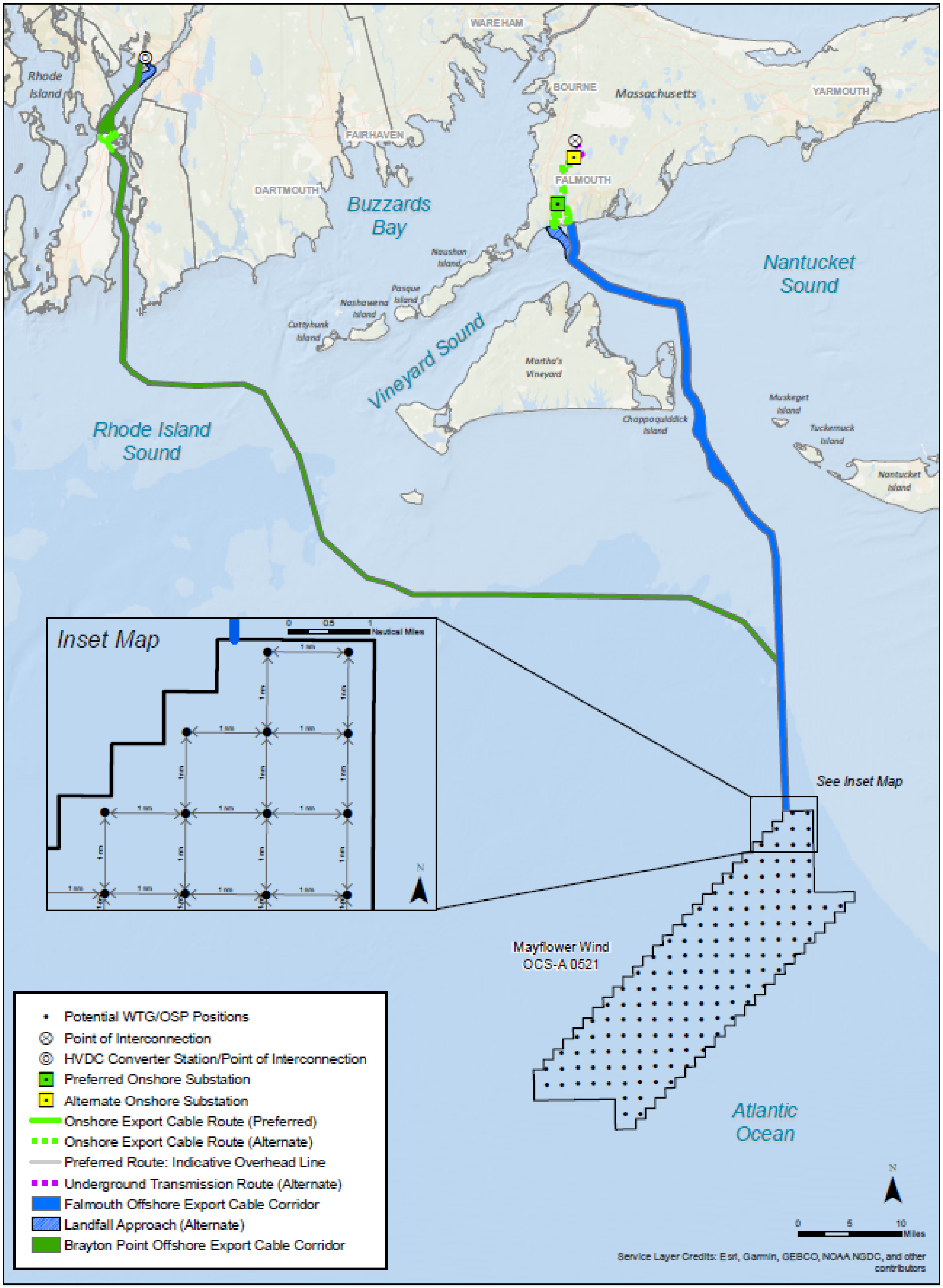


Figure 2-1. Location of Mayflower Wind Offshore Wind Renewable Energy Generation Project

3.0 Assessment Approach

The description of the affected environment and assessment of potential effects on eelgrass and macroalgae were determined by reviewing public data sources and conducting Project-specific studies. Primary data sources used to aid in the characterization of the affected environment included:

- Eelgrass field surveys at the Falmouth ECC landings, conducted by CR in August 2020 (Attachment 1), that included bathymetric surveys, side scan sonar, and underwater video at the three potential export cable landfall sites;
- Benthic habitat surveys completed by Fugro and Integral Consulting in the Spring, Summer and Fall of 2020 that included SPI and PV imagery and benthic grab camera (grab cam) video (Integral 2020 a-c); and
- Massachusetts Department of Environmental Protection (MassDEP, 2020) Eelgrass Mapping Project data and mapping.
- Rhode Island's Environmental Monitoring Collaborative (RIEMC) – Eelgrass Mapping Task Force (RIGIS 2016).

Based on the results of the Benthic Habitat Surveys (hereafter referred to as benthic surveys), the Lease Area and the Falmouth ECC south of Muskeget Channel are not eelgrass habitat. No colonies or clusters of eelgrass or macroalgae were noted in the images from the Spring or Summer surveys. Therefore, these areas are not included in this report. The Falmouth ECC through and north of Muskeget Channel (see Figure 2-1) (referred to as the Falmouth Northern ECC in COP Appendix M - Benthic and Shellfish Resources Characterization Report) is the focus of this investigation (Figure 3-1). Eelgrass and macroalgae resources are described in the following subsections in terms of presence as observed during benthic habitat surveys or site-specific eelgrass surveys. These descriptions and discussion of presence along the Falmouth ECC are followed by an evaluation of potential Project-related effects.

No field studies specific to SAV have been conducted by Mayflower Wind for the Brayton Point ECC. However, it is expected that the Brayton Point ECC south of Rhode Island Sound will feature similar habitat to the Lease Area and Falmouth ECC south of Muskeget Channel based on USGS soil data and mapped water depths from navigational charts. Excessive depth greater than 150 ft [46 m]) and soft bottom substrate are generally unsuitable for eelgrass and macroalgae colonization. Through Rhode Island Sound, there are several areas of glacial moraine and the bottom substrate is likely coarser sands. The substrate of the Sakonnet River is expected to be fine sediment, with areas of coarser material including cobbles and boulders. A benthic sampling program including acoustic survey, benthic grab samples, video and SPI/PV imaging is being conducted to provide benthic habitat mapping specific to the Brayton Point ECC (Figure 3-2). Review of the Brayton Point ECC in shallow areas near shore is based on existing studies conducted by the MassDEP and RIEMC, and other relevant studies.

3.1 Benthic Surveys

Consistent with BOEM (2019) guidelines and NMFS (2020, 2021) recommendations, a series of benthic surveys are being conducted. Benthic surveys have been conducted over the Lease Area, along the Falmouth ECC (extending 0.6 miles [1.0 km] to either side of the ECC center line), and at control areas in order to characterize the benthic resources in the Offshore Project Area. Benthic surveys are being conducted along the Brayton Point ECC. The surveys are being conducted consistent with the *Benthic Infaunal and Seafloor Habitat Study Quality Assurance Project Plan* (AECOM, 2020a) and Field Study Plans are developed for each survey. The Field Study Plans are described in general terms below and details are provided in the Benthic and Shellfish Resources Characterization Report (COP Appendix M).

Each survey has been designed to characterize the surficial sediment quality through a series of investigations including the collection of sediment for benthic community structure and physical parameter (e.g., grain size and total organic carbon) analysis; SPI/PV imaging to determine the physical characteristics of the surficial sediment and presence of macrofauna eelgrass and macroalgae; and real-time video in conjunction with grab samples used to support the characterization of benthic conditions, including eelgrass and macroalgae. The techniques for assessing seafloor habitat together with high-resolution acoustic data (e.g., multibeam bathymetry, side scan sonar, and backscatter) collected during the concurrent geophysical surveys will allow Mayflower Wind to determine the baseline seafloor habitat conditions. While the surveys are not specifically intended to target eelgrass and macroalgae, images collected during the surveys will aid in identifying the presence of eelgrass and macroalgae as well as favorable habitats for these communities.

The full details of the benthic surveys are included in COP Appendix M (Benthic and Shellfish Resources Characterization Report). Only information related to the Falmouth ECC is provided below.

3.1.1 Falmouth ECC Benthic Sampling Campaign Scope

Four benthic surveys have been conducted in the Lease Area and along the Falmouth ECC; Spring 2020, Summer 2020, Fall 2020, and Spring 2021. Figure 3-1 provides sampling locations from all four benthic surveys along the northern portion of the Falmouth ECC. Each survey consisted of benthic grab stations with grab cam video and SPI/PV stations. Starting in Summer 2020, SPI/PV transects across the Falmouth ECC were added. Fall 2020 and Spring 2021 included the western route segment of the Falmouth ECC, which has been retained in the Project Design Envelope (PDE) for consideration; the central and eastern route options through Muskeget Channel have been removed from consideration in the PDE. Spring 2021 also included video transects at select locations along the Falmouth ECC. Details of the sampling surveys are provided in the Field Sampling Plans (AECOM 2020b-e) and results are provided in COP Appendix M.

The complete Spring and Summer 2020 Coastal and Marine Ecological Classification Standard (CMECS) Substrate Classification and habitat description are provided in Section 4.2.1 of COP Appendix M. Summer 2020 sampling included increased epifauna characterization using SPI/PV in areas of complex habitat in addition to analysis of five transects along the Falmouth ECC to better define adjacent habitat and further assess seafloor conditions (Figure 3-1).

3.1.2 Brayton Point Export Cable Corridor Benthic Sampling Campaign Scope

Benthic sampling was conducted along the Brayton Point ECC in Summer, 2021. The sampling locations are provided in Figure 3-2. In addition to SPI/PV images and grab cam videos, video transects have been collected from the Aquidneck Island landfall locations and Brayton Point landfall locations. The video images and all other images collected during the survey will be analyzed to confirm the presumed absence of seagrass in these areas.

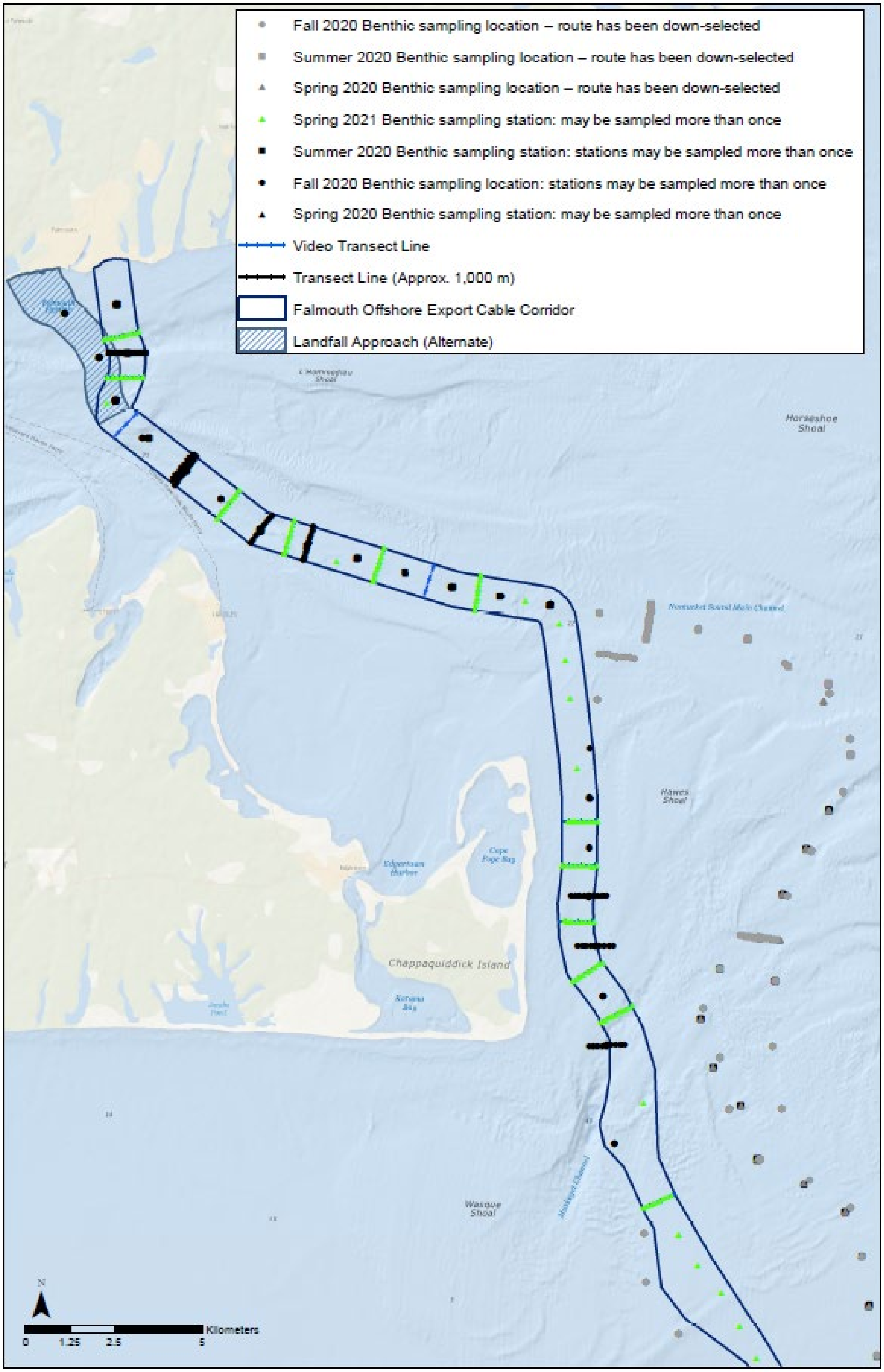


Figure 3-1. Benthic Sampling Locations Along the Northern Portion of the Falmouth Export Cable Corridor

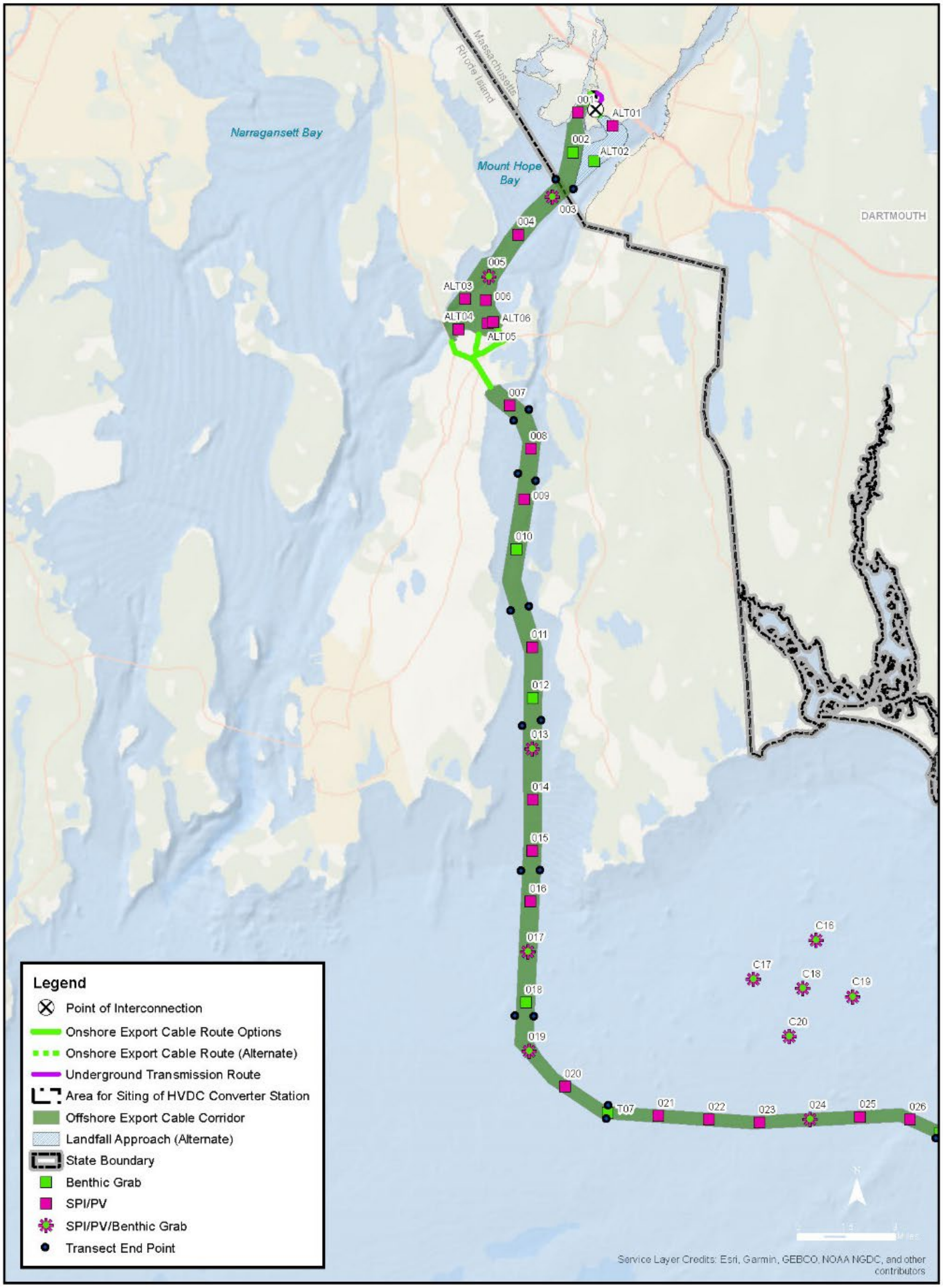


Figure 3-2. 2021 Benthic Sampling Locations Along the Brayton Point Export Cable Corridor

3.2 Site Specific Eelgrass Surveys

In August 2020, CR conducted an eelgrass survey for AECOM at three potential export cable landfall sites off of Shore Street, Mill Road, and Worcester Avenue in Falmouth, Massachusetts (Figure 3-3). Mill Road has been deselected as an option for landfall in the PDE. The nearshore eelgrass survey data collected at Mill Road are presented in the CR Report (Attachment 1). A second alternate landfall, Central Park, added to the Falmouth ECC was not specifically surveyed. However, as seen in Figure 3-3, Central Park is located adjacent to the Worcester Avenue landfall. Data collected from the Worcester Avenue landfall will be used to inform the approximate extent of eelgrass at Central Park. The surveys consisted of a combination of single beam echo sounding with precision navigation, side scan sonar, and towed underwater video. This approach provided multiple lines of evidence to accurately map the eelgrass distribution for the Falmouth landfall sites. Details and results of this survey are presented in CR's report (Attachment 1) and summarized below.

MassDEP and RI DEM eelgrass maps were examined for the Brayton Point ECC. No eelgrass beds were noted along the route. No comprehensive eelgrass surveys are planned for the Brayton Point landfall sites at Aquidneck Island or at Brayton Point. Should any seagrass be seen during the Summer 2021 benthic survey, these areas will be addressed during the permitting process.

3.2.1 Single Beam Bathymetry

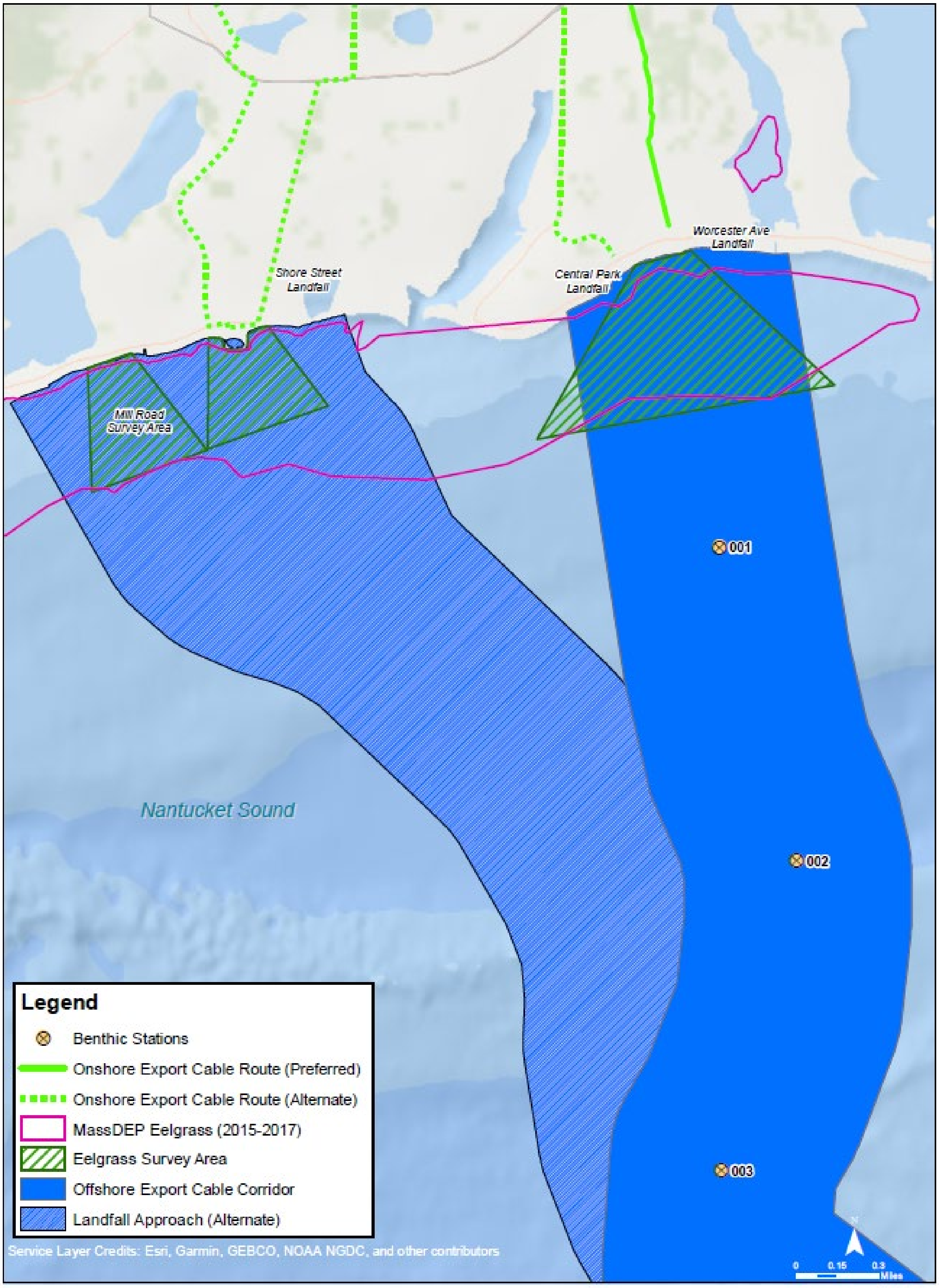
The bathymetric survey performed by CR at the Falmouth landfall sites included single beam echo sounding with precision navigation at the three landfall sites. These soundings were acquired using a Teledyne Odom Hydrographic Echotrac CV-100 single vertical beam echo sounder (VBES) equipped with an 8-degree 200-kilohertz (kHz) transducer. Over an 11-day survey period, sounding tracklines were completed parallel to the shore with 10-foot line spacing and perpendicular cross tracklines with 100-foot (30-meter) line spacing. Processing of the bathymetric data from the single beam echo sounder consisted of the removal of outlying data points associated with water column interference such as fish or debris. A database indicating SAV bed presence was created by deleting portions of data files lacking signatures associated with SAV bed.

3.2.2 Side Scan Sonar

Over a four-day period, the side scan sonar data were collected simultaneously with the bathymetry data using 60 to 80-foot (18- to 20-meter) line spacing depending on water depth. Full bottom coverage of the survey areas was collected using an Edgetech, Inc. Model 4125 400/900 kHz. Processing of side scan sonar data included removal of the water column portion of the records and correction for signal loss with distance using time varied gain (TVG) adjustments. The 400-kHz mosaics were selected for presentation because they more clearly depict sediment textural differences and the presence of eelgrass and were less affected by sea conditions than the 900-kHz signal.

3.2.3 Underwater Video Tows

Side scan sonars were used to guide the underwater video surveys at the landfall sites and were collected with CR's portable towed video sled. A one-day underwater video sled survey was performed at each landfall site to confirm the estimated eelgrass distribution derived from the echo sounder and side scan sonar data and to provide photographic documentation of eelgrass density and plant health. Fifteen video transects were completed at the Mill Road landfall site, 16 were completed at Shore Street landfall site, and 10 were completed at the Worcester Avenue landfall site. Transect length varied from approximately 1,000 to 2,000 feet (305 to 610 meters) at Mill Road, 700 to 2,200 feet (215 to 671 meters) at Shore Street, and 1,700 to 6,500 feet (520 to 1980 meters) at the Worcester Avenue landfall site. The underwater video data for all three landfall sites were reviewed by a marine biologist and field geologist at the CR office to identify the presence or absence of eelgrass, to characterize bottom substrate, and to observe biota.



Source: MassDEP, 2020

Figure 3-3. Falmouth Landing Site Eelgrass Survey Areas – August 2020

4.0 Existing Conditions

4.1 Environmental Setting – Regional Overview

The Mayflower Wind Lease Area and ECCs lie on the continental shelf off southern New England. The northeastern edge of the Lease Area is about 20 nm (37 km) southwest of Nantucket Island, Massachusetts.

4.1.1 Falmouth Export Cable Corridor

From the northern edge of the Lease Area, the Falmouth ECC traverses similar submerged terrain as the Lease Area until it reaches a distinctly shallower area between Martha's Vineyard and Nantucket Island into Nantucket Sound.

The Lease Area and Falmouth ECC south of Muskeget Channel range from approximately 46 to more than 197 feet (14 to more than 60 m) in water depth and are characterized by soft sediment bottoms. As the Falmouth ECC traverses north from the Lease Area, the shoals and channels of the shallows become prominent, surface sediment becomes coarser (sand with gravel), and hard bottoms (i.e., pavement) are common. This coarser material represents reworked glacial sediment. Surface sediment mobility is widespread throughout the Lease Area and Falmouth ECC, as indicated by the ubiquitous presence of bedforms (ripples and sand waves). A more complete description of the seafloor in the Project Area is provided in COP Appendix M (Benthic and Shellfish Resources Characterization Report) and the Marine Site Investigation Report (COP Appendix E).

4.1.2 Brayton Point Export Cable Corridor

From the northern edge of the Lease Area, the Brayton Point ECC traverses similar submerged terrain as the Lease Area until it reaches a shallower area (approximately 100 ft [30 m]) southwest of Noman's Island off Martha's Vineyard. The Brayton Point ECC crosses this shallower area and turns north. The water depth increases slightly to approximately 130 ft [40 m] until it passes southwest of Cuttyhunk Island. Here the water becomes shallow as the ECC enters Rhode Island Sound at the mouth of Buzzards Bay. As the ECC enters the Sakonnet River, the water depth averages approximately 25 ft (8 m). Within 3,000 ft (914 m) of the landfall site(s) for Aquidneck Island, water depth is as shallow as 10 ft (3 m). In Mount Hope Bay to Brayton Point, water depths are greater, exceeding 30 ft (10 m) near the Mount Hope Bridge. Approaching the landfalls, water depths are shallower (approximately 10 to 15 ft [3 to 4.5 m]).

Details of the sea bottom along the Brayton Point ECC will be provided in the revised COP Appendix M and the Marine Site Investigation Report (COP Appendix E).

4.2 MassDEP and RIEMC Eelgrass Mapping

4.2.1 Massachusetts

The MassDEP Eelgrass mapping program has acquired multiple years of high-resolution digital imagery captured during the season of maximum areal extent of eelgrass (i.e., during periods of low tide, low sun angle, and low winds). Extensive fieldwork was conducted to verify eelgrass abundance in areas with inconclusive imagery data. Field verification was conducted through the use of high-accuracy global positioning system (GPS), high-resolution sonar, and underwater video cameras. The final data were compiled and processed by MassDEP using ESRI ArcGIS Desktop software (MassDEP, 2020). The Lease Area is outside the extent of the mapped area of state waters for eelgrass by the MassDEP (Figure 4-1). The Falmouth ECC crosses through mapped patches of eelgrass in the nearshore portions connecting to the preferred landing location (Figure 4-2). The final 2 miles (3.2 km) of the Brayton Point ECC to the landing in Somerset are within Mount Hope Bay in Massachusetts waters. MassDEP does not show any eelgrass in Mount Hope Bay (Figure 4-3).

4.2.2 Rhode Island

Rhode Island's Eelgrass Mapping Task Force monitors the status of seagrasses and provides maps of their extent. The task force is comprised of a number of organizations, including the Coastal Resources Management Council, Save the Bay, and the University of Rhode Island, among others. The task force uses GIS aerial photography, remote sensing, and field monitoring with sample collection to document eelgrass populations. The most recent mapping available from 2016 surveys (CRMC 2016) shows no eelgrass beds mapped within the Brayton Point ECC. The Brayton Point ECC passes north through Rhode Island Sound, into the mouth of and through the Sakonnet River, passes overland over Aquidneck Island into Mount Hope Bay, and goes landward at the northern end of Mount Hope Bay via two potential landing points on the western and eastern sides of Brayton Point. RIEMC shows two populations of eelgrass along the mouth of the Sakonnet River. There is a 54-acre (21.9-ha) eelgrass bed located 1 mi (1.6 km) east of the ECC at Little Compton and a 49-acre (19.8 ha) bed located 0.67 mi (1.1 km) west of the ECC at Sachuest Point. (Figure 4-3). No eelgrass beds are shown in or near the ECC.

4.3 Benthic Habitats and Eelgrass Observed in the Project Area

4.3.1 Habitat Mapping and Results from the Falmouth ECC Benthic Campaign

The benthic habitat categories mapped were related to CMECS Substrate classifications using SPI/PV and benthic grab data. NMFS (2020, 2021) defines complex habitat to include the following three categories:

1) Hard bottom substrates (i.e., CMECS Groups: Gravel, Gravel Mixes, Gravelly, and Shell);
2) Hard bottom substrate with epifauna or macroalgae present; and
3) Vegetated habitats such as tidal wetlands and SAV.

Although these complex habitat categories are potential habitat for eelgrass and macroalgae, there are other factors that may affect the presence of these species, such as water depth, clarity, velocity, and nutrient levels. The NMFS (2020, 2021) recommendations provide modifiers to the CMECS substrate classification, which were used for the assessment of benthic habitat types. Within the Lease Area, benthic habitat is generally homogenous with little relief and no complex features, and eelgrass or macroalgae were not present. Areas of complex habitat were noted throughout the Falmouth ECC through and north of Muskeget Channel, primarily due to the Group Gravel or Gravelly classifications. This area of the Falmouth ECC is a high energy environment with a mobile seabed, especially in Muskeget Channel. Macroalgae was noted as present in seven of the sampling stations along the Falmouth ECC, however no eelgrass was present. A full characterization of benthic habitat types is presented in Section 4.2 of COP Appendix M (Benthic and Shellfish Resources Characterization Report).

4.3.2 Seagrass and Macroalgae

Macroalgae and SAV beds are best characterized using imagery of the seafloor. Video transects provide information on a broad area, while stationary imagery provides images of the seafloor only at the location of the image. During the SPI/PV survey, stationary imagery was obtained through the PV camera attached with the SPI camera, as well as with the video camera that was attached to the benthic grab framing, allowing for some seafloor imagery at the sample stations. The SPI/PV reports are provided as Attachments to COP Appendix M. Eelgrass was only observed in the spring at Stations 027 and 029, and in the summer at 002 relatively close to the nearshore bed and an observation at Station 024. However, the summer observation at 024 may be a transitory record because this observation is in relatively deep waters of the Muskeget Channel, beyond depths at which eelgrass typically occurs, as well as in an area of substantial velocity that may not be favorable to long-term eelgrass colonization. The observations from spring were likely in high-energy areas and were likely detrital eelgrass. With the exception of some algal fragments at Station 033, macroalgae were not found at stations south of Station 029. Of the stations where eelgrass was noted, only Station 002 is within the current Falmouth ECC design envelope. Table 4-1 summarizes observations of macroalgae as noted in the underwater SPI/PV and grab cam images and groups observations into the following qualitative categories: hard bottom with macroalgae, present/low cover, and absent. The data presented in this table reflect only those stations that are within the current Falmouth ECC design envelope.

4.3.3 Nearshore Eelgrass Mapping

The side scan sonar data provided an estimated eelgrass boundary in the nearshore area that was fine-tuned using the georeferenced single beam acoustic data and confirmed using the underwater video. The resulting delineation of the eelgrass bed extents at the three Falmouth landfall locations are shown in Figure 4-4. Details of the eelgrass survey results are provided in Attachment 1 (CR Environmental, Inc., 2020) and key points are summarized below.

The approach to the Mill Road and Shore Street landfall locations had nearly continuous SAV bed coverage consisting primarily of eelgrass, with only a few areas of open bottom. SAV bed coverage on the western side of the Mill Road landfall approach did not extend as far offshore as compared to the eastern side of the Mill Road landfall approach or the Shore Street landfall approach. The Worcester Avenue approach had a patchier eelgrass distribution with several large areas devoid of eelgrass. However, due to the shallower water depths, eelgrass at Worcester Avenue extends farther offshore than at the Mill Road or Shore Street sites. The underwater video data confirmed that the primary species present in the SAV bed was eelgrass, with some mixed stands of wire weed (*Sargassum filipendula*) and eelgrass along the shoreline and a few of the offshore transects. In addition, there were areas of wire weed and dead man's fingers (*Codium fragile*) near the nutrient-rich outflows of two coastal ponds: Oyster Pond at the Mill Road site and Green Pond at the Worcester Avenue site. The eelgrass and macroalgae in these areas were covered with epiphytic algae and bryozoans.

At the Mill Road and Shore Street landfall approaches, the eelgrass density ranged from moderate to dense along most of the transects, although there were small patches of open bottom and sparse eelgrass scattered throughout the bed. At the Worcester Avenue site, eelgrass abundance was less dense with more observations of sparse or no eelgrass. Overall plant heights throughout the three eelgrass beds ranged from 0.5 feet (0.2 m) to greater than 2 feet (0.6 m) and the plants appeared to be in good health. At the Mill Road and Shore Street landfall approaches, the extent of eelgrass coverage is limited by depth. At the Worcester Avenue approach, it appeared that, in addition to water depth limitations, wide areas of mobile sands that were identified on the side scan record contributed to limiting the offshore extent of the eelgrass bed, as well as the presence of a slipper limpet reef offshore. Marine fauna and flora observed in the three eelgrass beds included nine invertebrates, six fish species, and four macroalgal species. Dominant invertebrates included slipper limpets, bushy bryozoans, knobbed whelks, and horseshoe crabs, with only two bay scallops observed. Table 4-2 provides a complete listing of species observed in the video transects. Representative photos of eelgrass density as well as detailed notes regarding eelgrass density along each transect are also provided in Attachment 1 (CR Environmental, Inc., 2020).

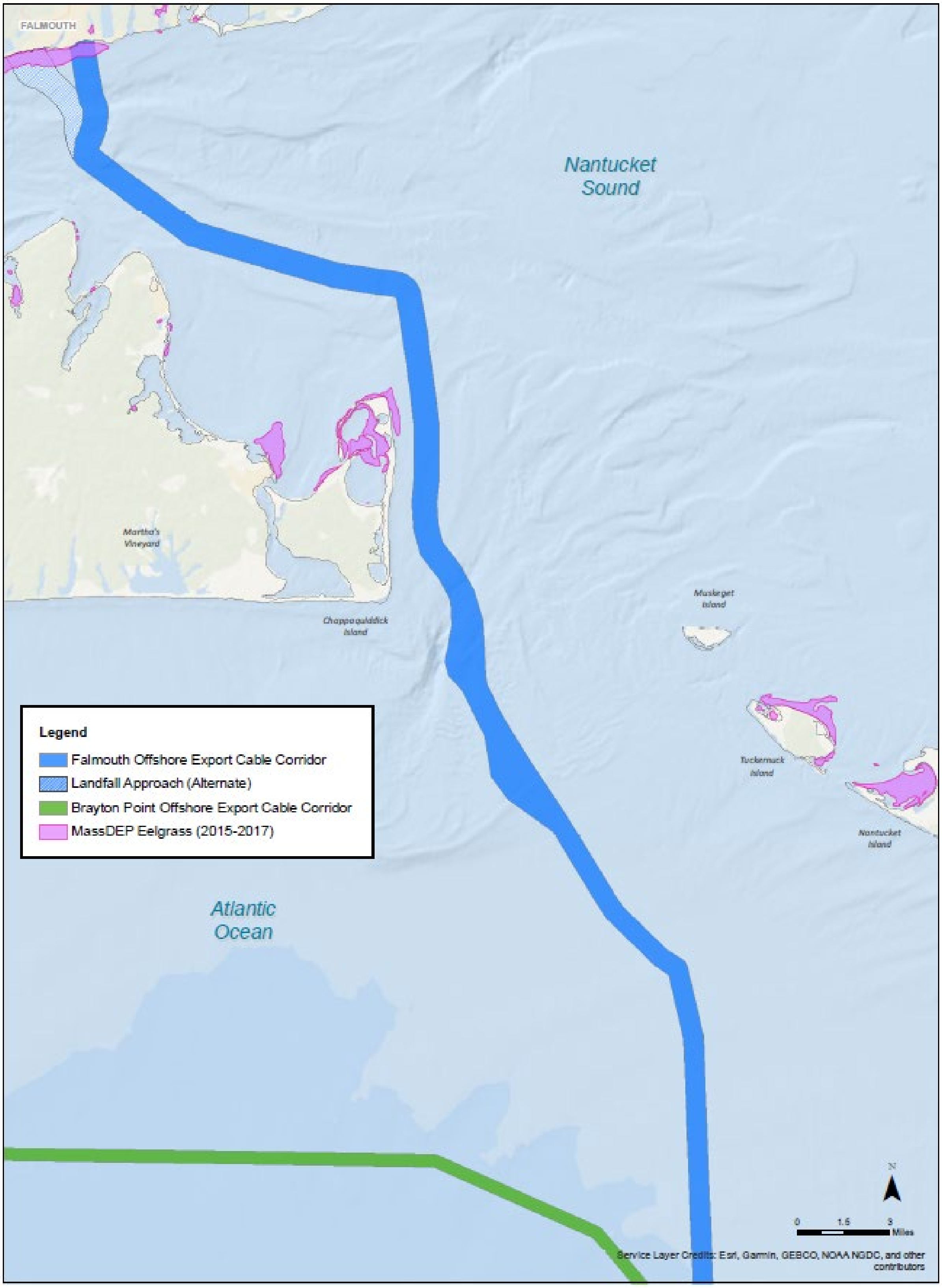
Table 4-1. Eelgrass and Macroalgae Abundance Based on Grab Cam and SPI/PV Images – Falmouth ECC, 2020

Station ID	Spring 2020 Data		Summer 2020 Data		Fall 2020 Data	
	Image Type	Macroalgae Abundance	Image Type	Macroalgae Abundance	Image Type	Macroalgae Abundance
001	SPI/PV	Hard bottom with macroalgae	SPI/PV	Hardbottom with macroalgae (red algae)	SPI/PV	Hard bottom with macroalgae
002	Grab Cam	Absent	SPI/PV transect	Softbottom and hardbottom with macroalgae (red algae). Eelgrass observed	SPI/PV	Absent
003	SPI/PV	Hard bottom with macroalgae	SPI/PV	Hardbottom with macroalgae (red algae)	SPI/PV	Present/Low cover
			Grab Cam	Macroalgae present	Grab Cam	Hard bottom with macroalgae
004	Grab Cam	Present/low cover	SPI/PV	Hardbottom with macroalgae	SPI/PV	Absent
005	SPI/PV	Hard bottom with macroalgae .	SPI/PV transect	Hardbottom with macroalgae	SPI/PV	Hard bottom with trace macroalgae
006	Grab Cam	Absent	Grab Cam	Absent	Grab Cam	Present/Low cover
007	SPI/PV	Hard bottom with macroalgae	SPI/PV	Hardbottom with macroalgae (red algae)	SPI/PV	Present/Low cover
			Grab Cam	Hardbottom with macroalgae		
008	Grab Cam	Present/low cover	Grab Cam	Shell reef/present/low cover	Grab Cam	Present/low cover
					SPI/PV	Present/Low cover
009	SPI/PV	Absent	SPI/PV	Absent	SPI/PV	Absent
010	Grab Cam	Absent	Grab Cam	Absent	Grab Cam	Present/Low cover
011	SPI/PV	Absent.	SPI/PV	Absent	SPI/PV	Absent
012	Grab Cam	Present/low cover	Grab Cam	Present/low cover	Grab Cam	Present/low cover
013	SPI/PV	Absent	SPI/PV	Present/low cover	SPI/PV	Absent
014	Grab Cam	Present/low cover	Grab Cam	Present/low cover	Grab Cam	Present/low cover
A01	Not sampled		Not sampled		Benthic	Present/Low cover
					SPI/PV	Present/Low cover
A02	Not sampled		Not sampled		SPI/PV	Present/Low cover
A03	Not sampled		Not sampled		Grab Cam	Present/Low cover

Station ID	Spring 2020 Data		Summer 2020 Data		Fall 2020 Data	
	Image Type	Macroalgae Abundance	Image Type	Macroalgae Abundance	Image Type	Macroalgae Abundance
A04	Not sampled		Not sampled		SPI/PV	Reef bottom/abundant cover (red algae)
A05	Not sampled		Not sampled		Grab Cam	Present/Low cover
A06	Not sampled		Not sampled		SPI/PV	Reef bottom/abundant cover (red algae)
A07	Not sampled		Not sampled		SPI/PV	Present/Moderate cover
A08	Not sampled		Not sampled		Grab Cam	Present/low cover
A09	Not sampled		Not sampled		SPI/PV	Absent
A10	Not sampled		Not sampled		SPI/PV	Absent
A11	Not sampled		Not sampled		SPI/PV	Present/Trace (red algae)
A12	Not sampled		Not sampled		Grab Cam	Absent
A13	Not sampled		Not sampled		SPI/PV	Present/Trace (red algae)
A14	Not sampled		Not sampled		Grab Cam	Present/Low cover
A15	Not sampled		Not sampled		SPI/PV	Absent
ALT01	Not sampled		Not sampled		SPI/PV	Absent
ALT02	Not sampled		Not sampled		SPI/PV	Present/Trace (red algae)

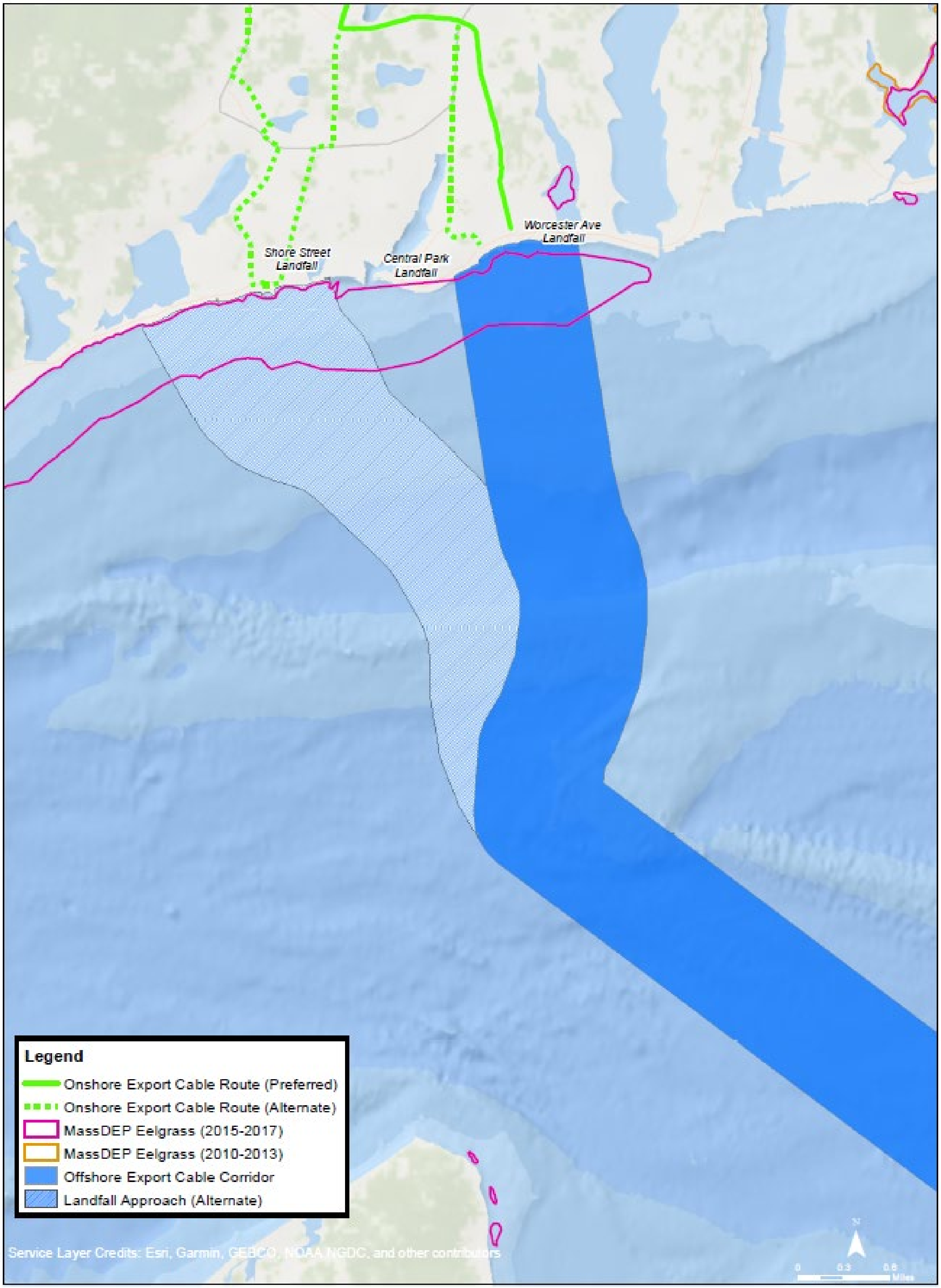
Table 4-2. Species Noted During the August 2020 Eelgrass Survey

Common Name	Latin Name	Landfall Approach		
		Mill Road (eliminated)	Shore Street	Worcester Avenue
BRYOZOA				
Bushy bryozoan	*Bugula turrita*	X	X	X
Encrusting bryozoan	*Schizoporella unicornis*	X	X	
MOLLUSCA				
Bay Scallop	*Argopecten irradians*	X		
Knobbed whelk	*Busycon carica*	X	X	
Slipper limpet	*Crepidula fornicata*	X	X	X
ARTHROPODA				
Merostomata				
Horseshoe Crab	*Limulus polyphemus*	X	X	X
Crustacea				
Flat-Clawed Hermit Crab	*Pagurus pollicaris*	X	X	
Lady crab	*Ovalipes occellatus*			X
ECHINODERMATA				
Forbes sea star	*Asterias forbesi*	X		
VERTEBRATA				
Osteichthyes				
Black sea bass (juvenile)	*Centropistes striatus*	X	X	X
Cunner	*Tautogolabrus adspersus*	X		
Northern puffer	*Sphoeroides maculatus*	X	X	
Northern searobin	*Prionotus carolinus*			X
Scup	*Stenotomus chrysops*		X	X
Summer flounder	*Paralicichthys dentatus*		X	X
SPECIES RICHNESS FAUNA		11	10	7
FLORA				
ALISMATALES				
Zosteraceae				
Eelgrass	*Zostera marina*	X	X	X
CHLOROPHYTA				
Dead Man's Fingers	*Codium fragile*	X	X	X
PHAEOPHYTA				
Wire weed	*Sargassum filipendula*	X	X	X



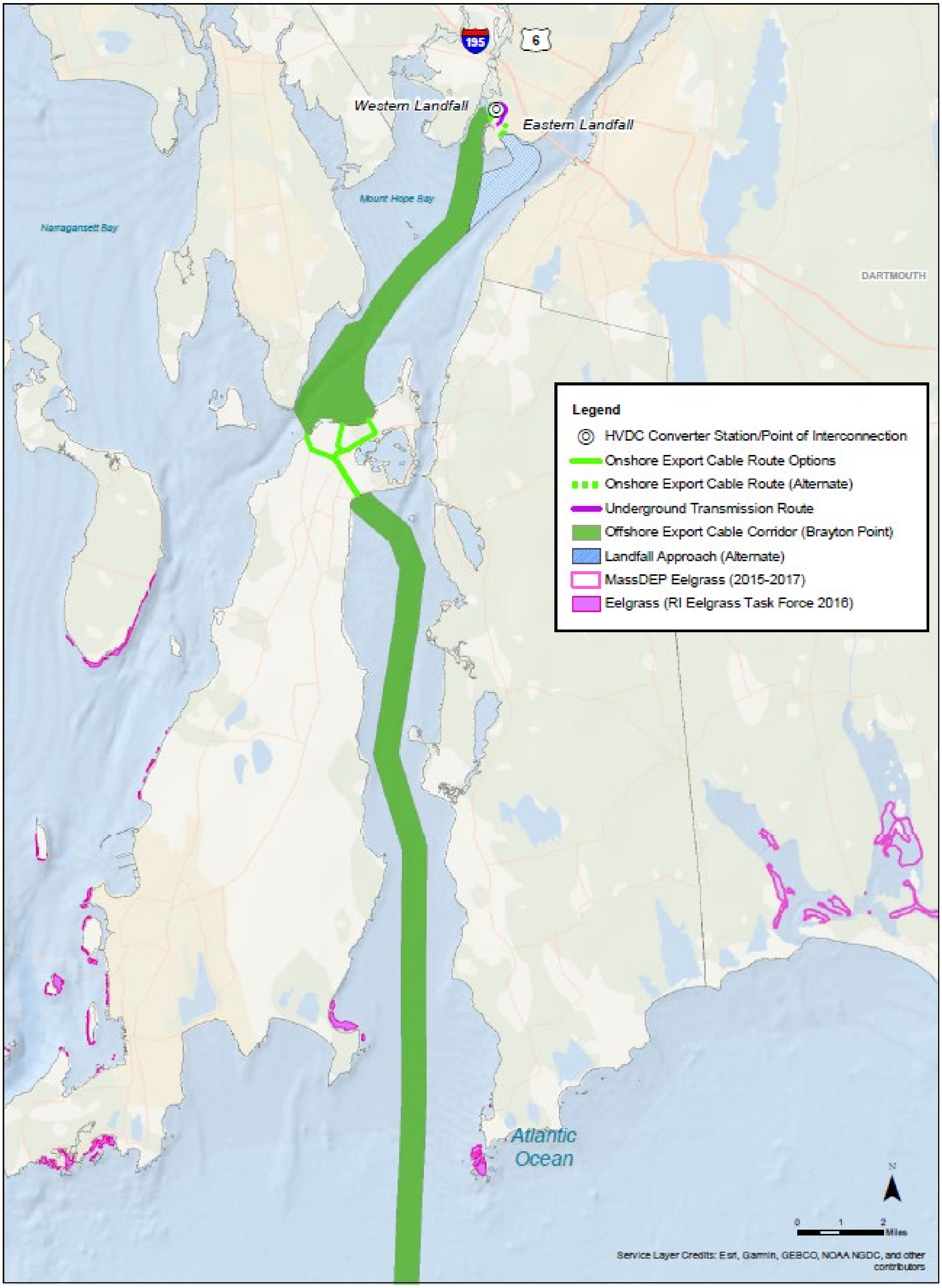
Source: MassDEP, 2020

Figure 4-1. MassDEP Mapped Eelgrass in the Falmouth ECC



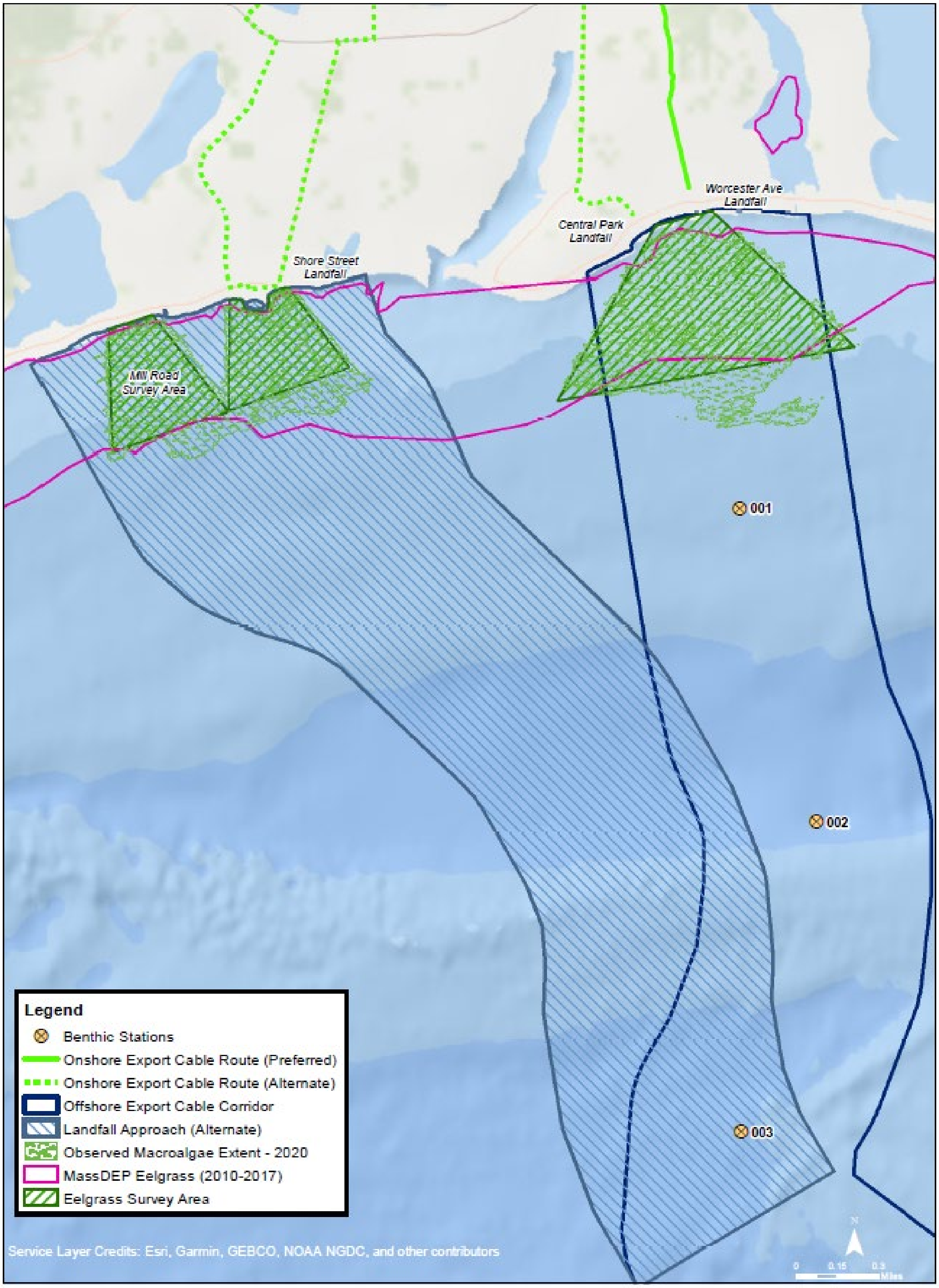
Source: MassDEP, 2020

Figure 4-2. MassDEP Mapped Eelgrass in the Nearshore Falmouth ECC



Source: RIGIS, 2016

Figure 4-3. MassDEP and RIEMC Mapped Eelgrass in the Brayton Point ECC



Source: MassDEP, 2020

Figure 4-4. Falmouth Landfall Eelgrass Survey Results – August 2020

5.0 Effect Characterization

5.1 Characterization Approach

The following provides a description of the approach used to characterize effects of the Project on resources (receptors) within or in the vicinity of the Project. This approach used in the Report includes three primary steps:

1. Identification and characterization of Impact-Producing Factors (IPFs);
2. Identification of potentially affected resources and associated sensitivity; and
3. Effect characterization.

5.1.1 Impact-Producing Factors

BOEM (2020a), in its *Information Guidelines for a Renewable Energy Construction and Operations Plan (COP),* identified seven potential IPFs which may affect biological resources. The spatial extent and duration of activities associated with each IPF are described in detail in Section 3.4 of the COP. Based on an assessment of the Project activities described in Section 2.0 and COP Section 3.3, Table 5-1 below provides definitions of the criteria used to qualitatively assess the anticipated effect intensity with the effect being a change to the resource brought about by the presence of a Project component or by the execution of a Project activity.

Table 5-1. Effect Criteria Qualitative Definitions

Effect Criteria	Definitions
Nature	• **Positive** – An effect that is considered to represent an improvement to the baseline or to introduce a new desirable factor. • **Negative** – An effect that is considered to represent an adverse change from the baseline, or to introduce a new undesirable factor.
Type	• **Direct** – An effect created as a direct result of the Project or Project activities. • **Indirect** – An effect which may be caused by the Project but will occur in the future or outside the direct area of Project influence.
Reversibility	• **Temporary** – Effects that are transient, intermittent or occasional in nature and/or largely reversible. • **Permanent** – Effects that occur during the development of the Project and cause a permanent change in the affected impact indicator or resource that endures substantially beyond the Project lifetime (irreversible).
Duration	• **Short-Term** – Effects that are predicted to last only for a limited period (less than four years) but will cease on completion of an activity, or as a result of mitigation measures and natural recovery. • **Medium-Term** – Effects that will occur over a period of four to 10 years. This will include impacts that may be intermittent or repeated rather than continuous if they occur over an extended time period. • **Long-Term** – Impacts that will occur over an extended period (more than 10 years). This will include impacts that may be intermittent or repeated rather than continuous if they occur over an extended time period.
Geographical Extent (Area)	• **Local** – Effects that alter or influence locally important resources or are restricted to a single (local) administrative area or local community (not widespread).

Effect Criteria	Definitions
	• **Regional** – Effects that alter or influence regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries (fairly widespread). • **National** – Effects that alter or influence nationally important resources, affect an area that is nationally important/protected or macro-economic consequences (widespread).
Cumulative	• **Cumulative** – Direct or indirect effects that could have a greater expression due to the proximity and timing of other activities in the Project Area. • **Synergistic** - Direct or indirect effects that could have a greater expression due to the additive or interactive nature of the effect in a particular place and within a particular time.

Notes:
(a) Effect criteria and definitions adapted from IISD (2016)

Based on that qualitative assessment and the application of professional judgment, each anticipated effect is assigned one of the intensity levels defined in Table 5-2.

Table 5-2. IPF Intensity Levels and Defining Characteristics

IPF Intensity Level	Example Characteristics
High	• Negative effect is irreversible or permanent. • Long-term negative effects (more than 10 years) that are widespread (i.e., regional or national). • Effects that negatively influence or alter nationally important resources. • Effects that change ambient conditions to cause (or reasonably may cause) death or injury with population level effects to non-protected species. • Changes to ambient conditions that may cause death or injury to a protected species and could influence overall species survival. • Cumulative or synergistic effects will occur, or may be reasonably expected to occur and have population level effects on protected species
Medium	• Medium-term effects (five to 10 years) that are geographically widespread (national or regional). • Direct or indirect effects that are temporary (reversible), with recovery over a longer period of time. • Water contamination or coastal pollution by toxic or slightly biodegradable products and/or hazardous substances.
Low	• Shorter-term effects (one to five years); effects that are local and reversible. • Level of water and coastal pollution detectable, but below thresholds known to have a negative effect on vegetation.
Very Low	• Short-term effects (less than one year), local and reversible. • Post-construction/operation levels (e.g., light, electromagnetic fields [EMF], vegetation cover) similar to background levels or pre-construction conditions. • Little to no change in the ecosystems and/or landscape; no permanent change to ecosystems or landscapes. • Waste effluents released into water at near-background concentrations. • No impact on protected species.
No/None	• Intensity is so immaterial that any resulting impact is scoped out of the impact assessment process.

Based on an assessment of the environment described in Section 4.0, the eelgrass and macroalgae resources are assigned a **sensitivity** "ranking" based on a qualitative assessment of the criteria presented in Table 5-3, whereby sensitivity is ranked as follows: Very Low, Low, Medium and High. The degree of sensitivity of the resource is, in part, based on the resource's resilience, its ability to naturally adapt to changes or recover from impact.

Table 5-3. Biological Resource Sensitivity Ranking

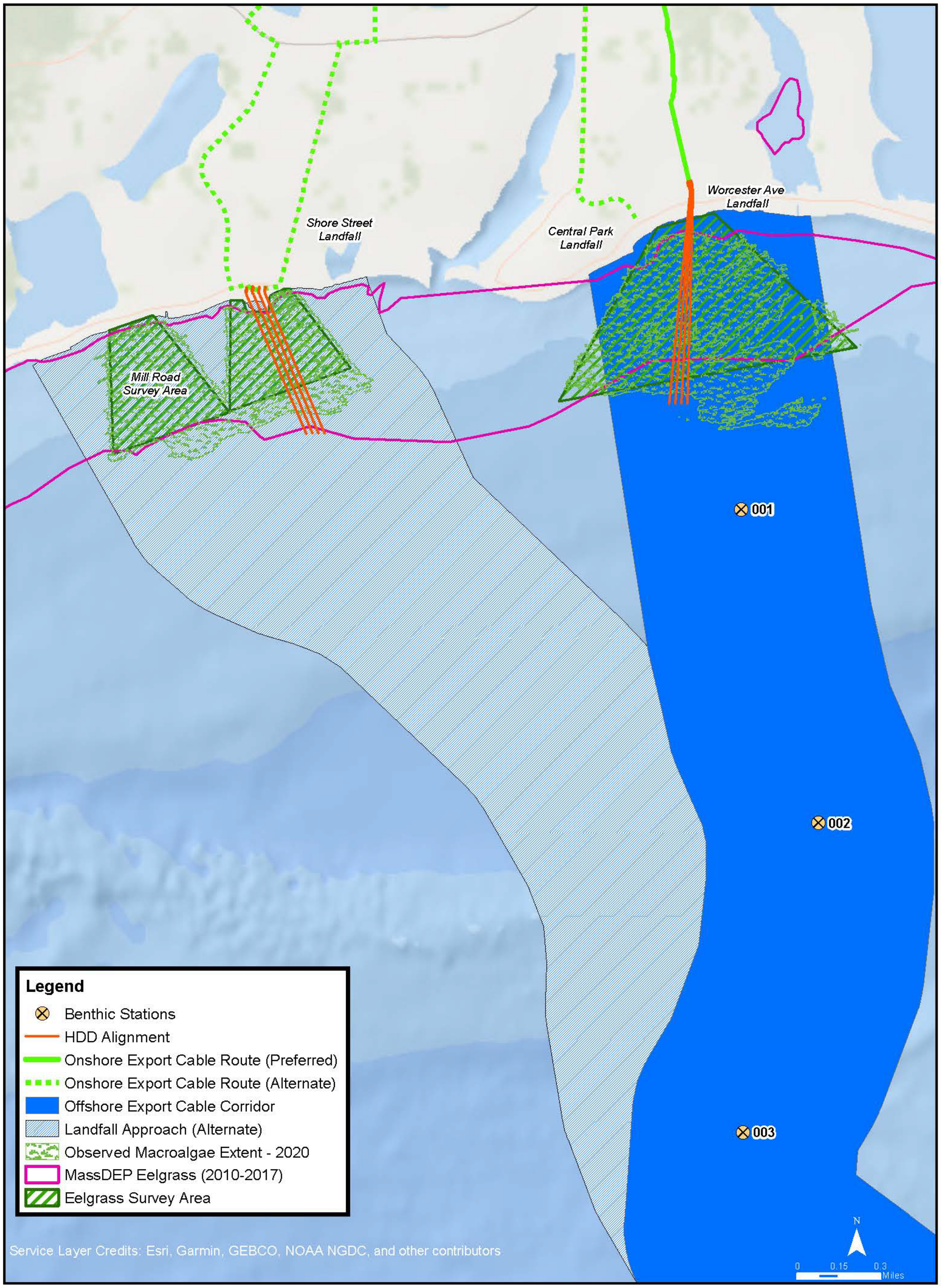
Ranking	Resource Characteristics
High	• Numerous sensitive or protected fauna and/or flora where a high level of biodiversity can be observed; or is a protected ecosystem of regional, state, or federal importance. • An already vulnerable resource with very little capacity and means to adapt to or tolerate the changed conditions.
Medium	• A few species of sensitive or protected fauna and/or flora or a sensitive ecosystem or a locally protected ecosystem or habitat. • A protected species or habitat with limited capacity and means to adapt to change and tolerate changed conditions. Adaptation may take time and/or may only be partial.
Low	• Very few individuals of sensitive or protected fauna and/or flora or is an ecosystem which is not protected at local, state, or federal levels. • A resource with some capacity and means to adapt to change and maintain/improve current conditions. Adaptation may take time and/or may only be partial.
Very Low	• No sensitive or protected fauna and/or flora or is an ecosystem that is not sensitive or that is already impacted. • A resource with the capacity and means to adapt to change and tolerate the changed conditions.

5.1.2 Potentially Affected Resources

For this assessment, the potentially affected resources are described in Section 4.3, and include green, red, and brown macroalgae throughout the extent of the Falmouth ECC in and north of Muskeget Channel. In addition, eelgrass is present in the northernmost section of the Falmouth ECC in the nearshore area. No eelgrass or macroalgae is present in the southern part of the Falmouth or Brayton Point ECC or in the Lease Area because water depths exceed those which support the growth of eelgrass and attached macroalgae. No eelgrass is presumed present in the northern portion of the Brayton Point ECC based on desktop assessment. Benthic surveys conducted include visual assessment of shallow areas and will be used to confirm this.

5.2 Identification and Characterization of Effects

The following sections describe the potential for effects associated with planned Project activities (construction, operations & maintenance [O&M] and decommissioning) for the HDD at landfall locations and the offshore export cables. The HDD design and the mapped eelgrass beds at the Falmouth landfall locations are provided in Figure 5-1.The IPF intensity is characterized under pre- and post-mitigation conditions in Table 5-4 for construction and operations and maintenance. Decommissioning IPFs are expected to be similar to those associated with construction where equipment removal and/or facility demolition is planned.



Source: MassDEP, 2020

Figure 5-1. Mapped Eelgrass and HDD Path for the Falmouth Landfall Locations

Potential effects on eelgrass and macroalgae are detailed in the sub-sections that follow, described by type of effect. As explained below, recolonization of nearshore eelgrass beds is uncertain and would take many years if open-cut trench excavation was used for cable installation in these areas; however planned HDD installation will greatly reduce impacts, limiting effects to incidental and unplanned disturbance. Thus, effects to the eelgrass resources in this area are considered to be negative, short-term and indirect. Along the Falmouth ECC, the majority of the substrates are expected to return to pre-Project conditions, and macroalgae is expected to recolonize.

5.2.7 Sea Bottom Disturbance

5.2.7.1 Construction and Decommissioning

Construction of the Project will result in the disturbance of the seafloor from seafloor preparation, export cable installation, scour protection installation, and vessel anchoring (including spuds). The installation of the cables will result in seafloor sediment being sidecast and backfilled, or temporarily disturbed and suspended if plowing or jet plowing installation methods are used. Burial of the export cables is necessary to protect the cables from anchors, storms, or other interferences that could damage the export cables. Macroalgae in the area of direct disturbance will be dug up and buried, and in the sidecast areas, macroalgae may be buried.

In the nearshore Falmouth area, sea-to-shore transition of cables at landfall will be made via HDD in order to avoid direct impacts to mapped SAV beds dominated by eelgrass to the extent possible. HDD will also be used in the nearshore of Aquidneck Island and Brayton Point despite the absence of SAV beds. Vessel anchoring and spudding is not planned to occur within eelgrass areas. Anchoring and spudding at the HDD exit may affect eelgrass if mapped beds cannot be avoided. These activities will temporarily resuspend soft sediments due to sediment remobilization. Eelgrass beds located near the Falmouth cable landfall location(s) may be affected by soft sediments settling on the blades/leaves suspended by anchoring or spudding.

Construction activities are expected to cause sediment suspension and deposition near the sea floor as well as direct disturbance (e.g., burial) of habitats within the limit of disturbance. Sediment plume analyses for the ECC (COP Appendix F1, Sediment Plume Impacts from Construction Activities) indicate that deposition of sediments is expected to be minor. Sediment deposition varies based on the installation method and region of the Project Area.

- In Muskeget Channel, the majority of accretion is less than 0.04 inches (approximately one millimeter) deep. Deposition of sediment deeper than 0.04 inches (approximately one millimeter) may occur 100 feet (30 m) in any direction from where the cables are installed. Eelgrass beds were not noted in Muskeget Channel, but potential accretion is provided for completeness. No eelgrass beds are anticipated to be present along the Brayton Point ECC in the Sakonnet River, Mount Hope Bay, Lee River or Taunton River
- The Falmouth HDD exit pit dredging may cause more impact on a spring tide (0.008 inches [0.2 millimeters] deep appr oximately 460 feet [140 m] from the pit) than a neap tide (no accretion expected up to 328 ft [100 m] from the pit).

Post-construction, the habitat suitability for eelgrass and macroalgae is expected to be similar to the pre-construction condition. Because of the potential for vegetative regrowth and/or recruitment from spores, macroalgae may recolonize the disturbed areas in the short-term. The HDD pit is planned for outside the eelgrass beds mapped in Falmouth. However, if eelgrass is inadvertently disturbed, re-establishment at the HDD exit pit may naturally occur; such re-establishment may occur over the long-term.

Recolonization of macroalgae in the complex habitat area of the Falmouth ECC (inclusive of the Muskeget Channel) and the shallow zones of the Brayton Point ECC is expected to occur. Effects on macroalgae within this area are characterized as short-term, indirect and direct, with an intensity level of **Low**.

No eelgrass beds were identified in the ECC offshore of the Falmouth landfall locations (Figure 4-4) and no eelgrass beds were identified in Muskeget Channel (COP Appendix M - Benthic and Shellfish Resources Characterization Report). The Project anticipates the use of HDD for the installation of the export cables beneath the shallower nearshore areas at landfall. The use of HDD is expected to substantially reduce the effects of sediment disturbance on any mapped eelgrass in the nearshore area. The presence of eelgrass beds will be considered in the evaluation of ECC options and landfall locations for the Falmouth and Brayton Point ECC. While eelgrass beds have been identified and mapped near the Falmouth landfall locations, none have been identified at Brayton Point landfall locations. Effects on eelgrass are characterized as negative, short-term, indirect and direct, with a **Medium** intensity level.

If the export cables are removed during decommissioning, the displacement effects would be similar to those for construction. It is also possible that the cables may be decommissioned in place, thus resulting in no further change to the seafloor.

5.2.7.2 Operations & Maintenance

Typical operation of the WTGs, inter-array cables, and associated export cables will not result in further sediment disturbance during normal operations, and there are no planned operation and maintenance procedures that would entail anchoring. However, if/when required, the repair or replacement of the inter-array cables or export cables would result in additional short-term temporary sediment disturbances, comparable with those expected during construction. These activities are expected to have negative, short-term, indirect and direct, effects on macroalgae due to displacement resulting from sediment disturbance. Minor, short-term, indirect effects on nearshore eelgrass at the landing locations may occur if repair or replacement of the cables proximal to the nearshore landing locations is needed, as this would resuspend soft sediments which could settle on eelgrass blades/leaves. Anchoring and spudding at the HDD exit may affect eelgrass if mapped beds cannot be avoided and would result in direct impacts to eelgrass. The intensity level is **None** for routine O&M to **Very Low** for potential repair or replacement of the export cables.

5.2.8 Changes to Ambient Light

5.2.8.1 Construction and Decommissioning

Seagrasses and macroalgae need light penetration through the water column and may be negatively affected by increased turbidity. Turbidity in the water column resulting from export cable installation is expected to be of short duration, localized, and temporary (i.e., reversible). The plume model (COP Appendix F1, Sediment Plume Impacts from Construction Activities), modeled turbidity (as total suspended solids [TSS]). The TSS is expected to drop below 10 milligrams per liter (mg/L) within an hour of installation activities along the Falmouth ECC and in less than a minute after installation activities at the HDD exit pit. TSS will drop below 1 mg/L within 10 minutes at the HDD exit pit, and within approximately two hours in the Falmouth ECC. TSS in the Brayton Point ECC and HDD pits will be modeled; no eelgrass is anticipated present along the Brayton Point ECC. Therefore, the intensity of this IPF on eelgrass and macroalgae is characterized as **Very Low**. It is anticipated that construction lighting will have no material effect on eelgrass and macroalgae due to its short duration and lack of interference with ambient daylight.

If the export cables are removed during decommissioning, the displacement effects would be similar to those for construction. It is also possible that the cables may be decommissioned in place, causing no change to ambient lighting. The intensity level is **Very Low** for effects from changes to ambient light during decommissioning.

5.2.8.2 Operations and Maintenance

No alteration of ambient lighting will occur with the operation of the export cables. Repair or replacement of the export cable, if required, would have effects similar to those described for construction and decommissioning. The intensity level is **Very Low** for potential repair or replacement of the export cables.

5.2.9 Displacement of Eelgrass and Macroalgae

5.2.9.1 Construction and Decommissioning

Physical displacement of macroalgae will occur during the construction of the export cables with the detachment and fragmenting of the macroalgae. Because of the potential for vegetative regrowth, fragments of macroalgae may be transported away from the immediate work area by currents and re-establish at a new location. Macroalgae spores may also be transported away from the area of disturbance and allowed to re-establish in other suitable habitats. Macroalgae may rapidly recolonize in disturbed areas.

The construction of the export cables and the location of the HDD exit are planned for outside the eelgrass mapped at the Falmouth cable landfall locations; however, eelgrass may be inadvertently affected. As discussed previously, no eelgrass beds are anticipated along the Brayton Point ECC or the landfall locations. HDD will be used for the Aquidneck Island and Brayton Point landfalls. The potential for large-scale re-establishment at a new location of rooted species fragments that may inadvertently be displaced during construction is unlikely since eelgrass can only propagate via rhizome extension from an extant bed, or from successful seed germination. Re-establishment of eelgrass may naturally occur over a much longer period but is less certain. Without mitigation, recolonization of eelgrass in the complex habitat area in the nearshore area is less certain and expected to occur over a longer period of time.

Therefore, effects within this area without mitigation are characterized as potentially permanent (for eelgrass), long-term, and direct with a **Medium** (for macroalgae) to **High** (for eelgrass) intensity level.

If the export cables are removed during decommissioning, the displacement effects would be similar to those for construction. It is also possible that the cables may be decommissioned in place, causing no displacement.

5.2.9.2 Operations & Maintenance

Operation of the WTGs, inter-array cables, and export cables will not result in displacement of eelgrass and macroalgae during normal operations. However, if/when required, the repair or replacement of the inter-array cables or export cables would result in additional displacement, comparable with those expected during construction. These activities are expected to have minor, short-term direct and indirect effects on macroalgae from displacement due to sediment disturbance. Minor short- to long-term, indirect effects will be associated with habitat disturbance during O&M and corresponding recovery time from the areas impacted. The intensity level is **None** for routine O&M to **Medium** (macroalgae) to **High** (eelgrass) for potential repair or replacement of the export cables.

5.2.10 Direct Injury or Death

5.2.10.1 Construction and Decommissioning

During construction, the installation of the export cables may result in direct mortality of macroalgae in the export cable footprint. Macroalgae recolonization is expected to be short-term due to the variety of reproductive routes, such as vegetative regrowth of surviving individuals and/or recruitment from spores, that characterize many macroalgae species (American Scientist, 2013). Effects are characterized as potentially semi-permanent, short-term, direct, and indirect. Therefore, the intensity of this IPF is **Low** (macroalgae) to **High** (eelgrass).

If the export cables are removed during decommissioning, the displacement effects would be similar to those for construction. It is also possible that the cables may be decommissioned in place, causing no direct injury or death.

5.2.10.2 Operations & Maintenance

Normal operations will not cause death or injury to macroalgae. In the case of repair or replacement of cables, effects similar to those described for construction and decommissioning would be expected. The intensity level is **None** for routine O&M to **Low** (macroalgae) to **High** (eelgrass) for potential repair or replacement of EC.

5.2.11 Electromagnetic Fields

5.2.11.1 Construction and Decommissioning

Construction and decommissioning of the Project is not expected to generate EMF that would affect macroalgae and eelgrass in the Offshore Project Area. Marine organisms, including macroalgae and eelgrass, currently receive continuous EMF exposures associated with natural EMF sources in the marine environment, and they may also receive transient, localized EMF exposures from existing telecommunications and electrical power transmission cables in the southern New England coastal area. Construction and decommissioning activities are not expected to elevate EMF significantly above existing conditions.

5.2.11.2 Operations & Maintenance

Operation of the submarine cables will generate EMF, although several elements of the Project design will contribute to the minimization and mitigation of EMF, as described in COP Appendix P1, Electric and Magnetic Field (EMF) Assessment for the Proposed Mayflower Wind Submarine Export Cables. EMF modeling conducted for the Project indicates that HDD installation in near-shore areas will reduce but not entirely eliminate EMF in the area of the eelgrass beds near the Falmouth landing locations. EMF in offshore areas beyond the eelgrass beds would be anticipated to be somewhat greater, with magnetic fields generated being greatest at the cable centerline and decreasing as distance from the centerline increases. Some research indicates that EMF may serve as a stressor on plant metabolism and may affect growth and reproduction (Vian, et. al. 2016; S. Cucurachi et. al., 2013). However, the COP Appendix P1 concludes that the effect intensity of the EMF associated with the submarine cables would be in the very low to low range. Therefore, although EMF may be present, and may have some minor effects on plant metabolism, it would not be expected that a noticeable reduction in presence or extent of distribution would occur. The modeled EMF is based on alternating current; Brayton Point export cables will be direct current which produces lower levels of EMF. Therefore, should eelgrass be found near the Brayton Point ECC, effects are expected to be minimal. The effect on macroalgae and eelgrass is expected to be indirect and long-term, at a **Very Low** intensity level.

5.2.12 Planned Discharges

5.2.12.1 Construction and Decommissioning

Vessels used during offshore construction activities may routinely release bilge water, engine cooling water, deck drainage and/or ballast water (COP Section 3.1.16). Such releases would quickly be dispersed and diluted and would cease when construction is complete. Due to expected dispersion and dilution, no negative effects of discharges to vegetation are expected.

Vessels and the construction activities offshore will comply with the regulatory requirements related to the prevention and control of discharges. Decommissioning-related discharges are expected to be comparable to those for construction. Discharges are expected to occur as allowed by law, and will be temporary, short-term, and highly localized.

The assigned intensity level for discharges during construction and decommissioning is **Very Low**.

5.2.12.2 Operations & Maintenance

Planned and unplanned discharges are expected to have minor, short-term effects on the submerged vegetation along the ECC during O&M. The assigned intensity level for discharges during O&M is **Very Low**.

5.2.13 Accidental Events

5.2.13.1 Construction and Decommissioning

Accidental events such as fuel spills or leaks from vessels (COP Section 3.3.16) could impact vegetation habitat. Vessels engaged in construction may 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. Vessels and the construction activities will comply with the regulatory requirements related to the prevention and control of discharges and the prevention and control of accidental spills as documented in the Project's Oil Spill Response Plan (OSRP) (COP Appendix AA). As with planned discharges, due to the expected dispersion and dilution of material released, and containment and clean up for larger releases, effects to vegetation are characterized as direct, temporary, and short-term. Therefore, the intensity of this IPF is categorized as **Very Low**.

5.2.13.2 Operations & Maintenance

Effects related to accidental events during O&M would be similar as addressed above. The intensity level associated with O&M activities is **Very Low**.

5.3 Potential Risks of Effects

Eelgrass beds have only been mapped near the shoreline at the Falmouth export cable landing locations. The plan is to position HDD exit pit(s) outside of the eelgrass beds and install the export cables below the nearshore area. However, if eelgrass is inadvertently affected by the HDD activities, effects would be long duration. The effects to macroalgae associated with construction, O&M, and decommissioning activities are anticipated to be short duration and limited to the immediate area of construction. Potential effects of the Project construction, O&M, and decommissioning were evaluated according to the methods described in the COP (COP Section 3.3). For installation of the export cables, construction will include seafloor preparation (e.g., removal of boulders or other buried hazards) and installation using methods appropriate to the conditions (e.g., vertical injector, jetting sled, pre-cut plow). The export cables may be retired in place or removed (COP Section 3.3). In the near-shore, HDD will be used for the sea-to-shore transition. At the HDD exit pit, a temporary structure such as a cofferdam may be required to facilitate construction.

5.3.1 Pre-Mitigation Potential Risk of Effect

Resource sensitivity combined with the projected intensity of IPFs help to identify the risk of potential effects (Table 5-3). The IPF intensity levels are expected to be very low (e.g., planned and accidental discharges) to high (e.g., seafloor disturbance). Resource sensitivity ranges from low (e.g., common species of macroalgae that can recolonize easily) to high (e.g., eelgrass that does not recolonize easily).

5.3.2 Mitigation and Residual Effects

Measures to mitigate potential effects were considered (Table 5-4) for each IPF identified. Such measures may fall into several categories including:

- Site selection – Avoidance, where possible, of construction activities in areas of sensitive seafloor and benthic habitat;
- Regulatory compliance – compliance with applicable federal, state and local regulations that will lessen the potential for effect. During the Clean Water Act (CWA) 404/401 and Chapter 91 permitting, minimization of effects on eelgrass will be included;
- Construction methods – where possible, selection of construction methods that are less impact-producing (such as the use of HDD for nearshore cable installation); and
- Control measures/Best Management Practices (BMPs) – measures that when employed, will lessen the potential for effects (such as minimization of trench and sidecasting widths for export cable installation and anchoring outside of eelgrass beds where possible).

As noted in Table 5-4, selection of construction methods that can minimize effects to eelgrass will be used where possible. The use of HDD to avoid areas of eelgrass that may be near landing locations is an option that may be deployed in the Project construction phase.

Table 5-4. Pre and Post-Mitigation Potential Risk of Impact

IPF	Related Activities	Key Intensity Criteria [a]	Pre-Mitigation Intensity Level [b,c]	Receptor Sensitivity Rank [c,d]	Mitigation Type	Post-Mitigation Intensity Level [e]
Sea bottom disturbance	EC installation, including vessel anchoring	Direct and Indirect Temporary Short-term Local	Low to Medium	Low (macroalgae) High (eelgrass)	Selection of lower-impact construction methods where possible, HDD for nearshore EC	Low
	Secondary protection placement for EC	Direct Temporary Short-term Local	Low to Medium	Low (macroalgae) High (eelgrass)	HDD for nearshore EC	Low
	Routine EC O&M	Direct and Indirect Temporary Short-term Local	None to Very low	Low (macroalgae) High (eelgrass)	Selection of low-impact measures where possible, and minimization of EC repair limits of work	Very low to None
Changes to ambient light	EC installation	Indirect Temporary Short-term Local	Very low	Low (macroalgae) High (eelgrass)	Measures to minimize sediment transport where possible	Very low
	Repair or replacement of EC	Indirect Temporary Short-term Local	Very low	Low (macroalgae) High (eelgrass)	Measures to minimize sediment transport where possible	Very low
Displacement of biological resources	EC installation	Direct Medium-term Local	Medium (macroalgae) to High (eelgrass)	Low (macroalgae) High (eelgrass)	Selection of lower-impact construction methods where possible, HDD for nearshore EC	Low
	Repair or replacement of EC	Direct and indirect Short-term to long-term Local	None (routine O&M) Medium (macroalgae) to High (eelgrass)	Low (macroalgae) High (eelgrass)	Selection of lower-impact maintenance methods where possible, HDD for nearshore EC	Low
Direct injury or death	EC installation	Direct Medium-term Local	Low (macro-algae) to High (eelgrass)	Low (macroalgae) High (eelgrass)	Selection of lower-impact construction methods where possible, HDD for nearshore EC	Low to medium

IPF	Related Activities	Key Intensity Criteria [a]	Pre-Mitigation Intensity Level [b,c]	Receptor Sensitivity Rank [c,d]	Mitigation Type	Post-Mitigation Intensity Level [e]
	Repair or replacement of EC	Direct Medium-term Local	None (routine O&M) Low (macro-algae) to High (eelgrass)	Low (macroalgae) High (eelgrass)	Selection of lower-impact construction methods where possible, HDD for nearshore EC	Low to medium
EMF	EC O&M	Indirect Long-term Local	Very low	Low (macroalgae and eelgrass)	Burial depth; design elements including conductor bundling and twisting	Very Low
Planned discharges	EC installation	Direct Temporary Short-term Local	Very low	Low (macroalgae) High (eelgrass)	Regulatory compliance Onboard best practices	Very low
	O&M vessels	Direct Temporary Short-term Local	Very low	Low (macroalgae) High (eelgrass)	Regulatory compliance Onboard best practices	Very low
Accidental events	EC installation	Direct Temporary Short-term Local	Very low	Low (macroalgae) High (eelgrass)	Regulatory compliance Onboard best practices OSRP implementation	Very Low to None
	O&M vessels	Direct Temporary Short-term Local	Very low	Low (macroalgae) High (eelgrass)	Regulatory compliance Onboard best practices OSRP implementation	Very Low to None

Notes:

Notes:

EC – export cable(s)

O&M – operations and maintenance

OSP – offshore substation platform

OSRP – oil spill response plan

(a) See Table 5-1

(b) Pre-Mitigation – IPF intensity level is characterized assuming no additional efforts to avoid, minimize and mitigate effects

(c) Potential effects on eelgrass anticipated to be applicable to only the Falmouth landing location(s).

(d) See Table 5-2

(e) Post-Mitigation – IPF intensity level represents residual level assuming implementation of mitigation measures including avoidance, minimizing, restoration, and offsetting.

6.0 Conclusions

The seagrass and macroalgae report provides an assessment of physical characteristics of the seafloor and presence of eelgrass and macroalgae along the ECC at the time of the eelgrass and benthic surveys. These data will be used to satisfy BOEM requirements for COP preparation.

The primary conclusions of this eelgrass and macroalgae habitat assessment are:

1. In the Falmouth ECC south of Muskeget Channel, no eelgrass or macroalgae was observed to be present in the benthic survey video images collected. Therefore, these areas were not included in the report.
2. The Falmouth ECC through and north of Muskeget Channel contains complex habitat including the presence of eelgrass in the nearshore area and the presence of macroalgae throughout. The primarily gravel or gravelly classification habitats are conducive to the presence of attached macroalgae.
3. Eelgrass beds are present at the export cable landing locations under consideration for Falmouth. The eelgrass beds extend between approximately 1,970 to 3,120 feet (600 to 950 meters) from shore. Although the eelgrass bed at the Worcester Avenue landing location and near the Central Park landing location extends slightly farther offshore than at the Shore Street site, the bed narrows as water depths increase further from shore. The eelgrass beds mapped provide valuable habitat for fish and other aquatic species, and it is possible that the eelgrass beds extend between the three sites and may be interconnected.
4. There are no current mapped SAV beds along the Brayton Point ECC. It is anticipated that the macroalgae is present along the Brayton Point ECC where water depth permits growth.
5. Effects associated with the construction, O&M, and decommissioning are characterized as follows:
    a. Effects to macroalgae along the Falmouth ECC and Brayton Point ECC are expected to be low, localized, and short-term. Macroalgae has the ability to recolonize naturally in a relatively short timeframe.
    b. Effects to eelgrass at the Falmouth landing locations could be high and medium-term. Mayflower Wind anticipates the use of HDD for the nearshore approach of the export cables to the onshore landing locations. Based on current plans, it appears that the construction of the ECC in the area of the eelgrass beds in Falmouth would be avoided as this portion of the export cable installation is anticipated to occur via HDD. Mayflower Wind expects to select final mitigation measures based on the final landfall locations selected and in consultation with regulators during the Chapter 91 and 404/401 permitting processes.
    c. The substrates are expected to return to pre-construction conditions, and recolonization of macroalgae is expected to readily occur. Recolonization of eelgrass may occur naturally over a longer period of time or can be enhanced with supplemental replanting.

7.0 References

AECOM. 2020a. Benthic Infaunal and Seafloor Habitat Study Quality Assurance Project Plan. May 1, 2020 and subsequent revisions

AECOM. 2020b. Mayflower Wind Benthic Infaunal and Seafloor Habitat Field Study Plan – Spring 2020.

AECOM. 2020c. Mayflower Wind Benthic Infaunal and Seafloor Habitat Field Study Plan – Summer 2020.

American Scientist., 2013. *The Science of Seaweeds*. Volume 101, No. 6. Page 458.

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

BOEM. 2020a. Information Guidelines for a Renewable Energy Construction and Operation Plan (COP).

BOEM. 2020b. Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585.

Cucurachi, S.; W.L.M Tamis, M.G. Vijver, W.J.G.M Peijnenburg, J.F.B. Bolte, and G.R de Snoo, 2013. A review of the ecological effects of radiofrequecy electromagnetic fields (RF-EMF). Environmental International 51(2013) 116-140.

CR Environmental, Inc. (CR). 2020. Eelgrass Survey Report, Proposed Mayflower Wind Landing Sites, Vineyard Sound, Falmouth, MA.

Fugro. 2021. Brayton Point Benthic Survey Summer 2021 – Survey Overview Draft. Figures.

Integral Consulting, Inc. (Integral). 2020a. Sediment Profile and Plan View Imaging Survey of the Mayflower Wind Project Areas. May 15-25, 2020.

Integral. 2020b. Sediment Profile and Plan View Imaging Survey of the Mayflower Wind Project Areas. August 22 – September 1, 2020.

Integral. 2020c. Sediment Profile and Plan View Imaging Survey of the Mayflower Wind Project Areas. November 10 – 28, 2020

International Institute for Sustainable Development (IISD). 2016. Environmental Impact Assessment Training Manual. International Institute for Sustainable Development, Manitoba, Canada. https://www.iisd.org/learning/eia/wp-content/uploads/2016/06/EIA-Manual.pdf

Leschen, Alison S; Ford, Kathryn H, and Evans, N. Tay. January, 2010. Successful Eelgrass (*Zostera marina*) Restoration in a Formerly Eutrophic Estuary (Boston Harbor) Supports the Use of a Multifaceted Watershed Approach to Mitigating Eelgrass Loss. *Estuaries and Coasts.*

Massachusetts Department of Environmental Projection (MassDEP), 2020. Eelgrass Mapping Project. Available online at: https://www.mass.gov/info-details/massgis-data-massdep-eelgrass-mapping-project#overview-Last accessed on September 4, 2020.

National Marine Fisheries Service (NMFS), 2020. Recommendations for Mapping Fish Habitat. National Oceanic and Atmospheric Administration, National Marine Fisheries Service GARFO Habitat Conservation and Ecosystem Services Division. January 2020.

NMFS. 2021. Recommendations for Mapping Fish Habitat. National Oceanic and Atmospheric Administration, National Marine Fisheries Service GARFO Habitat Conservation and Ecosystem Services Division. March 2021.

Rhode Island Geographic Information System (RIGIS). 2016. 2016 Rhode Island Eelgrass Mapping Taskforce Orthophotography. https://www.rigis.org/pages/2016-eelgrass-imagery. Last accessed June 30, 2021.

Via, Alain; E. Davies, M. Gendraud, and P. Bonnet, 2016. Plant Responses to High Frequency Electromagnetic Fields. Biomed Research International. February 14, 2016.

ATTACHMENT 1. *Eelgrass Survey Report, Proposed Mayflower Wind Landing Sites*, Vineyard Sound, Falmouth, MA. CR Environmental, Inc., 2020

EELGRASS SURVEY REPORT
Proposed Mayflower Wind Landing Sites
Vineyard Sound, Falmouth, MA

Eelgrass distribution based on single beam analysis at the proposed Worcester Avenue Landfall

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INTRODUCTION

Over the period from August 6 to August 24, 2020 CR Environmental, Inc. (CR) conducted a submerged aquatic vegetation (eelgrass, *Zostera marina*) survey for AECOM at three potential Mayflower Wind cable landfall sites off Shore Street, Mill Road, and Worcester Avenue in Falmouth, MA. The surveys consisted of a combination of single beam echo sounding with precision navigation, side scan sonar and towed underwater video. This approach provided multiple lines of evidence to accurately map the eelgrass distribution for the three Falmouth landfall approaches.

2.0 METHODS

2.1 <u>Vessel and Navigation</u>

Vessel operations were performed from CR's 25-foot custom aluminum survey boat, *Cyprinodon*, with a large enclosed pilothouse, benches for survey equipment, over-the-side transducer boom, and 110 and 12 volt power supplies.

Navigation for the surveys was accomplished using a Hemisphere VS330 Real-time Kinematic Global Positioning System (RTK GPS). The horizontal accuracy of the navigation system is approximately 1.0 centimeter horizontally and 2 centimeters vertically (Root Mean Squared 1-sigma). Horizontal accuracy in differential or float mode is approximately 1 foot. RTK corrections were provided via NTRIP internet connection by KeyNet GPS, Inc.

The RTK GPS was serially interfaced to a shipboard computer running HYPACK 2015 hydrographic surveying software. During the survey, this system calculated X and Y positions in the desired grid system (MA State Plane, NAD83, US Foot), recorded the depth and navigation data, and provided a steering display for the vessel captain. HYPACK also depicted the progress of the survey using georeferenced imagery (e.g. orthophotos) as background files, ensuring that the entire survey area was adequately insonified.

2.2 Survey Methods

Designated survey boundaries were provided by AECOM, however, during survey operation, it was observed that eelgrass coverage extended seaward of the Mill Road, Shore Street and Worcester Avenue site boundaries. A subset of the bathymetric survey cross lines were extended further offshore until eelgrass was no longer detected, and the survey design at each site modified to incorporate the additional area of eelgrass coverage.

2.2.1 Bathymetric Survey Methods

2.2.1.1 Bathymetric data acquisition

Soundings were acquired using a Teledyne Odom Hydrographic Echotrac CV-100 single (vertical) beam echo sounder (VBES) equipped with an 8-degree 200-kHz transducer. Shore parallel tracklines with 10 foot line spacing and a series of perpendicular cross ties with 100 foot line spacing were occupied at the landfall approaches over an eleven day survey period.

System accuracy and the measured transducer draft were checked at the start and end of each day by comparing echo sounder water depth measurements to known water depths obtained using the "bar check" method in which a metal plate is lowered beneath the echo sounder's transducer to a measured distance (10 feet) below the water's surface. Additional calibrations were conducted *in situ* by collecting water column profiles of sound velocity using a YSI Castaway sound velocimeter.

2.2.1.2 Bathymetric data processing

Processing of the single beam echo sounder data consisted of the removal of outlying data points associated with water column interference (e.g., fish, debris). Data cleaning was guided by detailed inspection of profile echograms for each line file. Portions of data files without signatures associated with submerged aquatic vegetation (SAV) were deleted, yielding a database indicating SAV presence. These SAV points were plotted in GIS and used to digitize a shapefile depicting the distribution of SAV.

2.2.2 Side Scan Sonar Methods

2.2.2.1 Side scan sonar data acquisition

Full bottom coverage of the survey areas was collected using an Edgetech, Inc. Model 4125 400/900 kHz. The side scan sonar and bathymetric data were collected simultaneously over a four day period using 60 to 80 foot line spacing depending on water depth. Side scan cable out was recorded, and the layback offset from the side scan sonar towfish to the GPS antennae was used to adjust towfish positioning during processing. Data were collected using a 25 meter per channel swath width and recorded in JSF format using Edgetech's Discover software interfaced to the RTK GPS.

2.2.2.2 Side scan sonar processing

Processing of side scan data included removal of the water column portion of the records and correction for signal loss with distance using Time Varied Gain (TVG) adjustments. Data for each swath file were exported as georeferenced TIF files and imported to GIS. The 400-kHz data were organized and merged into GeoTIF mosaics using ESRI ArcGIS and Chesapeake Technologies SonarWiz software. The 400-kHz mosaics were selected for presentation because they more clearly depict sediment textural differences, the presence of SAV (eelgrass), and were less impacted by sea states than the 900-kHz signal..

2.2.3 Underwater Video Methods

2.2.3.1 Underwater video data acquisition

Side scan sonar mosaics were imported into HYPACK survey software as background files and used to guide the underwater video surveys at the landfall sites. A one day underwater video sled survey was performed at each landfall site to confirm (i.e. ground truth) the estimated eelgrass distribution derived from the echo sounder and side scan sonar data, and provide photographic documentation of eelgrass density and plant health. Fifteen video transects were occupied at the Mill Road landfall site, 16 at Shore Street, and 10 at the Worcester Avenue landfall site. Transect length varied from approximately 1,000 to 2,000 feet at Mill Road, 700 to 2,200 feet at Shore Street, and 1,700 to 6,500 feet at the Worcester Avenue landfall site.

Underwater video data were collected with CR's portable towed video sled consisting of a lightweight aluminum frame, Outland Technologies' high-resolution low light color camera, and two wide-angle LED video lights with variable output control. The video camera was cabled to an OTI-960 DVR recorder and high resolution daylight monitor at the surface. The video sled cable out was recorded, and the layback offset from the sled to the GPS antennae was entered into the HYPACK survey software. The sled was raised and lowered using a stern mounted davit and lobster pot hauler, and the height of the system off the bottom was continuously adjusted to achieve the best bottom coverage and video quality. When the video camera was one foot off the bottom, the viewing area of the camera was approximately 1.5 feet x 1.5 feet (18 inches x 18 inches), and the video quality was optimal for characterizing eelgrass densities, bottom sediment descriptions, and identifying biota.

2.2.3.2 Underwater video data processing

The underwater video data for the three landfall sites were reviewed by a marine biologist and field geologist at the CR office, and the presence or absence of eelgrass, the bottom substrate and observed biota were noted. Eight representative underwater video screen captures were taken along each of the video transects. Time along transect was used to identify the screen capture positions along transects.

3.0 RESULTS

3.1 <u>Single Beam Acoustic and Side Scan Sonar Submerged Aquatic Vegetation Mapping Results</u>

The bathymetric and side scan sonar survey track lines for the Mayflower Wind eelgrass survey at Mill Road and Shore Street (Figure 1), and Worcester Avenue (Figure 2) landfall approaches illustrate the extent of survey coverage.

3.1.1 Side Scan Sonar Results

Side scan sonar data for the landfall approaches are presented as gray shaded images (Figures 3 and 4). The shade of gray corresponds to the strength of the returning signal and can be used to infer bottom type (sediment texture) and to identify submerged aquatic vegetation (e.g. eelgrass), underwater structures or debris. A key to sonar shading is provided below.

Key to Side-scan Sonar Image Shading

Sonar shadow------------ Weak Signal Return-------------------------Strong Signal Return

In general, weak signal returns correspond to smooth substrates (e.g., fine sediments with little microtopography), soft materials that absorb the signal, or seabed sloping away from the signal source (towfish). These features appear lighter gray in sonar imagery. Strong signal returns correspond to rough substrates (e.g., gravel, cobble), highly reflective materials, or to a seabed sloping towards the signal source. These features appear as dark gray to black in the sonar imagery.

Features that rise above the seabed (e.g., boulders, pilings) reflect more of the sonar energy than the surrounding substrate resulting in strong signal returns due to the decreased angle of incidence. These features often prevent insonification of the area opposite the signal source, resulting in a sonar “shadow” (white imagery). The length of these shadows may be used to estimate the approximate height of the feature above the seabed.

Eelgrass appears on the side scan mosaics for the Mill Road, Shore Street and Worcester Avenue landfall approaches as a distinctive rough irregular feature, while open areas of sand appear smooth and white, and areas of gravel bottom as smooth and light gray (Figures 3 and 4). The Mill Road mosaic also showed areas of exposed cables and possible wreckage or debris (Figure 3).

The side scan sonar data provided an estimated eelgrass boundary that was fine-tuned using the georeferenced single beam acoustic data and ground-truthed using the underwater video.

3.1.2 Single Beam Acoustic Results

Distinct acoustic signatures indicating dense stands of submerged aquatic vegetation (SAV) rising above the seabed were observed on the single beam track line echograms (Figure 5) and allowed the creation of SAV distribution maps for the three landfall approaches (Figures 6 and 7).

The approach to the Mill Road and Shore Street landfalls had nearly continuous SAV coverage with only a few areas of open bottom. SAV coverage on the western side of the Mill Road landfall approach did not extend as far offshore compared to the eastern side of the Mill Road landfall approach or the Shore Street landfall approach (Figure 6).

The Worcester Avenue approach had a patchier SAV distribution with several large areas devoid of SAV. However, due to the shallower water depths, SAV at Worcester Avenue extends farther offshore than at the Mill Road or Shore Street sites.

The maximum water depth observed for SAV growth at the three sites was estimated to be approximately 16.8 to 17.8 feet above mean lower low water (MLLW) or about 18 to 19 feet NAVD88. At the Mill Road and Shore Street landfall approaches the eelgrass distribution is limited by depth. At the Worcester Avenue approach water depth as well as the presence of wide areas of mobile sands visible on the side scan record (Figure 4) and slipper limpet reef offshore appear to be limiting eelgrass growth.

A shape file in ArcGIS of the SAV boundary is provided as a final deliverable.

3.1.3 Underwater Video Eelgrass Ground Truth Results

Underwater video screen captures are provided on plates for Mill Road video transects (MR-1 to MR-15), Shore Street transects (SS-2 to SS-18), and Worcester Avenue transects (WA-2 to WA-12) over the landfall approaches. The positions of the video screen captures (A-H) along transects for Mill Road, Shore Street, and Worcester Avenue landfall approaches are plotted on

Figures 8, 9, and 10, respectively. The coordinates and an estimate of relative eelgrass density are reported for the screen captures (Tables 1-3). A few screen capture coordinates at the beginning of video tracklines are missing because the start of the video file preceded the start of the HYPACK file and GPS stream. Eelgrass density ranges were sparse (1-10 plants), moderate (11-25 plants) and dense (>25 plants).

The underwater video data confirmed that the SAV mapped by the single beam echosounder throughout the survey area was primarily eelgrass (*Zostera marina*) with the exception of mixed stands of wire weed (*Sargassum filipendula*) and eelgrass along the shoreline and a few of the offshore transects. Areas of wire weed and dead man's fingers (*Codium fragile*) were most abundant near the nutrient rich outflows of two coastal ponds, Oyster Pond at the Mill Road site and Green Pond at the Worcester Avenue site. The eelgrass and macroalgae in these areas were covered with epiphytic algae and bryozoans.

The underwater video data agreed well with the side scan sonar and single beam data. Areas of open bottom and stands of eelgrass observed during the video sled survey were coincident with the side scan sonar record used as a background file during the survey.

At the Mill Road and Shore Street landfall approaches there were small patches of open bottom and sparse eelgrass but along most of transects the eelgrass density ranged from moderate to dense. No eelgrass was observed at the most offshore transect (MR-12 and MR-13; SS-15 and SS-16).

At the Worcester Avenue site eelgrass abundance was less dense with more observations of sparse or no eelgrass. A few observations of sparse to moderate eelgrass were observed at the two offshore transects (WA-2 and WA-11).

All three landfall approaches have strong currents and good water column visibility. Plant heights ranged from 0.5 feet to greater than 2 feet and appeared to be in good health.

The surficial bottom substrate at the Mill Road approach ranged from gravel to sandy gravel (MR-1 through MR-9) with sparse patches of fine sand. The bottom substrate of the most offshore transect, MR-13, had small patches of slipper limpets and broken shell.

The bottom substrate at the Shore Street approach was predominantly gravel close to shore and transitioned to gravelly sand. Portions of transects SS-3 and SS-6 had medium sand areas with small bidirectional ripples. Gravelly sand to sandy gravel was the dominant substrate until transect SS-13. Patches of slipper limpets and shell appear periodically among the gravel and sand substrate with increasing water depth.

Worcester Court near shore substrates consisted of mostly sandy gravel with large patches of medium sand, and transitioned to slightly gravelly sand through the middle of the approach. The substrate offshore was mostly sandy gravel with large patches of slipper limpets and shell.

Marine fauna and flora observed at the Mill Road, Shore Street, and Worcester Avenue landfall approaches included a total of nine invertebrate, six fish, and four macro algal species in addition to the eelgrass (Table 4). Dominant invertebrates included slipper limpets, bushy bryozoans, knobbed whelks, and horseshoe crabs. Only two bay scallops were observed during the survey Wire weed, dead man’s fingers, and several species of branching red algae were observed at all three sites.

TABLES

TABLE 1
MILL ROAD LANDFALL APPROACH
UNDERWATER VIDEO SCREEN CAPTURE POSITIONS

Transect Name	Screen Capture[1]	Eelgrass Density[2]	Time	X	Y
MR-1	A	M	7:37:48	895578.9	2658785
MR-1	B	N	7:40:00	895703	2658821
MR-1	C	M	7:45:37	896017.2	2658941
MR-1	D	M	7:46:19	896060.8	2658959
MR-1	E	S	7:48:59	896223.8	2659022
MR-1	F	D	7:50:31	896347.7	2659049
MR-1	G	D	7:50:55	896378.6	2659054
MR-1	H	M	7:51:09	896399.6	2659057
MR-2	A	M	7:57:54	895734.2	2658634
MR-2	B	S	7:58:12	895752.8	2658635
MR-2	C	D	8:01:20	895957.3	2658719
MR-2	D	D	8:02:44	896066.4	2658754
MR-2	E	S	8:03:06	896103.1	2658773
MR-2	F	M	8:04:20	896231.9	2658797
MR-2	G	D	8:05:58	896384.1	2658855
MR-2	H	M	8:07:09	896466	2658911
MR-3	A	D	8:16:19	895750.2	2658418
MR-3	B	S	8:19:50	895979.1	2658517
MR-3	C	M	8:20:26	896014.7	2658527
MR-3	D	S	8:22:12	896143.7	2658562
MR-3	E	M	8:23:16	896212.3	2658611
MR-3	F	D	8:25:10	896348.1	2658657
MR-3	G	D	8:25:00	896333.5	2658653
MR-3	H	N	8:29:51	not available	
MR-4	A	D	8:42:37	895742	2658206
MR-4	B	S	8:42:56	895769.2	2658221
MR-4	C	D	8:46:17	896039.6	2658312
MR-4	D	M	8:47:11	896112.4	2658342
MR-4	E	M	8:48:50	896244.3	2658389
MR-4	F	M	8:49:22	896280.7	2658405
MR-4	G	D	8:50:49	896386.6	2658435
MR-4	H	D	8:54:49	896659.4	2658541
MR-5	A	D	9:04:51	895631.1	2657963
MR-5	B	M	9:09:00	895989.2	2658072
MR-5	C	D	9:11:31	896185.5	2658153
MR-5	D	M	9:11:56	896222.4	2658163
MR-5	E	M	9:14:31	896448.9	2658250
MR-5	F	S	9:15:03	896486.8	2658262
MR-5	G	D	9:15:54	896548.8	2658302
MR-5	H	S	9:18:42	896780.4	2658382
MR-6	A	M	9:31:06	895870.7	2657826
MR-6	B	D	9:32:26	896016	2657877
MR-6	C	S	9:35:09	896189.4	2657962
MR-6	D	D	9:36:09	896238.1	2657967

TABLE 1
MILL ROAD LANDFALL APPROACH
UNDERWATER VIDEO SCREEN CAPTURE POSITIONS

Transect Name	Screen Capture[1]	Eelgrass Density[2]	Time	X	Y
MR-6	E	M	9:38:37	896421.5	2658018
MR-6	F	D	9:40:52	896599.6	2658084
MR-6	G	M	9:43:02	896805.3	2658185
MR-6	H	D	9:46:52	897091.5	2658274
MR-7	A	D	9:56:16	895891	2657601
MR-7	B	D	9:59:41	896214.6	2657724
MR-7	C	M	10:00:10	896255.9	2657739
MR-7	D	D	10:00:48	896320.8	2657776
MR-7	E	M	10:04:15	896621.4	2657908
MR-7	F	M	10:06:02	896775.8	2657977
MR-7	G	M	10:09:06	897034	2658068
MR-7	H	D	10:10:29	897166.1	2658116
MR-8	A	D	10:29:17	896538.3	2657664
MR-8	B	D	10:29:30	896559.7	2657671
MR-8	C	D	10:30:00	896604.5	2657685
MR-8	D	M	10:30:40	896665.3	2657710
MR-8	E	S	10:31:51	896771.1	2657753
MR-8	F	S	10:32:44	896866.8	2657780
MR-8	G	D	10:33:13	896911.7	2657794
MR-8	H	S	10:37:02	897287.1	2657938
MR-9	A	S	10:51:31	not available	
MR-9	B	S	10:53:19	895898.4	2657208
MR-9	C	M	10:54:20	896007.2	2657246
MR-9	D	S	10:57:14	896349	2657368
MR-9	E	M	10:58:29	896497.9	2657426
MR-9	F	M	10:59:40	896632.1	2657484
MR-9	G	S	11:00:33	896744.1	2657523
MR-9	H	D	11:01:26	896846.4	2657561
MR-10	A	N	11:20:00	896251.4	2657114
MR-10	B	N	11:21:38	896479.6	2657205
MR-10	C	M	11:24:31	896869.6	2657356
MR-10	D	M	11:25:48	897047.4	2657422
MR-10	E	M	11:28:06	897359.5	2657540
MR-10	F	D	11:28:42	897441.9	2657572
MR-10	G	S	11:29:00	897478.1	2657588
MR-10	H	M	11:29:09	897498.4	2657597
MR-11	A	N	11:38:56	896631.7	2657067
MR-11	B	N	11:39:01	896645.8	2657073
MR-11	C	D	11:39:19	896696.5	2657084
MR-11	D	S	11:41:24	896983.3	2657184
MR-11	E	S	11:43:30	897275.9	2657299
MR-11	F	N	11:45:09	897500.8	2657381
MR-11	G	N	11:45:53	897605.7	2657417
MR-11	H	N	11:46:41	897717.4	2657463

TABLE 1
MILL ROAD LANDFALL APPROACH
UNDERWATER VIDEO SCREEN CAPTURE POSITIONS

Transect Name	Screen Capture[1]	Eelgrass Density[2]	Time	X	Y
MR-12	A	N	11:58:00	896605.7	2656941
MR-12	B	N	11:58:12	896635.6	2656955
MR-12	C	N	11:59:22	896805.4	2657020
MR-12	D	N	11:59:48	896864	2657044
MR-12	E	N	12:01:16	897075.5	2657116
MR-12	F	N	12:03:01	897331.7	2657220
MR-12	G	N	12:03:31	897405.1	2657253
MR-12	H	N	12:04:10	897506.2	2657288
MR-13	A	N	12:13:54	896555.6	2656822
MR-13	B	N	12:16:38	896991.3	2656983
MR-13	C	N	12:16:52	897024.8	2656996
MR-13	D	N	12:17:25	897115.1	2657032
MR-13	E	N	12:18:26	897285.6	2657100
MR-14	A	N	12:32:45	895934.6	2657103
MR-14	B	N	12:33:05	895984.2	2657119
MR-14	C	N	12:33:24	896028.8	2657137
MR-14	D	S	12:37:20	896600.5	2657354
MR-14	E	M	12:38:42	896776.2	2657425
MR-14	F	S	12:39:47	896921.9	2657479
MR-14	G	M	12:44:57	897556.7	2657718
MR-14	H	M	12:44:49	897540	2657712
MR-15	A	S	12:54:05	896391.6	2657080
MR-15	B	S	12:55:52	896689.7	2657181
MR-15	C	M	12:56:30	896789.6	2657221
MR-15	D	M	12:58:09	897049	2657327
MR-15	E	S	12:59:46	897299.9	2657423
MR-15	F	S	13:01:26	897573	2657522
MR-15	G	M	13:01:46	897623.5	2657540
MR-15	H	S	13:02:19	897712.9	2657576

Notes:

1 For screen captures see Plates MR 1-MR-15
2 (S) sparse = 1-10 plants; (M) moderate = 11-25 plants and (D) dense = >25 plants
N= not present

TABLE 2
SHORE STREET LANDFALL APPROACH
UNDERWATER VIDEO SCREEN CAPTURE POSITIONS

Transect Name	Screen Capture[1]	Eelgrass Density[2]	Time	X	Y
SS-2	A	N	7:29:10	not available	
SS-2	B	S	7:29:15	not available	
SS-2	C	S	7:29:51	897332.8	2659232
SS-2	D	S	7:29:53	897335.7	2659232
SS-2	E	M	7:30:04	897344	2659235
SS-2	F	M	7:32:29	897391.5	2659172
SS-2	G	M	7:32:25	897388.8	2659176
SS-3	A	N	7:41:16	897590.9	2659332
SS-3	B	N	7:41:19	897588.6	2659332
SS-3	C	N	7:42:08	897534	2659313
SS-3	D	N	7:42:19	897513.1	2659312
SS-3	E	N	7:42:34	897484.7	2659312
SS-3	F	N	7:42:39	897475.8	2659309
SS-4	A	N	7:49:19	897820.6	2659202
SS-4	B	N	7:49:55	897771.7	2659197
SS-4	C	D	7:50:46	897682.6	2659170
SS-4	D	M	7:51:46	897638.3	2659137
SS-4	E	D	7:52:21	897578.2	2659111
SS-4	F	D	7:52:52	897516	2659103
SS-4	G	S	7:52:59	897504.1	2659099
SS-4	H	M	7:53:47	897432.6	2659035
SS-6	A	N	8:03:39	898583.3	2659501
SS-6	B	N	8:06:10	898342.3	2659422
SS-6	C	S	8:06:03	898356.8	2659425
SS-6	D	S	8:06:21	898319.5	2659420
SS-6	E	M	8:06:52	898261.7	2659395
SS-6	F	N	8:07:14	898217.8	2659381
SS-6	G	N	8:09:02	898080.4	2659308
SS-6	H	M	8:09:39	898051.8	2659296
SS-7	A	M	8:21:25	898595.5	2659278
SS-7	B	N	8:21:30	898592.1	2659271
SS-7	C	M	8:23:10	898373.3	2659222
SS-7	D	N	8:23:38	898308.8	2659201
SS-7	E	N	8:24:34	898214.8	2659154
SS-7	F	D	8:24:48	898196.5	2659135
SS-7	G	D	8:26:28	898007	2659096
SS-7	H	D	8:31:45	897386.5	2658833
SS-8	A	D	8:40:17	898765	2659136
SS-8	B	D	8:42:30	898540.6	2659064
SS-8	C	M	8:43:33	898417.9	2659011
SS-8	D	N	8:44:02	898368.1	2659005
SS-8	E	S	8:46:08	898158.2	2658917
SS-8	F	S	8:50:49	897825	2658784
SS-8	G	D	8:51:03	897800.9	2658774

TABLE 2
SHORE STREET LANDFALL APPROACH
UNDERWATER VIDEO SCREEN CAPTURE POSITIONS

Transect Name	Screen Capture[1]	Eelgrass Density[2]	Time	X	Y
SS-8	H	D	8:52:57	897672.9	2658726
SS-9	A	S	9:12:05	898791	2658906
SS-9	B	D	9:13:22	898676.7	2658898
SS-9	C	M	9:16:27	898419.9	2658834
SS-9	D	S	9:18:15	898255.4	2658733
SS-9	E	D	9:20:58	898012.3	2658656
SS-9	F	D	9:23:07	897752.6	2658541
SS-9	G	M	9:23:14	897742.5	2658531
SS-9	H	D	9:23:16	897739.3	2658528
SS-10	A	D	9:35:00	not available	
SS-10	B	S	9:36:38	898904.4	2658776
SS-10	C	M	9:38:31	898711.3	2658685
SS-10	D	S	9:39:41	898584	2658645
SS-10	E	M	9:42:50	898314.8	2658547
SS-10	F	M	9:46:03	898074.3	2658459
SS-10	G	D	9:48:31	897852.8	2658382
SS-10	H	D	9:52:48	897375.1	2658188
SS-11	A	S	10:04:04	899126	2658632
SS-11	B	S	10:05:05	899012.3	2658589
SS-11	C	S	10:06:50	898833.9	2658521
SS-11	D	M	10:08:29	898660.8	2658482
SS-11	E	M	10:13:06	898228	2658298
SS-11	F	M	10:15:32	897983	2658226
SS-11	G	D	10:15:58	897931.5	2658199
SS-11	H	M	10:21:58	897325.9	2657958
SS-12	A	M	10:33:19	899270	2658425
SS-12	B	S	10:35:16	899231.3	2658483
SS-12	C	M	10:36:37	899071.8	2658413
SS-12	D	S	10:38:25	898905.9	2658365
SS-12	E	S	10:40:49	898694.8	2658270
SS-12	F	S	10:42:23	898632	2658250
SS-12	G	M	10:43:46	898589.3	2658179
SS-12	H	S	10:51:09	897943.9	2657965
SS-13	A	S	11:05:51	899370.5	2658290
SS-13	B	N	11:09:54	899071	2658203
SS-13	C	N	11:11:17	898942.4	2658148
SS-13	D	S	11:12:50	898802.9	2658089
SS-13	E	S	11:13:08	898776.9	2658081
SS-13	F	M	11:18:56	898438.9	2657972
SS-13	G	M	11:21:23	898260.6	2657884
SS-13	H	S	11:27:41	897784.6	2657742
SS-14	A	N	11:38:58	not available	
SS-14	B	N	11:41:25	899236.6	2658045
SS-14	C	S	11:43:26	899083.8	2657998
SS-14	D	M	11:47:00	898799.2	2657896

TABLE 2
SHORE STREET LANDFALL APPROACH
UNDERWATER VIDEO SCREEN CAPTURE POSITIONS

Transect Name	Screen Capture[1]	Eelgrass Density[2]	Time	X	Y
SS-14	E	N	11:53:37	898293.2	2657698
SS-14	F	N	11:57:06	898072.2	2657604
SS-14	G	N	11:57:19	898058.1	2657598
SS-14	H	N	11:59:00	897918.4	2657562
SS-15	A	N	12:05:41	899100.4	2657860
SS-15	B	S	12:06:39	899060.2	2657870
SS-15	C	S	12:10:39	898875.7	2657806
SS-15	D	N	12:17:19	898356.7	2657607
SS-15	E	N	12:20:30	898161.7	2657531
SS-15	F	N	12:22:56	898032.8	2657482
SS-15	G	N	12:24:01	897947.2	2657455
SS-15	H	N	12:25:05	897871.4	2657424
SS-16	A	N	12:33:26	899182.3	2657948
SS-16	B	N	12:35:57	898982.4	2657734
SS-16	C	N	12:36:52	898904.6	2657696
SS-16	D	N	12:38:25	898763.5	2657650
SS-16	E	N	12:40:12	898640.7	2657598
SS-16	F	N	12:40:50	898563.1	2657577
SS-16	G	N	12:41:16	898512.9	2657555
SS-16	H	N	12:43:48	898271	2657460
SS-17	A	S	12:49:46	897706.9	2657581
SS-17	B	M	12:55:22	898352.9	2657792
SS-17	C	N	12:55:58	898416.5	2657839
SS-17	D	M	12:56:56	898535.5	2657889
SS-17	E	M	12:58:02	898724.7	2657907
SS-17	F	S	12:59:53	898965.4	2658043
SS-17	G	M	13:00:36	899060	2658079
SS-17	H	M	13:03:17	899370.6	2658209
SS-18	A	S	13:09:47	not available	
SS-18	B	S	13:14:55	898043.7	2657908
SS-18	C	M	13:19:34	898609.8	2658106
SS-18	D	M	13:20:06	898684.6	2658145
SS-18	E	S	13:22:09	898870.1	2658230
SS-18	F	M	13:23:32	899040.8	2658337
SS-18	G	M	13:23:57	899082.4	2658378
SS-18	H	M	13:25:23	899197.8	2658379

Notes:

1 For screen captures see Plates SS-2 to SS-4 and SS-6 to SS-18

2 (S) sparse = 1-10 plants; (M) moderate = 11-25 plants and (D) dense = >25 plants
N= not present

TABLE 3
WORCESTER AVENUE LANDFALL APPROACH
UNDERWATER VIDEO SCREEN CAPTURE POSITIONS

Transect Name	Screen Capture[1]	Eelgrass Density[2]	Time	X	Y
WA-2	A	N	7:57:09	not available	
WA-2	B	N	8:09:16	901214.4	2657109
WA-2	C	N	8:20:19	902086.4	2657282
WA-2	D	N	8:00:49	not availabe	
WA-2	E	S	8:46:35	904347.4	2657719
WA-2	F	S	8:47:39	904416.8	2657736
WA-2	G	N	9:11:49	906633.3	2658177
WA-2	H	S	9:01:36	905513.4	2657953
WA-3	A	N	9:27:13	906287.8	2658530
WA-3	B	N	9:30:00	905839.9	2658434
WA-3	C	M	9:37:40	904532.6	2658169
WA-3	D	M	9:39:00	904318.7	2658124
WA-3	E	M	9:36:06	904778.6	2658224
WA-3	F	N	9:47:08	902833.2	2657845
WA-3	G	N	9:50:52	902108.8	2657690
WA-3	H	N	9:51:23	902029.5	2657682
WA-4	A	N	10:03:29	902463.7	2658141
WA-4	B	N	10:08:48	903018.4	2658253
WA-4	C	S	10:23:36	904460.6	2658529
WA-4	D	N	10:25:54	904668.6	2658584
WA-4	E	S	10:35:08	905349.8	2658699
WA-4	F	S	10:35:55	905405.3	2658710
WA-4	G	S	10:39:37	905670.6	2658770
WA-4	H	S	10:45:29	906132.1	2658867
WA-5	A	S	10:54:09	not available	
WA-5	B	M	10:54:15	906141.6	2659355
WA-5	C	M	10:55:11	906014.7	2659271
WA-5	D	N	11:00:10	905232	2659084
WA-5	E	S	11:01:43	904969.4	2659035
WA-5	F	N	11:05:11	904422.3	2658925
WA-5	G	D	11:09:56	903664.9	2658786
WA-5	H	M	11:15:38	902814.3	2658622
WA-6	A	D	11:25:41	not available	
WA-6	B	D	11:27:18	902834.7	2659022
WA-6	C	N	11:39:13	904550	2659359
WA-6	D	M	11:39:25	904576.4	2659364
WA-6	E	S	11:40:56	904783	2659412
WA-6	F	N	11:41:21	904844.6	2659422
WA-6	G	S	11:45:16	905378.8	2659518
WA-6	H	D	11:46:43	905568.5	2659557
WA-7	A	D	11:56:10	not available	
WA-7	B	D	11:56:11	not available	
WA-7	C	M	11:59:13	904901.4	2659855
WA-7	D	M	12:01:59	904457.6	2659746

TABLE 3
WORCESTER AVENUE LANDFALL APPROACH
UNDERWATER VIDEO SCREEN CAPTURE POSITIONS

Transect Name	Screen Capture[1]	Eelgrass Density[2]	Time	X	Y
WA-7	E	S	12:03:07	904279	2659706
WA-7	F	M	12:03:14	904258.6	2659705
WA-7	G	S	12:03:43	904178.4	2659694
WA-7	H	M	12:05:52	903797	2659617
WA-9	A	N	12:24:11	903167.6	2659899
WA-9	B	M	12:24:30	903201.6	2659930
WA-9	C	N	12:24:46	903238.8	2659937
WA-9	D	M	12:25:24	903334.5	2659946
WA-9	E	D	12:26:47	903534.8	2659979
WA-9	F	D	12:27:32	903628	2659993
WA-9	G	M	12:30:48	904047.4	2660067
WA-9	H	M	12:36:16	904775.5	2660228
WA-10	A	N	12:48:29	904476.6	2660483
WA-10	B	N	12:49:12	904395	2660471
WA-10	C	M	12:51:20	904167.1	2660419
WA-10	D	D	12:53:49	903879.8	2660331
WA-10	E	M	12:53:50	903878.5	2660330
WA-10	F	M	12:54:37	903813.2	2660304
WA-10	G	M	12:57:00	903590.5	2660210
WA-10	H	N	12:57:07	903578.3	2660207
WA-11	A	N	13:27:00	902109.8	2657492
WA-11	B	N	13:30:52	902666.2	2657592
WA-11	C	N	13:32:02	902861.6	2657641
WA-11	D	M	13:40:02	904235	2657900
WA-11	E	N	13:41:25	904473.5	2657932
WA-11	F	N	13:41:47	904534.1	2657945
WA-11	G	M	13:42:03	904579.5	2657950
WA-11	H	N	13:46:49	905385	2658151
WA-12	A	S	14:05:09	906583.3	2658777
WA-12	B	N	14:07:46	906279.8	2658718
WA-12	C	N	14:14:55	905546.2	2658548
WA-12	D	S	14:18:22	905174.6	2658504
WA-12	E	M	14:25:25	904554	2658371
WA-12	F	M	14:31:17	904064.3	2658287
WA-12	G	N	14:38:23	903375.5	2658132
WA-12	H	N	14:50:13	902470	2657994

Notes:

1 For screen captures see Plates WA-2 to WA-7 , WA-9 to WA-12

2 (S) sparse = 1-10 plants; (M) moderate = 11-25 plants and (D) dense = >25 plants
N= not present

TABLE 4
SPECIES OBSERVATIONS UNDERWATER VIDEO DATA
MAYFLOWER WIND PROPOSED LANDFALL APPROACHES
FALMOUTH, MA

LANDFALL APPROACH		Mill Road	Shore Street	Worcester Ave.
Common Name	**Latin Name**			
BRYOZOA				
Bushy bryozoan	*Bugula turrita*	X	X	X
Encrusting bryozoan	*Schizoporella unicornis*	X	X	
MOLLUSCA				
Bay Scallop*[1]	*Argopecten irradians*	X		
Knobbed whelk*	*Busycon carica*	X	X	
Slipper limpet	*Crepidula fornicata*	X	X	X
ARTHROPODA				
Merostomata				
Horseshoe Crab	*Limulus polyphemus*	X	X	X
Crustacea				
Flat-Clawed Hermit Crab	*Pagurus pollicaris*	X	X	
Lady crab	*Ovalipes occellatus*			X
ECHINODERMATA				
Forbes sea star	*Asterias forbesi*	X		
VERTEBRATA				
Osteichthyes				
Black sea bass (juvenile)	*Centropistes striatus*	X	X	X
Cunner	*Tautogolabrus adspersus*	X		
Northern puffer	*Sphoeroides maculatus*	X	X	
Northern searobin	*Prionotus carolinus*			X
Scup	*Stenotomus chrysops*		X	X
Summer flounder	*Paralicichthys dentatus*		X	X
SPECIES RICHNESS FAUNA[2]		11	10	7
FLORA				
ALISMATALES				
Zosteraceae				
Eelgrass*	*Zostera marina*	X	X	X
CHLOROPHYTA				
Dead Man's Fingers	*Codium fragile*	X	X	X
PHAEOPHYTA				
Wire weed	*Sargassum filipendula*	X	X	X

TABLE 4
SPECIES OBSERVATIONS UNDERWATER VIDEO DATA
MAYFLOWER WIND PROPOSED LANDFALL APPROACHES
FALMOUTH, MA

LANDFALL APPROACH		**Mill Road**	**Shore Street**	**Worcester Ave.**
RHODOPHYTA				
Branching red alga	Rhodophyta	X	X	X
Purple laver	*Porphyra umbilicalis*	X		
SPECIES RICHNESS FLORA[2]		5	4	4

1) An * designates species selected for assessment of 'important fish resource areas' an SSU under the Mass. Ocean Mangement Plan which includes knobbed whelk, bay scallop and eelgrass.

2) Species Richness = the total number of species observed - not normalized for length of transect

3) X designates presence at a landfall approach. Data not normalized for total length of transects at each approach.

FIGURES

www.crenvironmental.com

Mayflower Wind Bathymetric Tracklines
Mill Road and Shore Street Landfalls
Falmouth, MA

NOTES:
1) Survey conducted 08/06/2020 - 08/24/2020
2) Grid MA State Plane NAD 83 US Feet
3) RAW Bathy Tracklines

Feet
0 280 560

N W E S

Figure 1

Mayflower Wind Bathymetric Tracklines
Worcester Avenue Landfall
Falmouth, MA

www.crenvironmental.com

NOTES:
1) Survey conducted 08/06/2020 - 08/24/2020
2) Grid MA State Plane NAD 83 US Feet
3) RAW Bathy Tracklines

Feet
0 320 640

N W E S

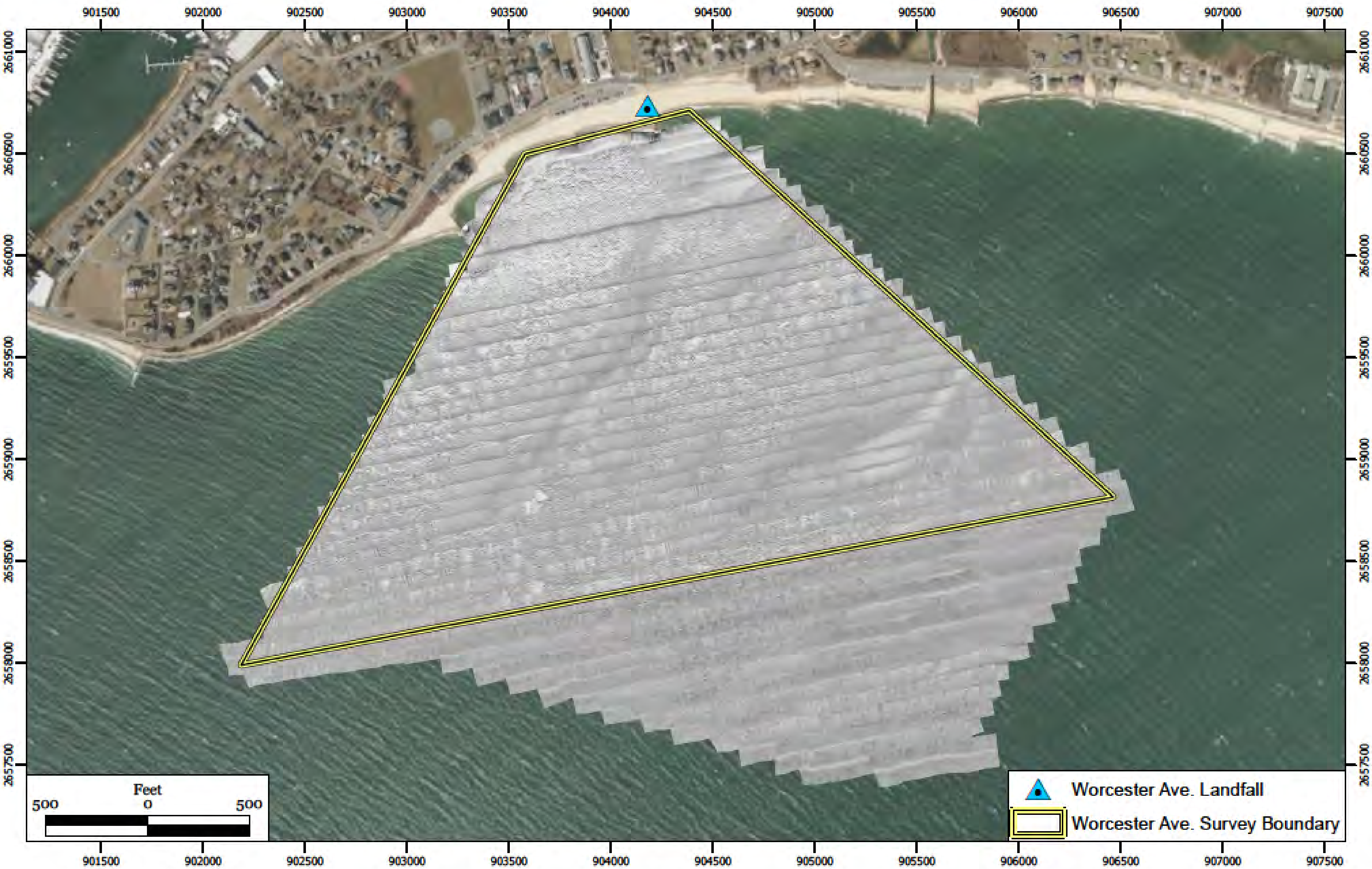
Figure 2

CR
www.crenvironmental.com

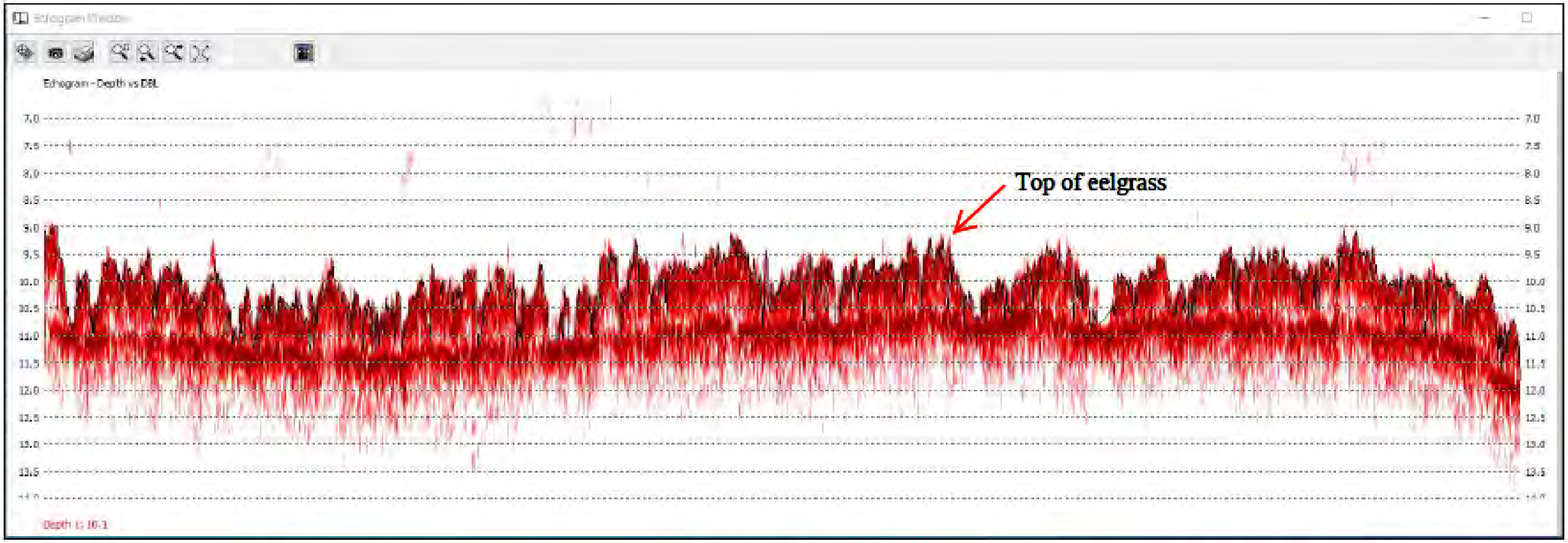
Mayflower Wind
Side Scan Sonar Mosaic
Mill Road and Shore Street Approaches
Falmouth, Massachusetts

NOTES:
1) Survey conducted August 6-24, 2020.
2) Grid: Massachusetts Mainland State Plane, NAD83, US Foot.

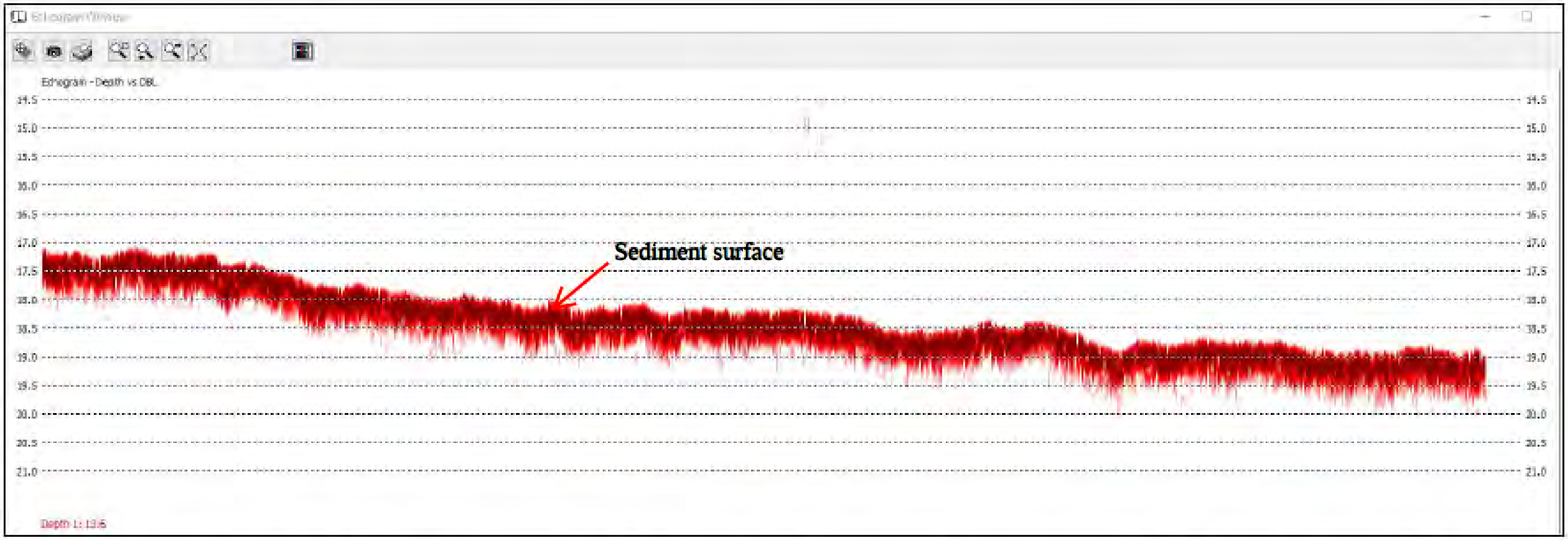
Figure 3



www.crenvironmental.com	Mayflower Wind Side Scan Sonar Mosaic Worcester Avenue Approach Falmouth, Massachusetts	N W E S	
	NOTES: 1) Survey conducted August 6-24, 2020. 2) Grid: Massachusetts Mainland State Plane, NAD83, US Foot.	Figure 4	



Echogram from the Mill Road Landfall Approach showing dense eelgrass standing 1.5 to 2 feet above the sediment surface. Horizontal lines are 0.5 foot increments.



Echogram from the Worcester Avenue Landfall Approach showing no eelgrass present only the top of the seabed.

FIGURE 5 Representative Single Beam Echograms - Mayflower Wind Landfall Approaches, Falmouth, MA

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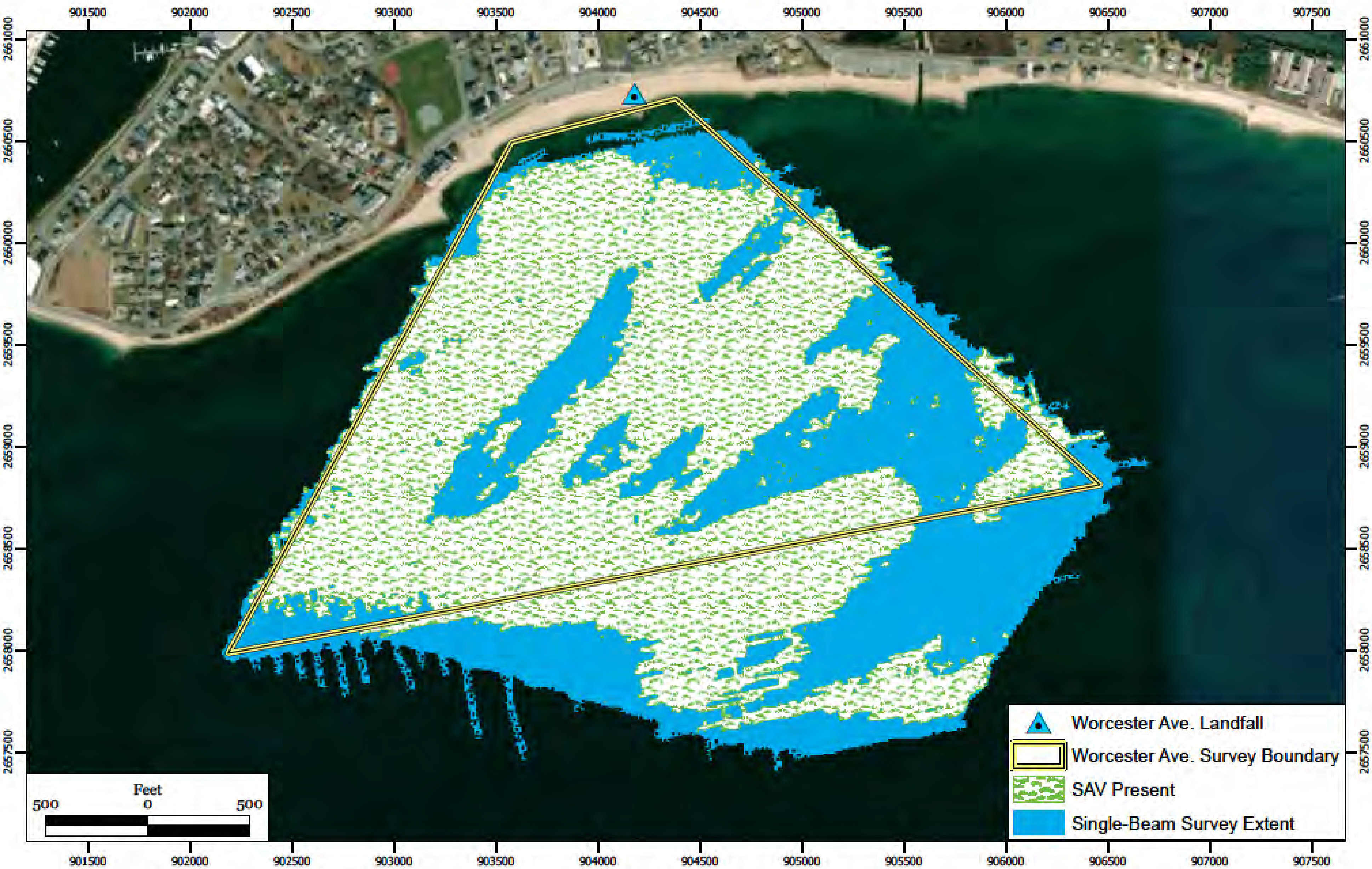
Mayflower Wind
Submerged Aquatic Vegatation Distribution
Mill Road and Shore Street Approaches
Falmouth, Massachusetts

N S E W

NOTES:
1) Survey conducted August 6-24, 2020.
2) Grid: Massachusetts Mainland State Plane, NAD83, US Foot.
3) SAV distribution based on single beam and side scan sonar records.

Figure 6



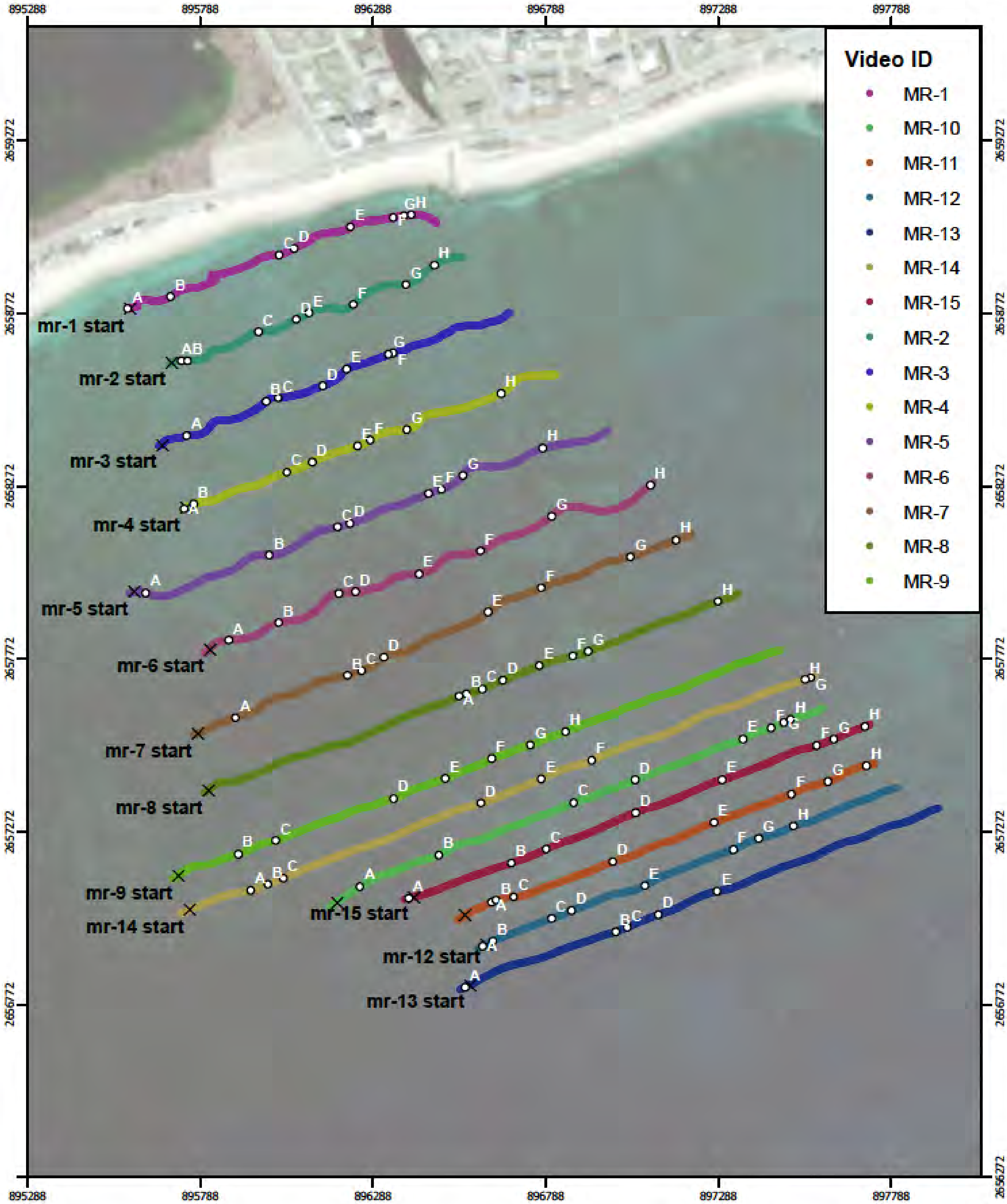
www.crenvironmental.com

Mayflower Wind
Submerged Aquatic Vegatation Distribution
Worcester Avenue Approach
Falmouth, Massachusetts

NOTES:
1) Survey conducted August 6-24, 2020.
2) Grid: Massachusetts Mainland State Plane, NAD83, US Foot.
3) SAV distribution based on single beam and side scan sonar records.

N W E S

Figure 7



www.crenvironmental.com

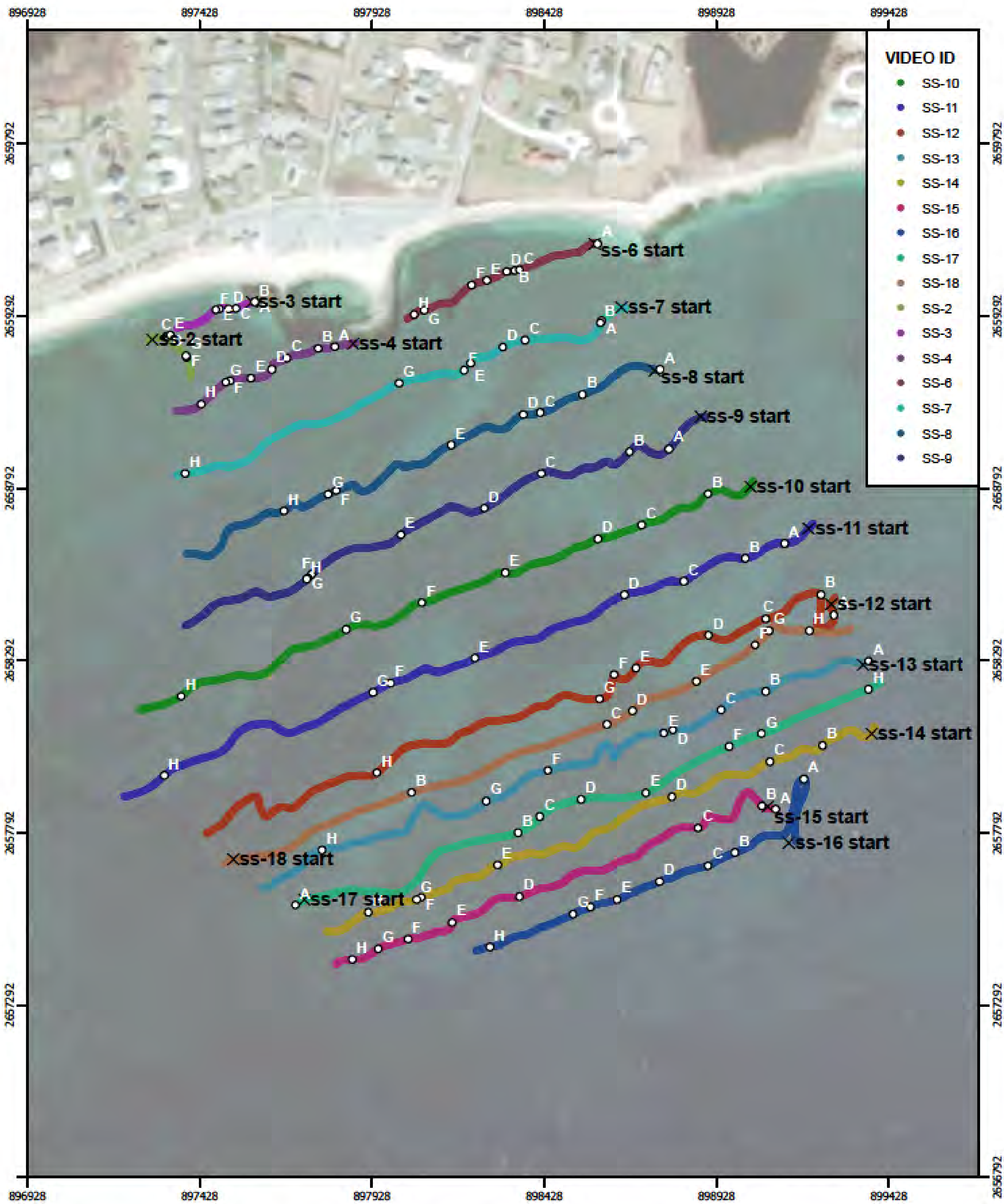
Mayflower Video Transect Lines and Screen Captures
Mill Road Landfall
Falmouth,MA

N W E S

NOTES:
1) A - H Screen captures of representative eelgrass cover, substrate and biota
2) Grid MA State Plane NAD 83 US Feet
3) Video Transects all start from the WEST
4) Survey conducted 08/25/2020

Feet
0 250 500

Figure 8



www.crenvironmental.com

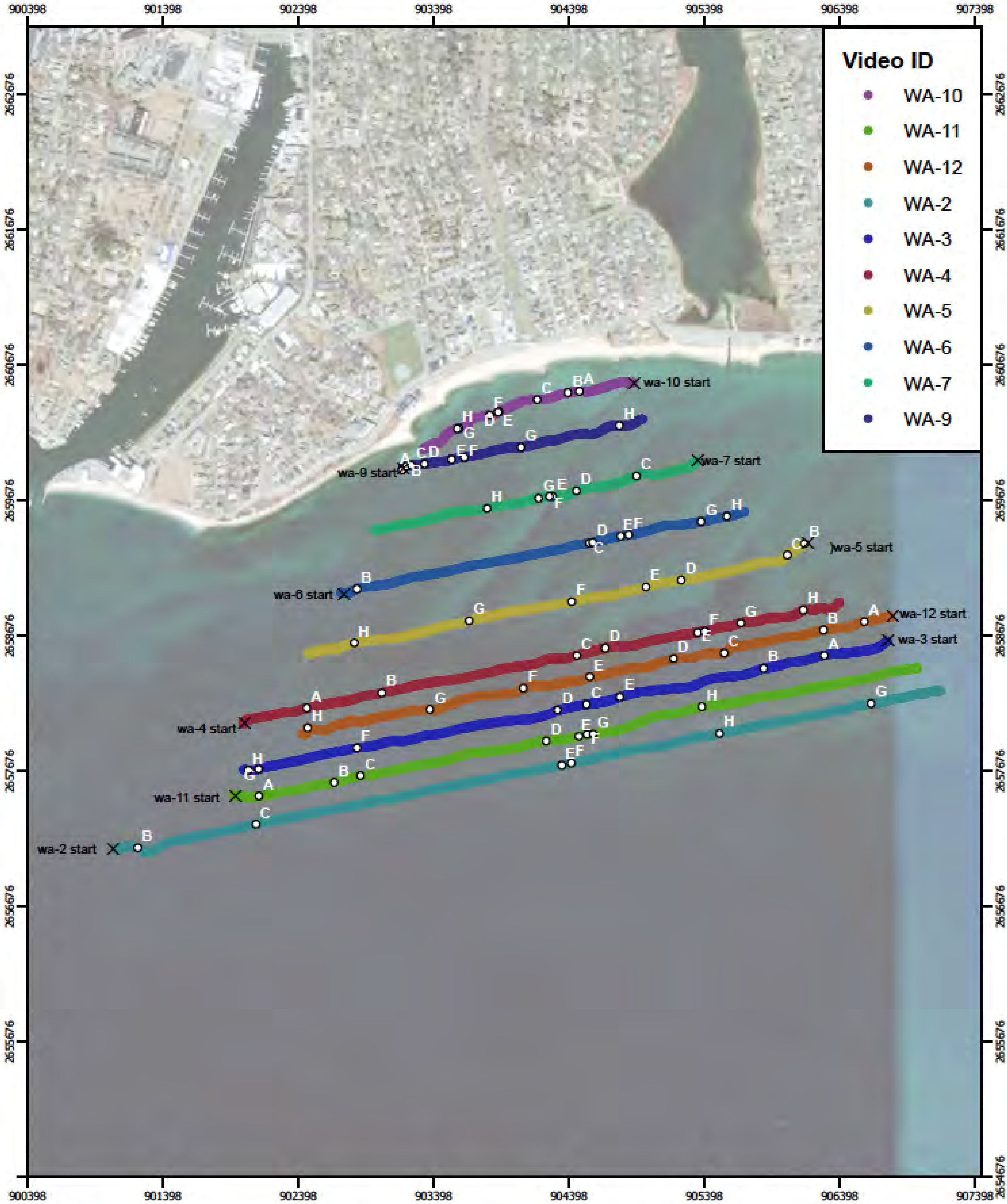
Mayflower Video Transect Lines and Screen Captures
Shore Street Landfall
Falmouth, MA

NOTES:
1) A - H Screen Captures of representative eelgrass cover, substrate, and biota
2) Grid MA State Plane NAD 83 US Feet
3) Video Transects are labeled with start points
4) Survey conducted 08/26/2020

Feet
0 250 500

N W E S

Figure 9



Mayflower Video Transect Lines and Screen Captures
Worcester Avenue Landfall
Falmouth, MA

www.crenvironmental.com

NOTES:
1) A - H Screen captures of representative eelgrass cover, substrate, and biota
2) Grid MA State Plane NAD 83 US Feet
3) Video Transects all start from the WEST
4) Survey conducted 08/27/2020

Feet
0 280 560

N W E S

Figure 10

PLATES

VIDEO TRANSECT SCREEN CAPTURES

MILL ROAD LANDFALL


A: Moderate eelgrass, *Sargassum*, red algae, gravel


B: *Codium*, *Sargassum*, branching red algae, gravel

C: Moderate eelgrass, algae, fine sand


D: Moderate eelgrass, algae, sandy gravel


E: Sparse eelgrass, red algae, *Codium*, sandy gravel

F: Dense eelgrass, *Sargassum*, gravelly sand


G: Dense eelgrass, *Sargassum*


H: Moderate eelgrass, *Sargassum*, gravelly sand

Plate MR-1. Mill Road Video Transect MR-1 Screen Captures

A: Moderate eelgrass, red algae, gravelly sand

B: Sparse eelgrass, *Sargassum*, gravelly sand with shell

C: Dense eelgrass, *Sargassum*

D: Dense eelgrass, on edge of sand patch

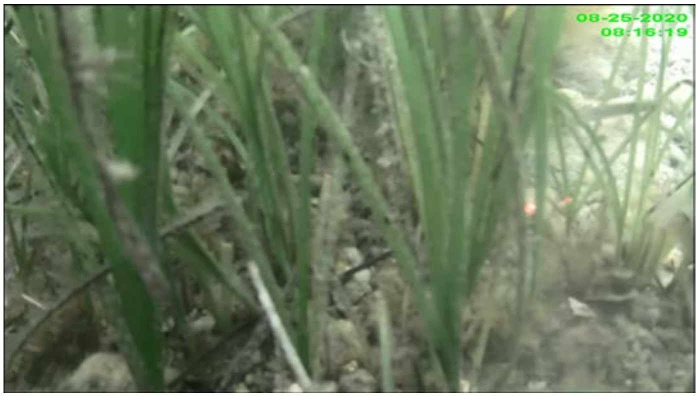
E: Sparse eelgrass, *Sargassum*, red algae, sand gravel

F: Moderate eelgrass, edge of sandy gravel patch, *Sargassum*

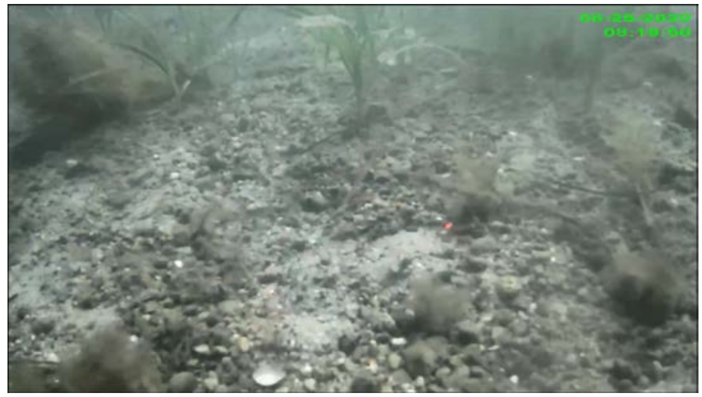
G: Dense eelgrass, *Sargassum*, gravelly sand

H: Moderate eelgrass, *Sargassum*, *Codium*, red algae, gravel

Plate MR-2. Mill Road Video Transect MR-2 Screen Captures



A: Dense eelgrass, gravel



B: Sparse eelgrass, *Sargassum*, sandy gravel

C: Moderate eelgrass, branching red algae, sandy gravel

D: Sparse eelgrass, branching red algae, sandy gravel

E: Moderate eelgrass, *Sargassum*, algae, sandy gravel

F: Dense eelgrass

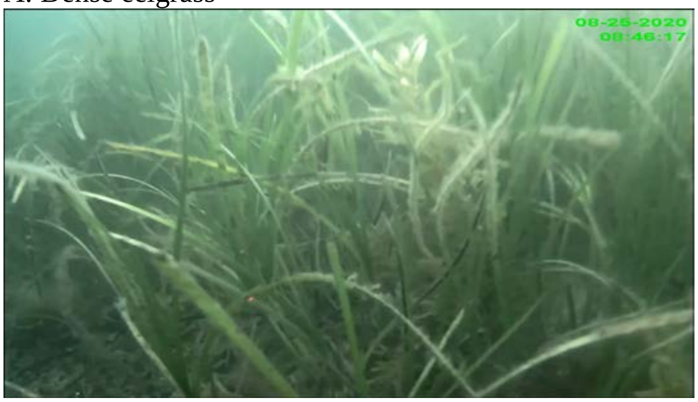
G: Dense eelgrass, *Sargassum*

H: *Sargassum*

Plate MR-3. Mill Road Video Transect MR-3 Screen Captures


A: Dense eelgrass


B: Sparse eelgrass, *Sargassum*, sandy gravel


C: Dense eelgrass with epiphytes, gravel


D: Moderate eelgrass, *Sargassum*, algae, sandy gravel


E: Moderate eelgrass with epiphytes, algae, gravel


F: Moderate eelgrass, *Sargassum*, algae, sandy gravel

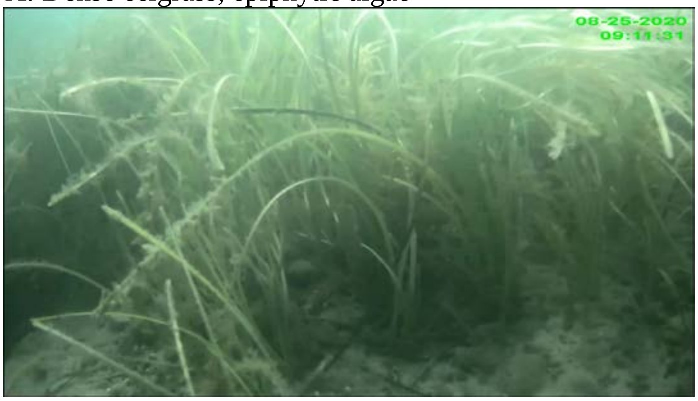

G: Dense eelgrass, *Sargassum*, gravel


H: Dense eelgrass

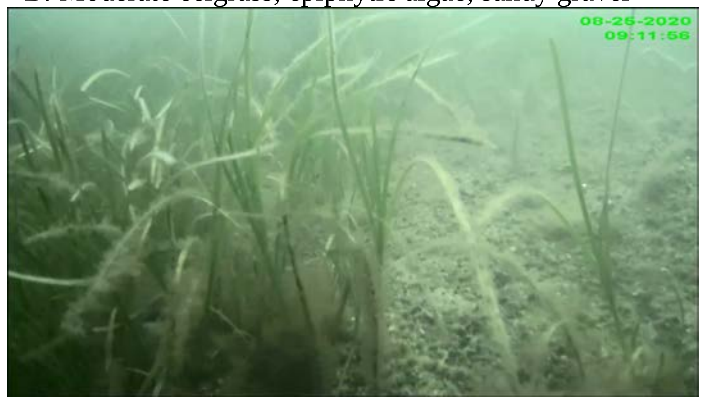
Plate MR-4. Mill Road Video Transect MR-4 Screen Captures

A: Dense eelgrass, epiphytic algae

B: Moderate eelgrass, epiphytic algae, sandy gravel

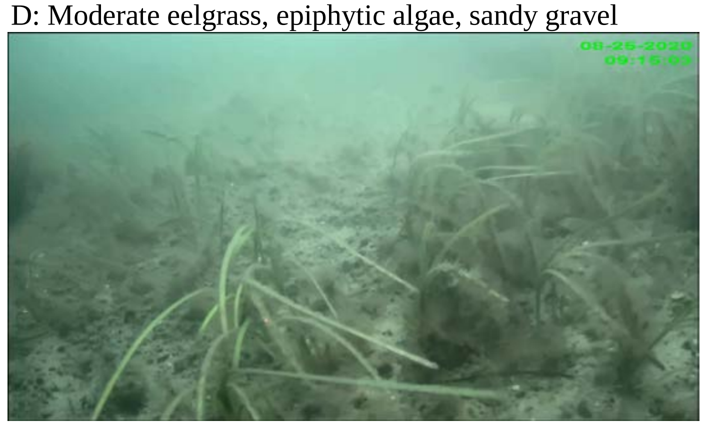


C: Dense eelgrass, *Sargassum*, gravelly sand



D: Moderate eelgrass, epiphytic algae, sandy gravel

E: Moderate eelgrass, epiphytic algae, gravel



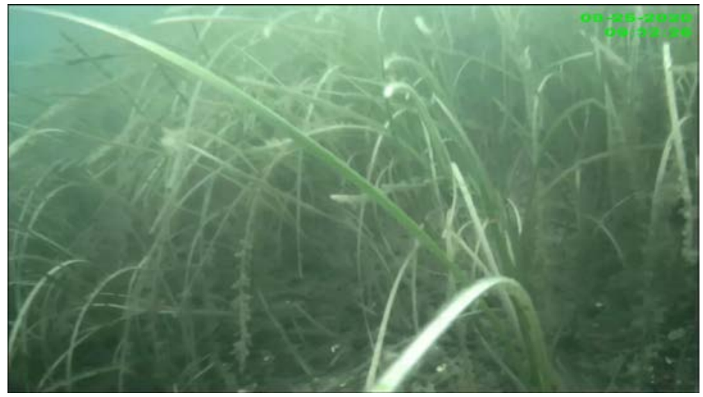
F: Sparse eelgrass, epiphytic algae, gravelly sand

G: Dense eelgrass, *Sargassum*

H: Sparse eelgrass, *Sargassum*, *Codium*, bryozoan, gravel

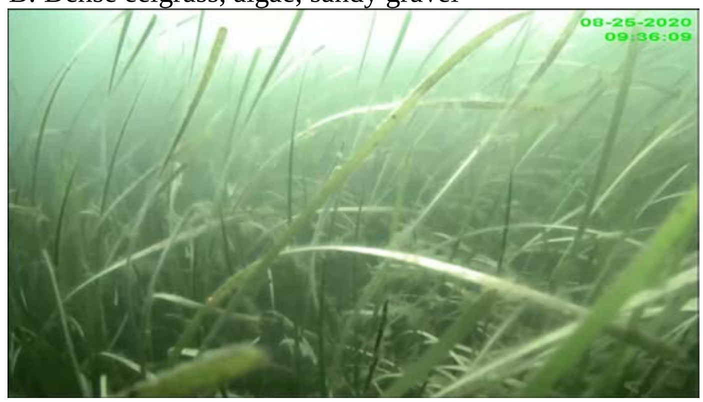
Plate MR-5. Mill Road Video Transect MR-5 Screen Captures

A: Moderate eelgrass, gravelly/shell sand



B: Dense eelgrass, algae, sandy gravel

C: Sparse eelgrass, gravel



D: Dense eelgrass

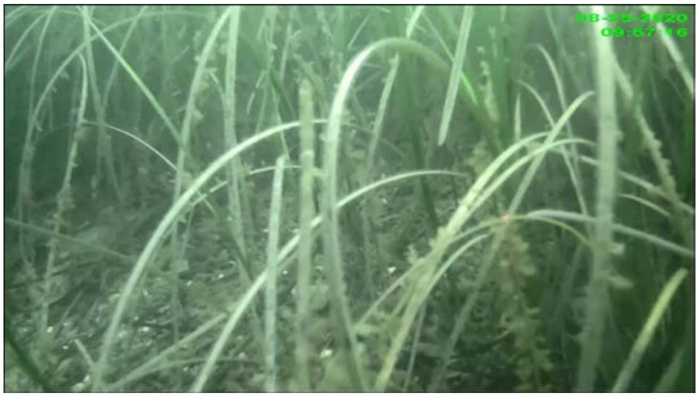
E: Moderate eelgrass, epiphytic algae, gravel

F: Dense eelgrass, algae

G: Moderate eelgrass, epiphytic algae, gravelly sand

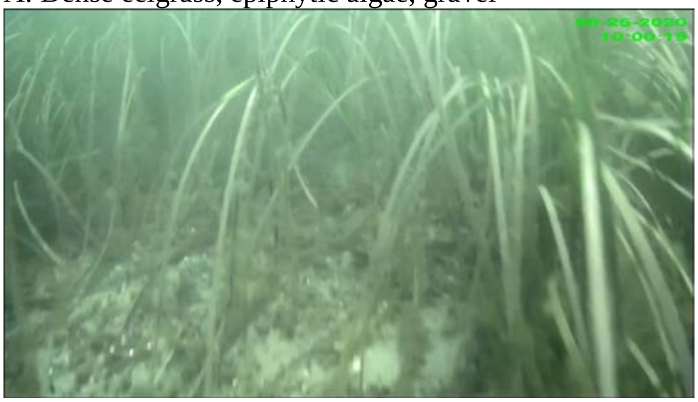
H: Dense eelgrass, algae, gravelly sand

Plate MR-6. Mill Road Video Transect MR-6 Screen Captures



A: Dense eelgrass, epiphytic algae, gravel

B: Dense eelgrass, epiphytic algae, gravelly sand

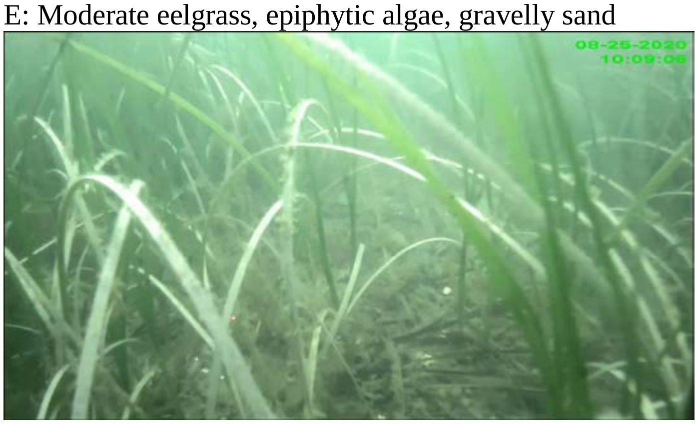


C: Moderate eelgrass, sandy gravel

D: Dense eelgrass

E: Moderate eelgrass, epiphytic algae, gravelly sand

F: Moderate eelgrass, *Sargassum*, sandy gravel



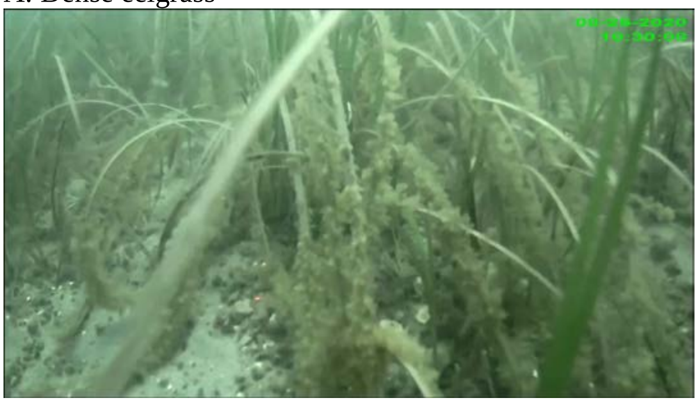
G: Moderate eelgrass, epiphytic algae, gravel

H: Dense eelgrass patch, gravelly sand

Plate MR-7. Mill Road Video Transect MR-7 Screen Captures

A: Dense eelgrass


B: Dense eelgrass, bryozoans, sand bottom


C: Dense eelgrass, bryozoans, gravelly sand


D: Moderate eelgrass, algae, bryozoans, sandy gravel

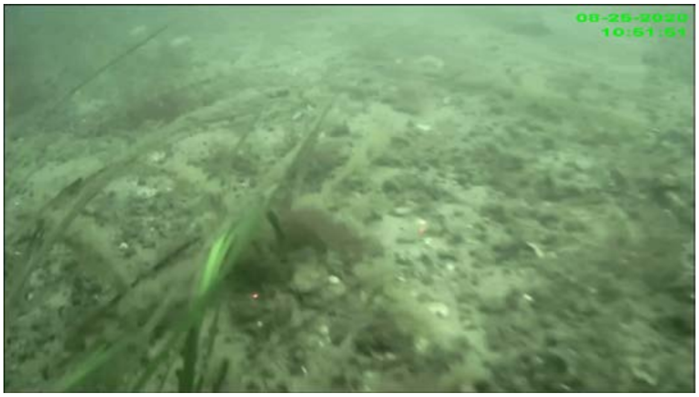

E: Sparse eelgrass, *Codium*, epiphytic algae, sandy gravel

F: Sparse eelgrass, epiphytic algae, gravelly/shell sand


G: Dense eelgrass, bryozoans, *Codium*, gravelly sand

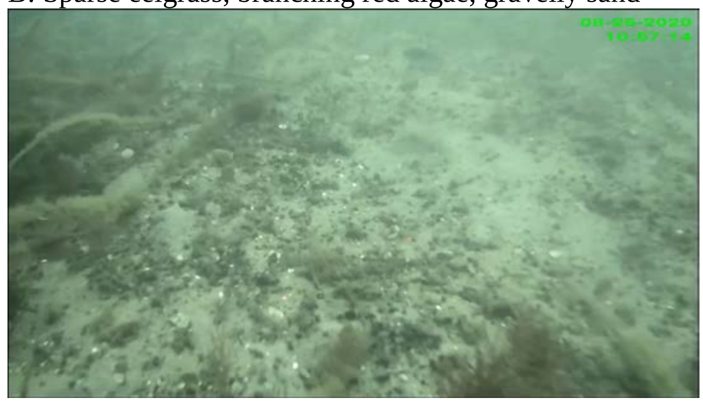

H: Sparse eelgrass, bryozoans, sandy gravel

Plate MR-8. Mill Road Video Transect MR-8 Screen Captures


A: Sparse eelgrass, epiphytic algae, sandy gravel


B: Sparse eelgrass, branching red algae, gravelly sand


C: Moderate eelgrass, bryozoans, gravelly/shell sand


D: Sparse eelgrass, algae, gravelly sand, juvenile sea bass


E: Moderate eelgrass, bryozoans, red algae, sandy gravel

F: Moderate eelgrass, bryozoans, shell bearing gravel


G: Sparse eelgrass, *Codium*, red algae, sandy/shell gravel

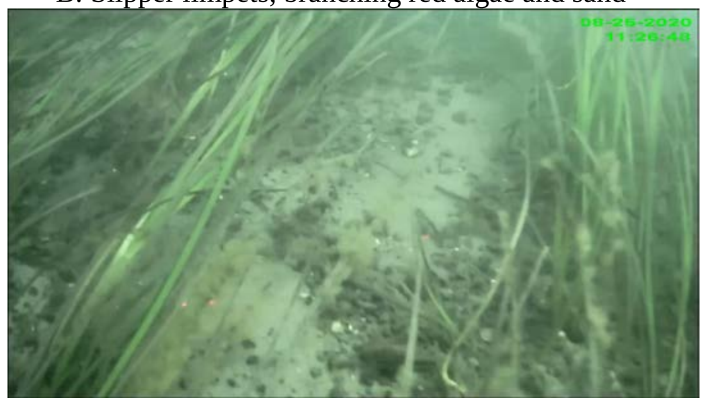

H: Dense eelgrass, epiphytic algae, gravelly sand

Plate MR-9. Mill Road Video Transect MR-9 Screen Captures

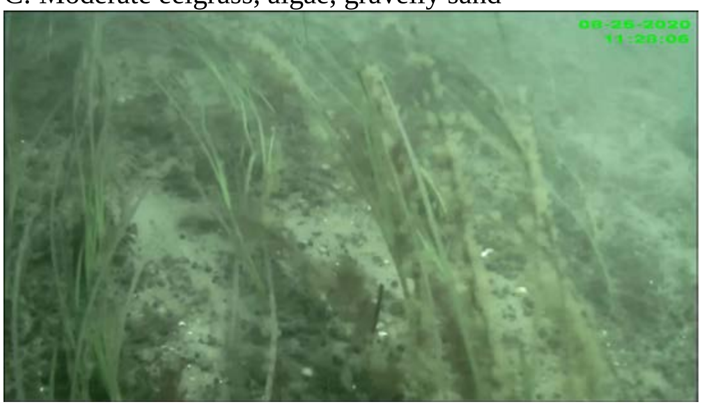
A: Slipper limpets and sand

B: Slipper limpets, branching red algae and sand

C: Moderate eelgrass, algae, gravelly sand



D: Moderate eelgrass, bryozoans, gravelly sand



E: Moderate eelgrass, epiphytic algae, gravelly sand

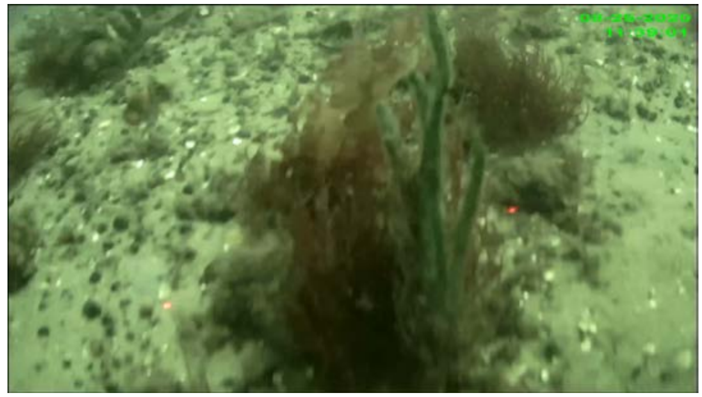
F: Dense eelgrass, gravelly sand

G: Sparse eelgrass, sargassum, bryozoans, sandy gravel

H: Moderate eelgrass, bryozoans, sandy gravel

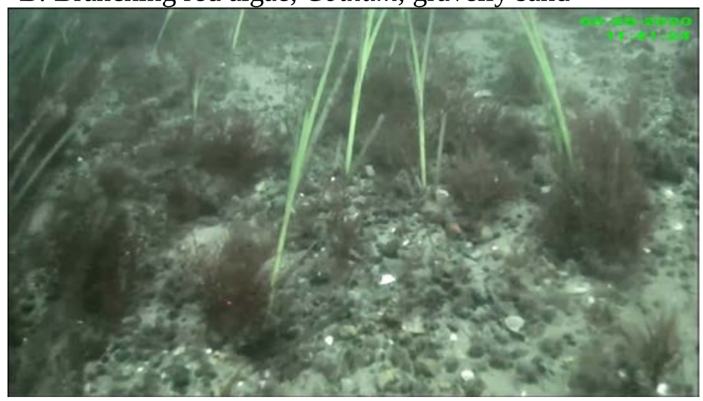
Plate MR-10. Mill Road Video Transect MR-10 Screen Captures

A: Branching red algae, gravelly sand, sea bass (top left)



B: Branching red algae, *Codium*, gravelly sand

C: Dense eelgrass, gravelly sand

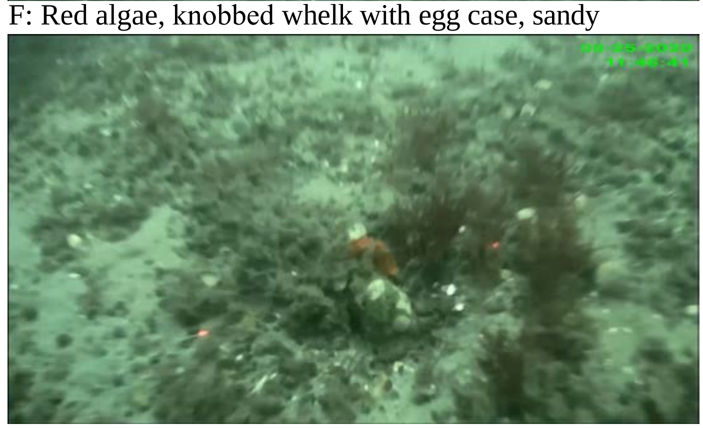


D: Spare eelgrass, branching red algae, gravelly sand

E: Sparse eelgrass, branching red algae, sandy gravel

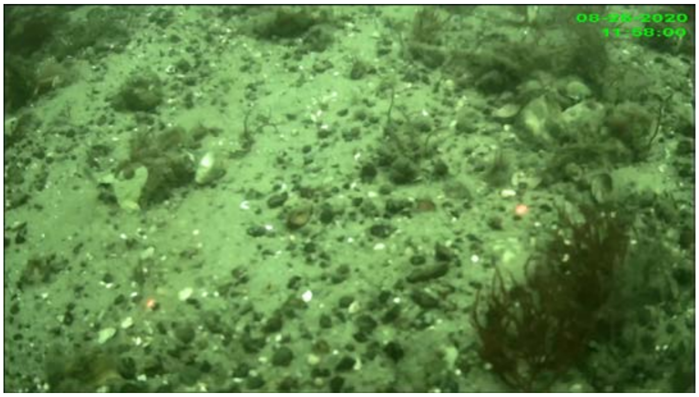
F: Red algae, knobbed whelk with egg case, sandy

G: Horseshoe crab, gravelly sand



H: Red algae, encrusting bryozoan, sandy gravel

Plate MR-11. Mill Road Video Transect MR-11 Screen Captures



A: Branching red algae, gravelly sand

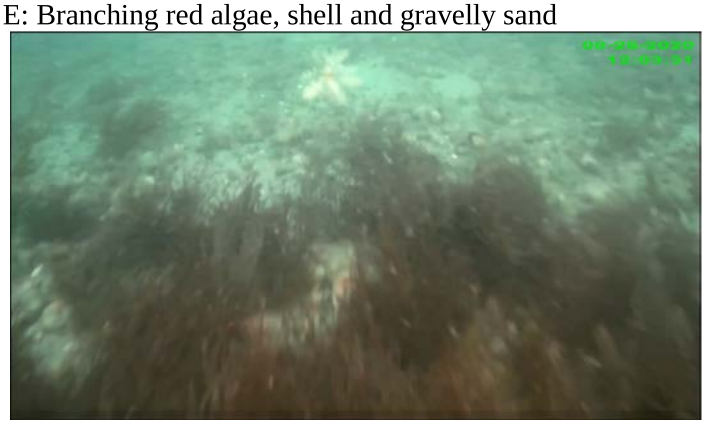
B: Branching red algae, horseshoe crabs, gravelly sand

C: Red algae, sargassum, bryozoans, gravelly sand

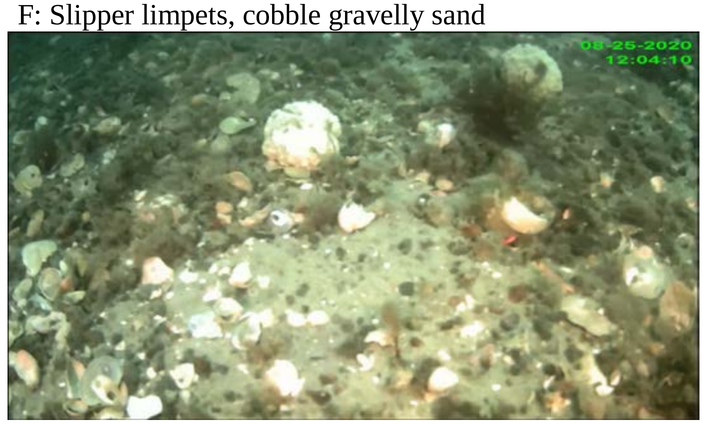
D: Branching red algae, bryozoans

E: Branching red algae, shell and gravelly sand

F: Slipper limpets, cobble gravelly sand

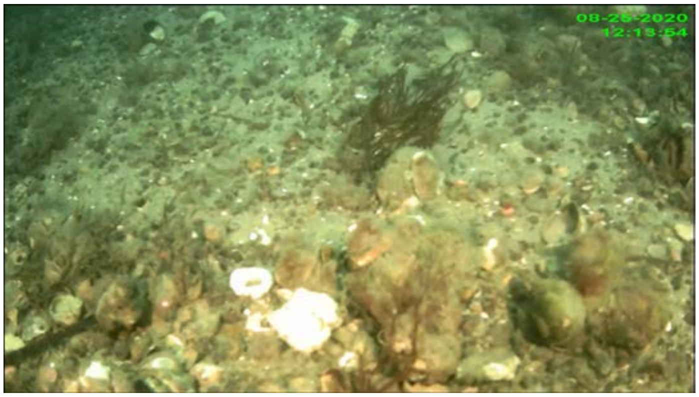


G: Branching red algae, gravelly sand



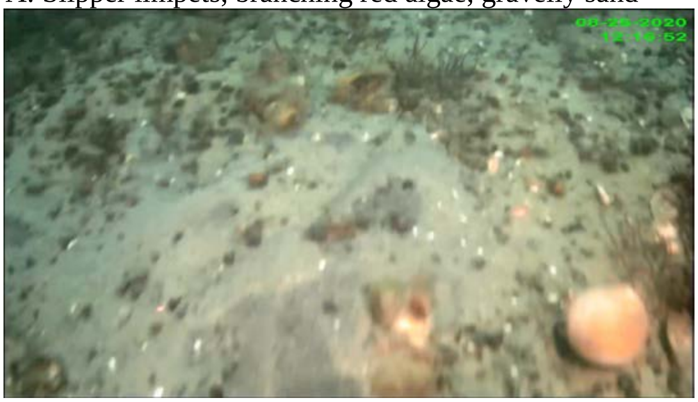
H: Red algae, gravelly sand

Plate MR-12. Mill Road Video Transect MR-12 Screen Captures



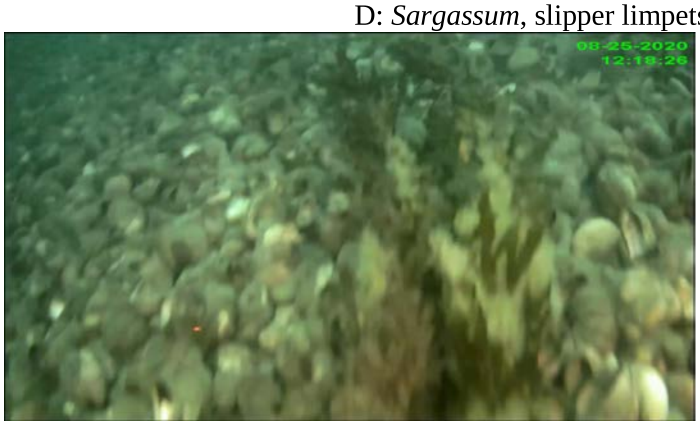
A: Slipper limpets, branching red algae, gravelly sand

B: Slipper limpets, red algae, shell hash, gravelly sand



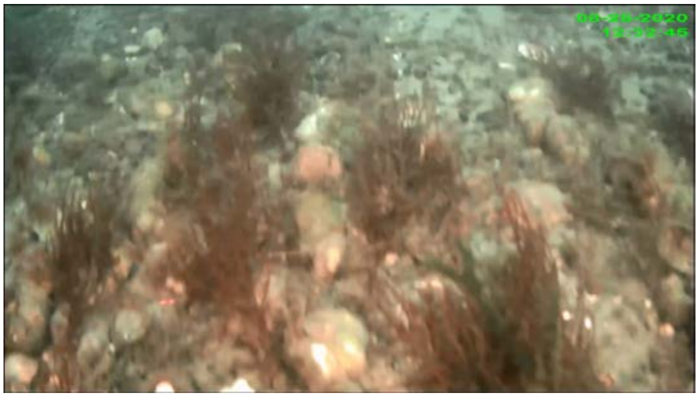
C: Hermit crab, gravelly sand

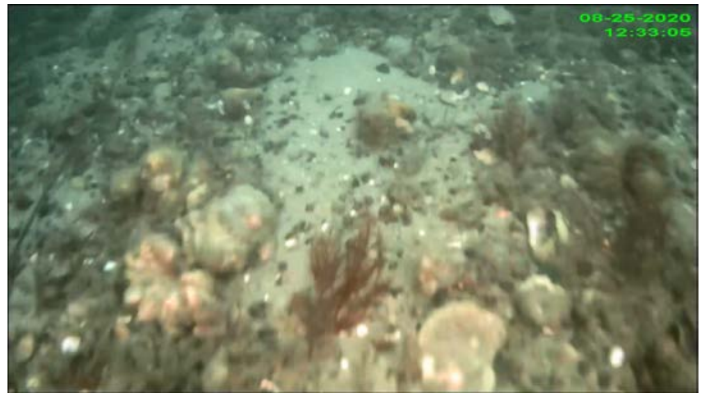
D: *Sargassum*, slipper limpets, gravelly sand



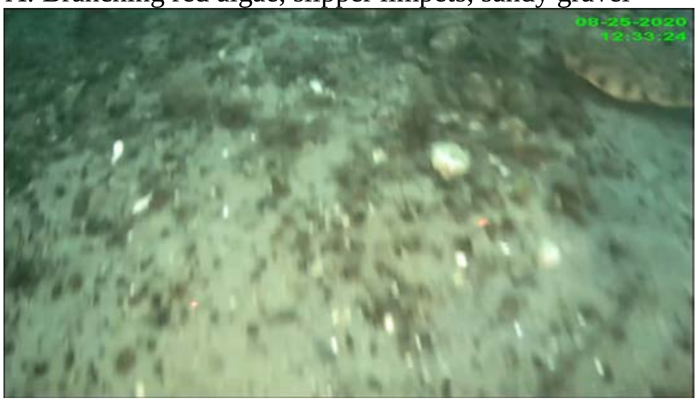
E: Slipper limpets, *Sargassum*, bryozoans

Plate MR-13. Mill Road Video Transect MR-13 Screen Captures

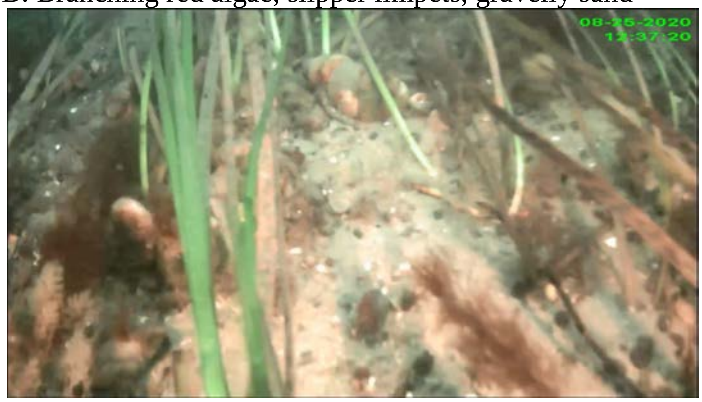

A: Branching red algae, slipper limpets, sandy gravel



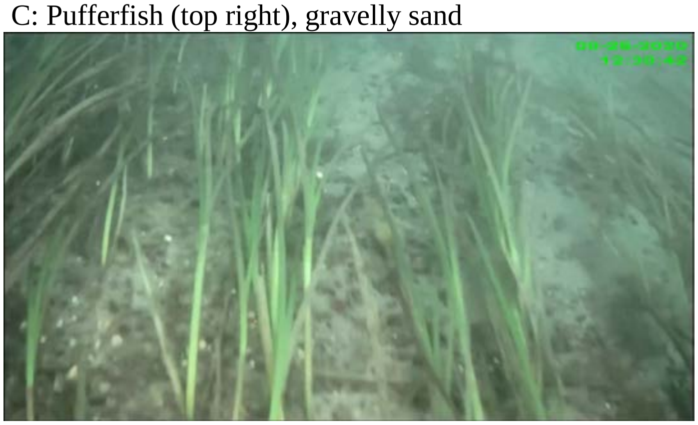
B: Branching red algae, slipper limpets, gravelly sand



C: Pufferfish (top right), gravelly sand



D: Sparse eelgrass, red algae, bryozoans, gravelly sand

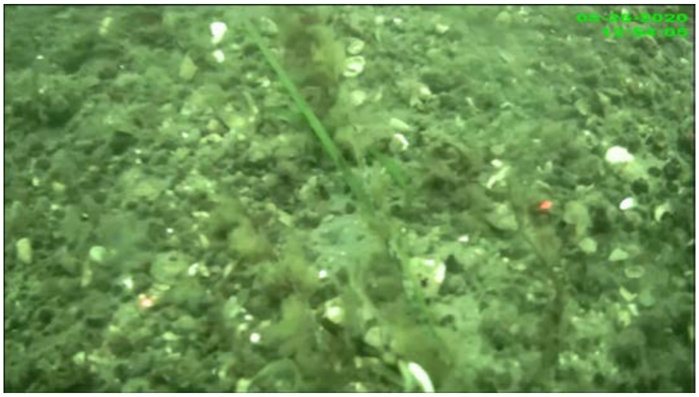

E: Moderate eelgrass, gravelly sand

F: Sparse eelgrass, bryozoans, red algae, sandy gravel

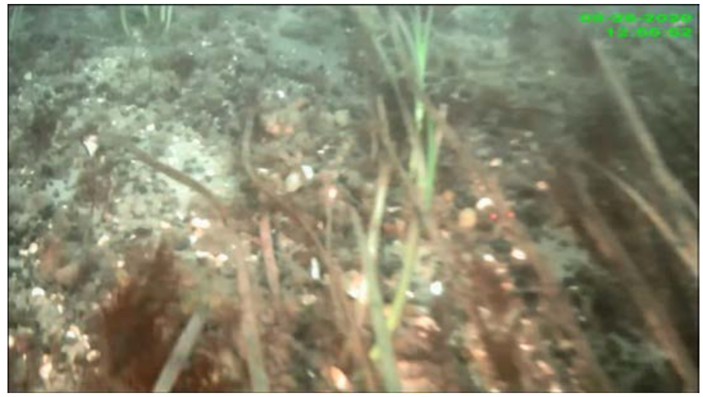
G: Moderate eelgrass, horseshoe crab, bryozoans, sand


H: Moderate eelgrass, bryozoans, gravelly sand

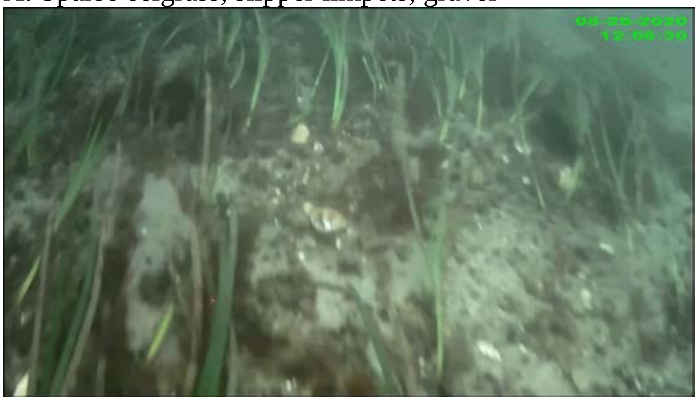
Plate MR-14. Mill Road Video Transect MR-14 Screen Captures



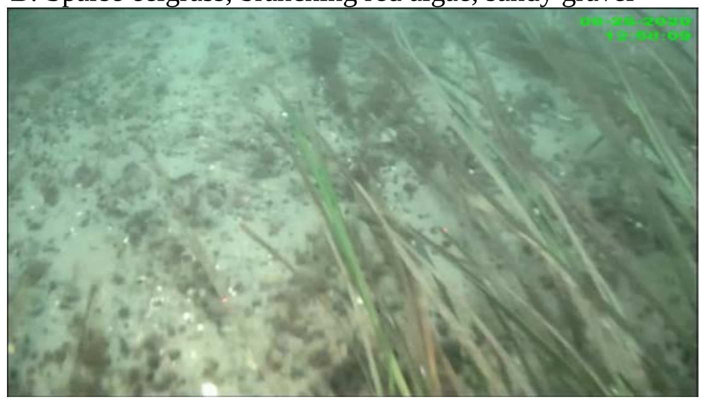
A: Sparse eelgrass, slipper limpets, gravel



B: Sparse eelgrass, branching red algae, sandy gravel



C: Moderate eelgrass, algae, shell hash, gravelly sand



D: Moderate eelgrass, algae, bryozoans, gravelly sand

E: Sparse eelgrass, red algae, bryozoans, shell hash, gravel

F: Sparse eelgrass, bryozoans, red algae, sandy gravel

G: Moderate eelgrass, bryozoans, red algae, gravelly sand

H: Sparse eelgrass, red algae, cunner, gravelly sand

Plate MR-15. Mill Road Video Transect MR-15 Screen Captures

VIDEO TRANSECT SCREEN CAPTURES

SHORE STREET LANDFALL

A: *Sargassum*, epiphytic algae, gravel

B: Sparse eelgrass, bryozoan, *Codium*, algae, gravel

C: Sparse eelgrass, *Sargassum*, epiphytic algae, gravel

D: Sparse eelgrass, epiphytic algae, sandy gravel

E: Moderate eelgrass, *Sargassum*, algae, sandy gravel

F: Moderate eelgrass, *Sargassum*, algae, gravelly sand

G: Moderate eelgrass, *Sargassum*, algae, gravelly sand

Plate SS-2. Shore Street Video Transect SS-2 Screen Captures

A: Sand ripples

B: Sand with few cobbles and shell

C: *Codium, Sargassum,* medium sand ripples

D: *Codium*, horseshoe crab, medium sand ripples

E: *Sargassum, Codium,* medium sand

F: *Sargassum,Codium*, sand

Plate SS-3. Shore Street Video Transect SS-3 Screen Captures

A: *Sargassum*, gravelly sand

B: *Sargassu*m, *Codium*, gravelly sand

C: Dense eelgrass, branching red algae

D: Moderate eelgrass, *Sargassum*, gravelly sand

E: Dense eelgrass patch, *Sargassum*, algae, gravelly sand

F: Dense eelgrass, algae, sandy gravel

G: Sparse eelgrass, sargassum, gravelly sand

H: Moderate eelgrass, *Sargassum*, bryozoan, sandy gravel

Plate SS-4. Shore Street Video Transect SS-4 Screen Captures


A: *Codium*, epiphytic algae, medium sand


B: *Sargassum*,*Codium*, epiphytic algae, sandy gravel


C: Sparse eelgrass, *Sargassum*, branching red algae, gravel


D: Sparse eelgrass, branching red algae, gravelly sand


E: Moderate eelgrass, *Sargassum*, algae, gravelly sand


F: *Sargassum*, branching red algae, gravelly sand


G: *Sargassum*, dense branching red algae


H: Moderate eelgrass, branching red algae, gravelly sand

Plate SS-6. Shore Street Video Transect SS-6 Screen Captures

A: Moderate eelgrass, *Sargassum*, red algae, gravelly sand

B: *Sargassum*,*Codium*, branching red algae, sandy gravel

C: Moderate eelgrass, *Sargassum*, gravelly sand

D: Knobbed whelk, branching red algae, gravelly sand

E: *Sargassum*, algae, slightly gravelly sand, exposed cable

F: Dense eelgrass, algae, gravelly sand

G: Dense eelgrass, *Sargassum*, sandy gravel

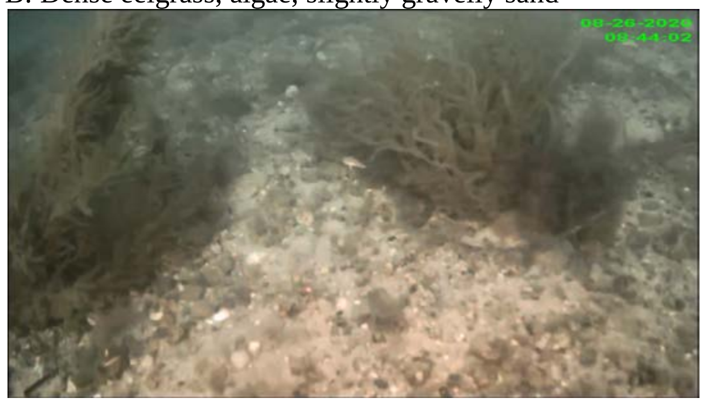
H: Dense eelgrass, branching red algae, gravelly sand

Plate SS-7. Shore Street Video Transect SS-7 Screen Captures

A: Dense eelgrass, sand bottom

B: Dense eelgrass, algae, slightly gravelly sand

C: Moderate eelgrass, *Sargassum*, algae, gravelly sand



D: *Sargassum*, minnow, sandy gravel

E: Sparse eelgrass, *Codium*, *Sargassum*, gravelly sand

F: Sparse eelgrass, branching red algae, sandy gravel

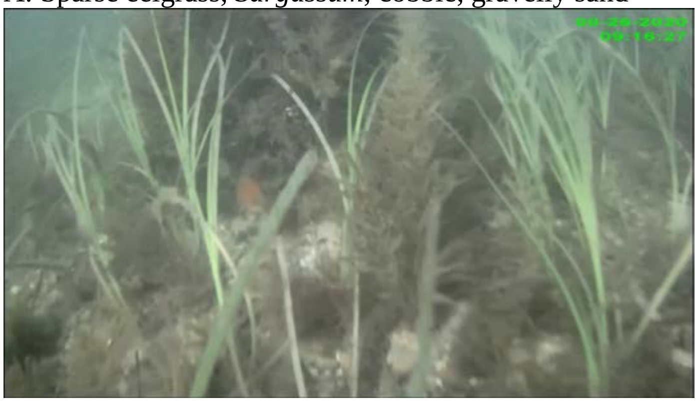
G: Dense eelgrass

H: Dense eelgrass, *Sargassum*, *Codium*, slightly gravelly sand

Plate SS-8. Shore Street Video Transect SS-8 Screen Captures

A: Sparse eelgrass, *Sargassum*, cobble, gravelly sand

B: Dense eelgrass, algae, slightly gravelly sand



C: Moderate eelgrass, *Sargassum*, sandy gravel

D: Sparse eelgrass, *Sargassum*, bryozoans, sandy gravel

E: Dense eelgrass, sandy gravel

F: Dense eelgrass, *Sargassum*, gravelly sand

G: Moderate eelgrass, *Sargassum*, gravelly sand

H: Dense eelgrass, some shell, gravelly sand

Plate SS-9. Shore Street Video Transect SS-9 Screen Captures

A: Dense eelgrass

B: Sparse eelgrass, *Sargassum*, algae, slightly gravelly sand

C: Moderate eelgrass, *Codium*, epiphytic algae

D: Sparse eelgrass, horseshoe crab, slightly gravelly sand

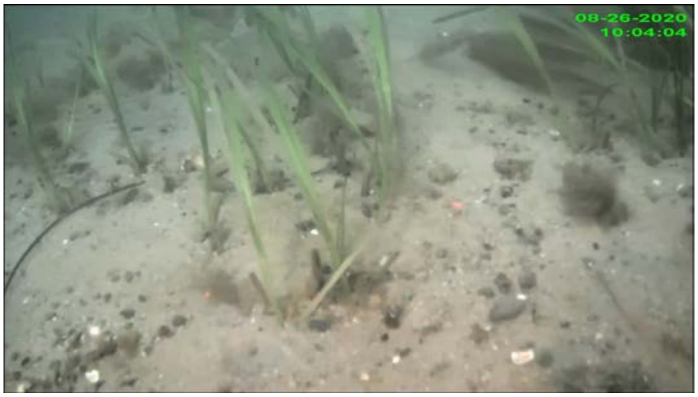
E: Moderate eelgrass, algae, sandy gravel

F: Moderate eelgrass, epiphytic algae, gravelly sand

G: Dense eelgrass

H: Dense eelgrass, sandy gravel

Plate SS-10. Shore Street Video Transect SS-10 Screen Captures



A: Sparse eelgrass, epiphytic algae, slightly gravelly sand

B: Sparse eelgrass, *Sargassum*, gravelly sand

C: Sparse eelgrass, epiphytic algae, gravelly sand

D: Moderate eelgrass, sargassum, sandy gravel

E: Moderate eelgrass, epiphytic algae, gravelly sand

F: Moderate eelgrass, bryozoans, algae, gravelly sand

G: Dense eelgrass, *Sargassum*, gravelly sand

H: Moderate eelgrass, epiphytic algae, gravelly sand

Plate SS-11. Shore Street Video Transect SS-11 Screen Captures

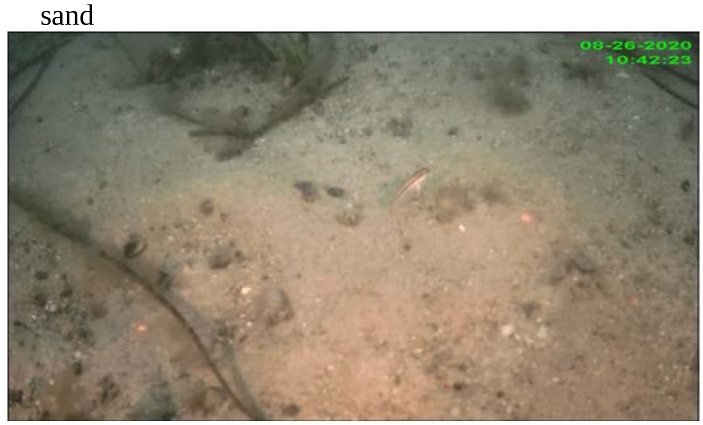
A: Moderate eelgrass, epiphytic algae, sandy gravel

B: Sparse eelgrass, epiphytic algae, gravelly sand

C: Moderate eelgrass, *Sargassum*, horseshoe crab, sand

D: Sparse eelgrass, *Codium*, bryozoans, slightly gravelly sand

E: Sparse eelgrass, epiphytic algae, slightly gravelly sand



F: Sparse eelgrass, juvenile seabass, slightly gravelly sand

G: Moderate eelgrass, bryozoans, algae, gravelly sand

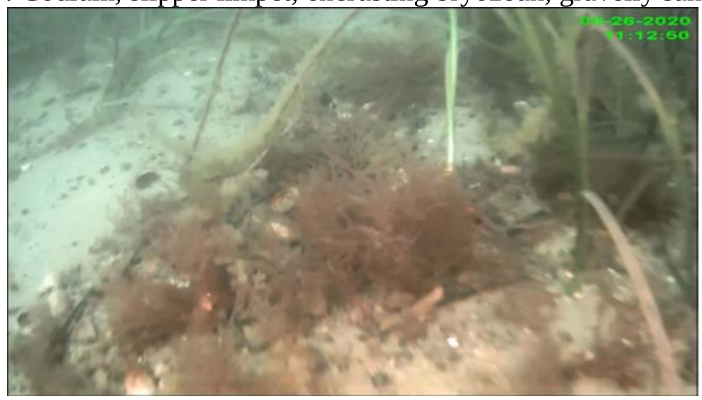
H: Sparse eelgrass, bryozoans, summer flounder, sandy gravel

Plate SS-12. Shore Street Video Transect SS-12 Screen Captures

A: Sparse eelgrass, red algae, bryozoans, gravelly sand

B: Codium, slipper limpet, encrusting bryozoan, gravelly sand

C: *Codium, Sargassum,* bryozoans, slipper limpets



D: Sparse eelgrass, branching red algae, gravelly sand

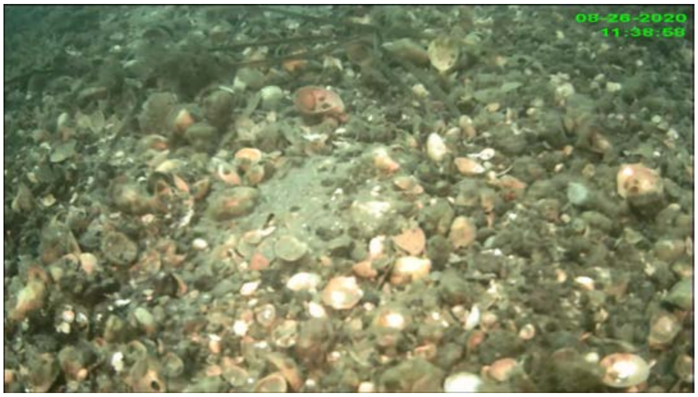
E: Sparse eelgrass, *Codium,* epiphytic algae, gravelly sand

F: Moderate eelgrass, epiphytic algae, gravelly sand

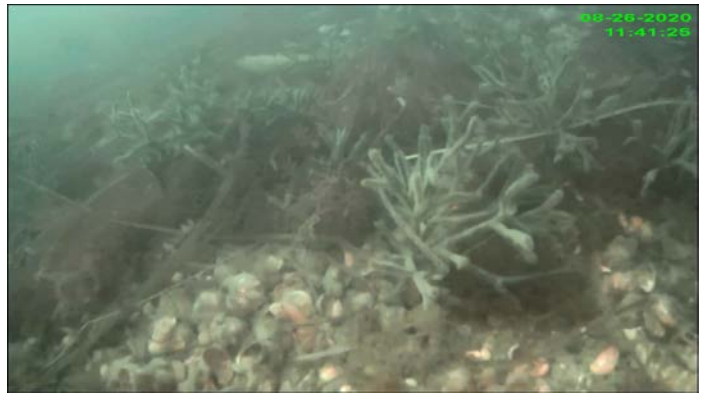
G: Moderate eelgrass, bryozoans, sandy gravel

H: Sparse eelgrass, horseshoe crab, gravelly sand

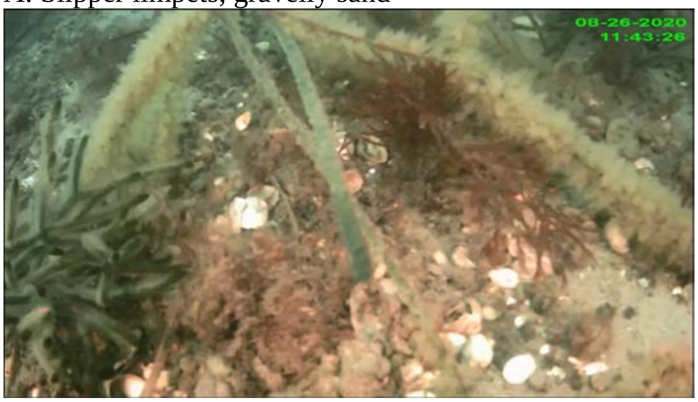
Plate SS-13. Shore Street Video Transect SS-13 Screen Captures



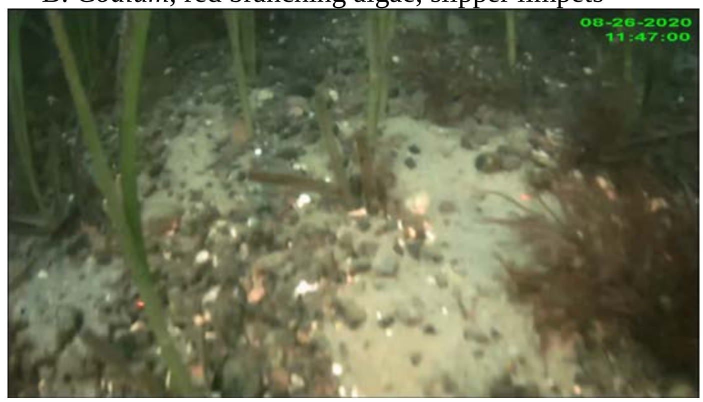
A: Slipper limpets, gravelly sand



B: *Codium*, red branching algae, slipper limpets



C: Sparse eelgrass, *Codium*, branching red algae, bryozoans

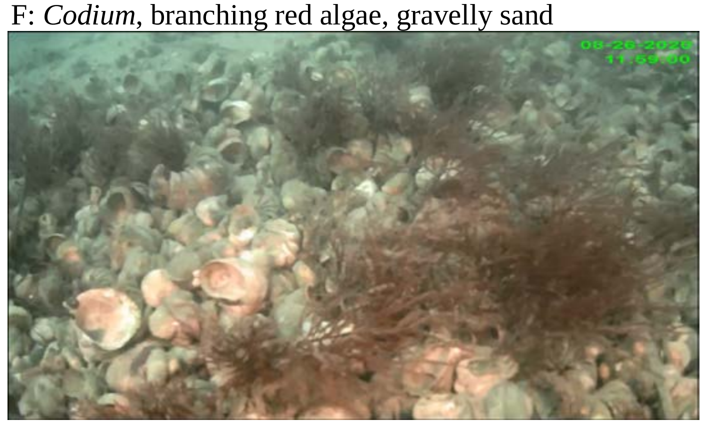


D: Moderate eelgrass, branching red algae, sandy gravel

E: Slipper limpets, shell hash, sandy gravel

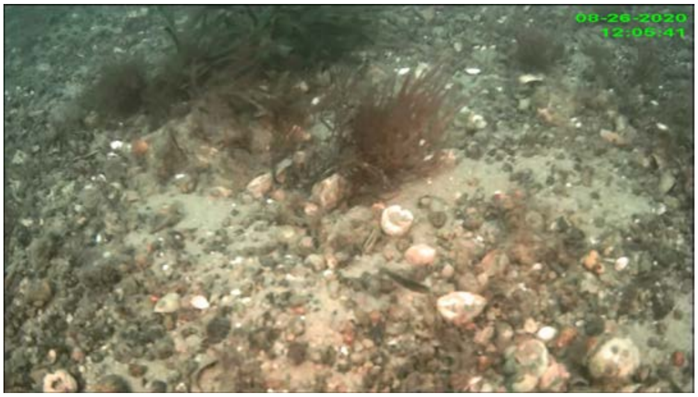
F: *Codium*, branching red algae, gravelly sand

G: Whelk egg case, *Codium*, gravelly sand

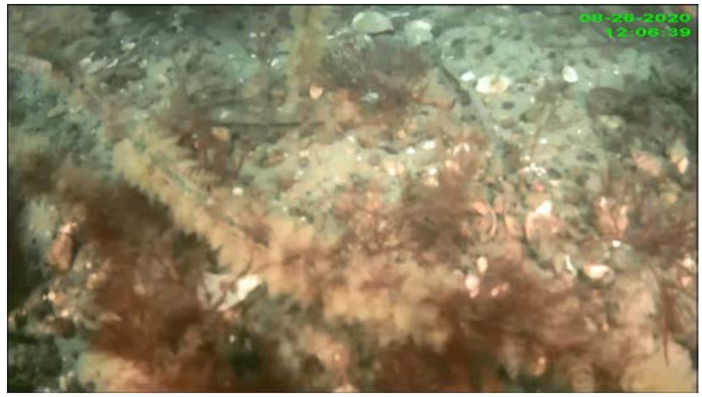


H: Branching red algae, slipper limpets

Plate SS-14. Shore Street Video Transect SS-14 Screen Captures

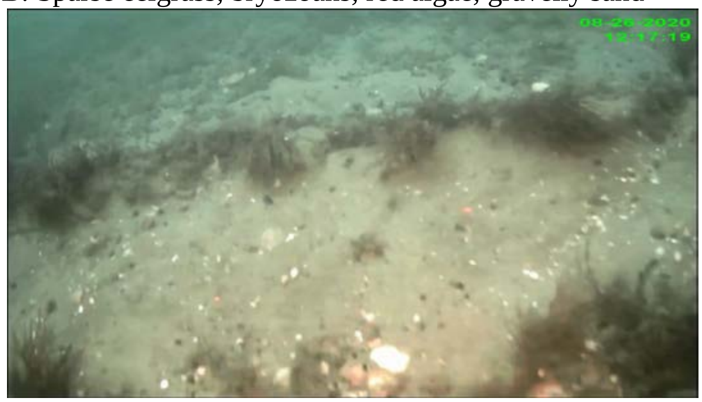


A: *Codium*, branching red algae, sandy gravel

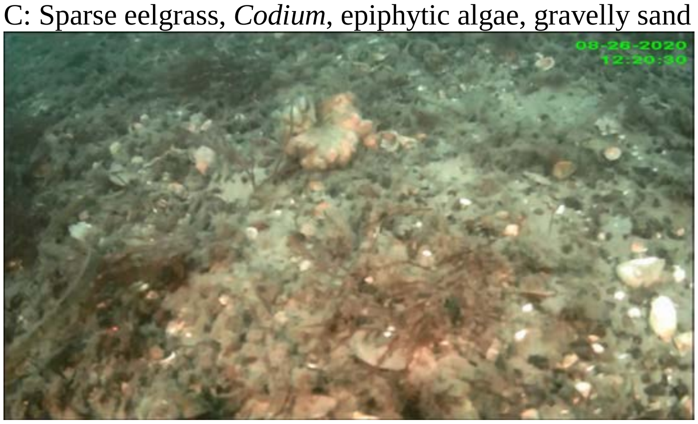


B: Sparse eelgrass, bryozoans, red algae, gravelly sand

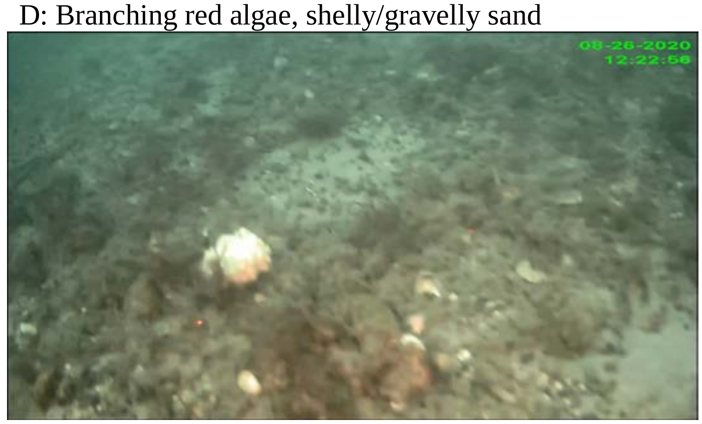
C: Sparse eelgrass, *Codium*, epiphytic algae, gravelly sand



D: Branching red algae, shelly/gravelly sand



E: Branching red algae, slipper limpets, gravelly sand



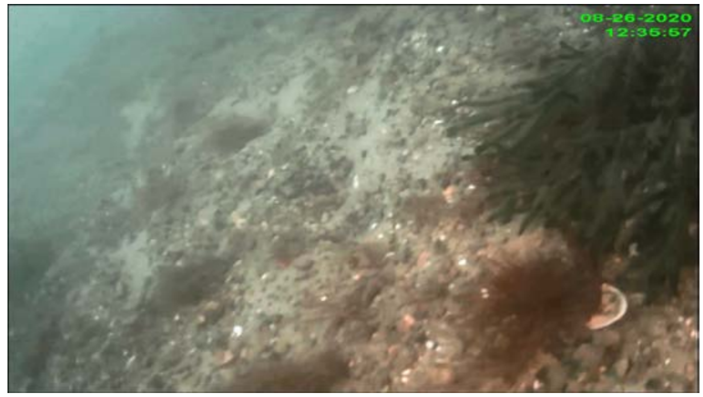
F: Sandy gravel

G: Whelk egg case, branching red algae, gravelly sand

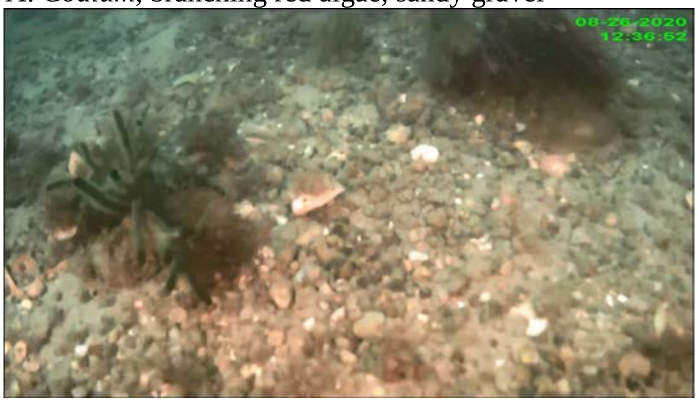
H: Branching red algae, gravelly sand

Plate SS-15. Shore Street Video Transect SS-15 Screen Captures

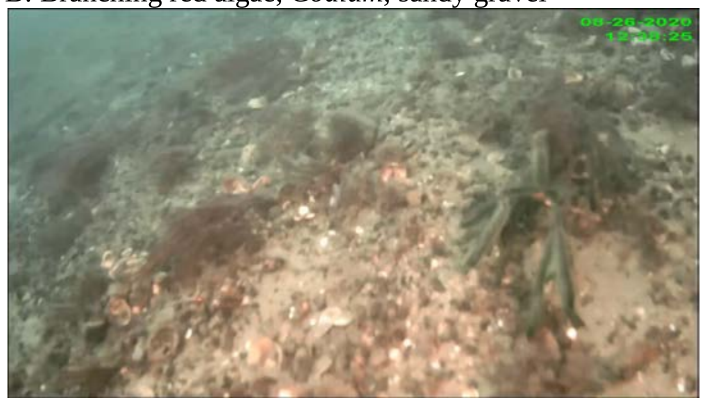
A: *Codium*, branching red algae, sandy gravel



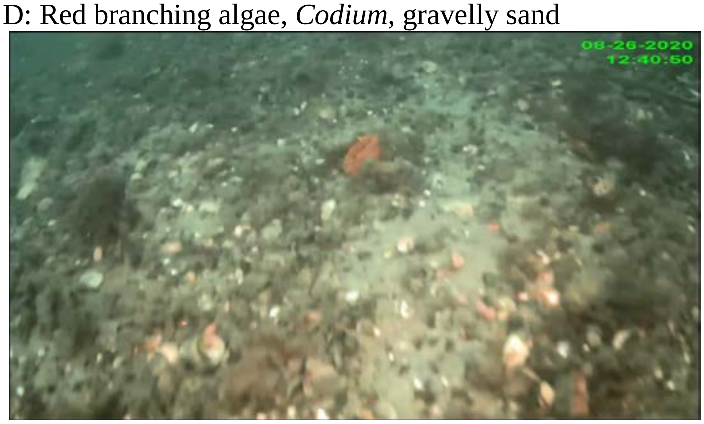
B: Branching red algae, *Codium*, sandy gravel



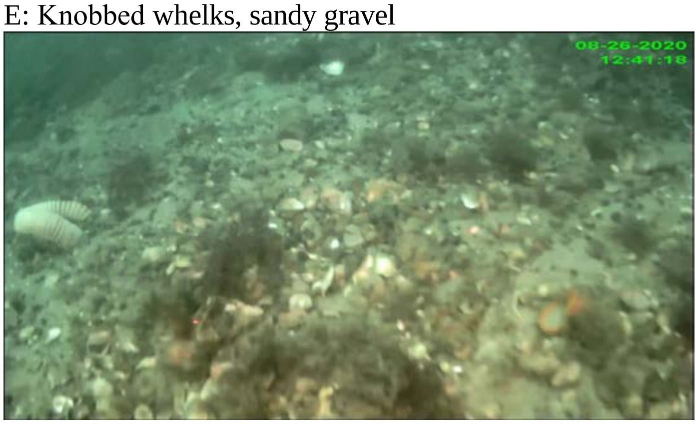
C: *Codium*, branching red algae, sandy gravel


D: Red branching algae, *Codium*, gravelly sand

E: Knobbed whelks, sandy gravel



F: Red branching algae, encrusting bryozoan, gravelly sand



G: Whelk egg case, red algae, slipper limpets, gravelly sand

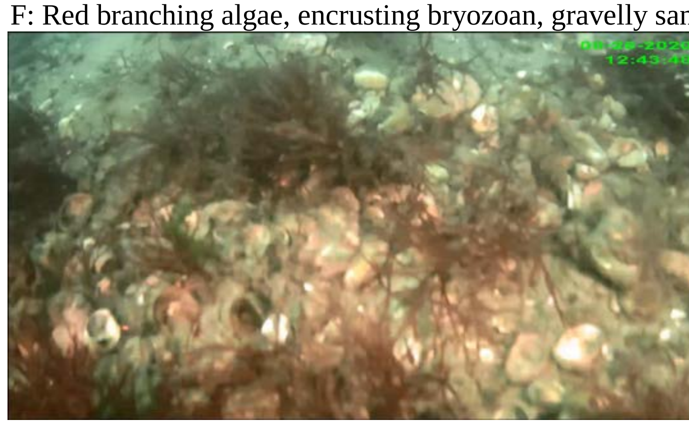
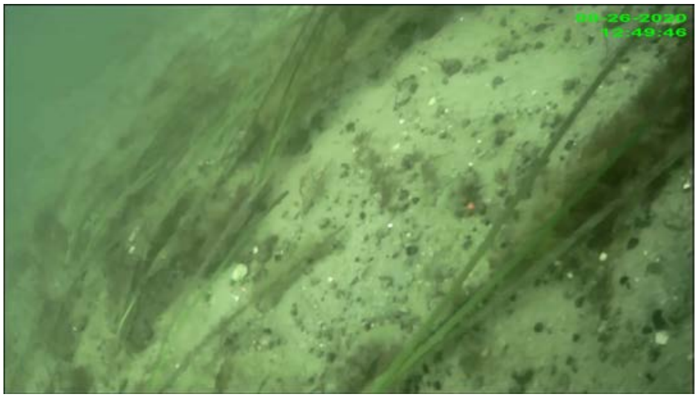

H: Branching red algae, slipper limpets, gravelly sand

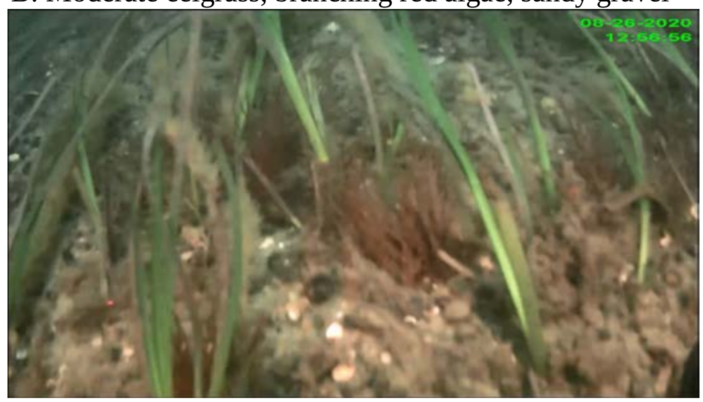
Plate SS-16. Shore Street Video Transect SS-16 Screen Captures



A: Sparse eelgrass, slightly gravelly sand

B: Moderate eelgrass, branching red algae, sandy gravel

C: Knobbed whelk shell, branching red algae, gravelly sand



D: Moderate eelgrass, bryozoans, red algae, sandy gravel

E: Moderate eelgrass, branching red algae, gravelly sand

F: Sparse eelgrass, branching red algae, slipper limpets

G: Moderate eelgrass, *Sargassum*, horseshoe crab, gravel

H: Moderate eelgrass, algae, bryozoans, sandy gravel

Plate SS-17. Shore Street Video Transect SS-17 Screen Captures

A: Sparse eelgrass, bryozoans, red algae, gravelly sand

B: Sparse eelgrass, knobbed whelk, slightly gravelly sand

C: Moderate eelgrass, red algae, bryozoans, gravelly sand

D: Moderate eelgrass, red algae, gravelly sand

E: Sparse eelgrass, pufferfish, slightly gravelly sand

F: Moderate eelgrass, algae, slightly gravelly sand

G: Moderate eelgrass, epiphytic algae, gravelly sand

H: Moderate eelgrass, bryozoans, red algae, sandy gravel

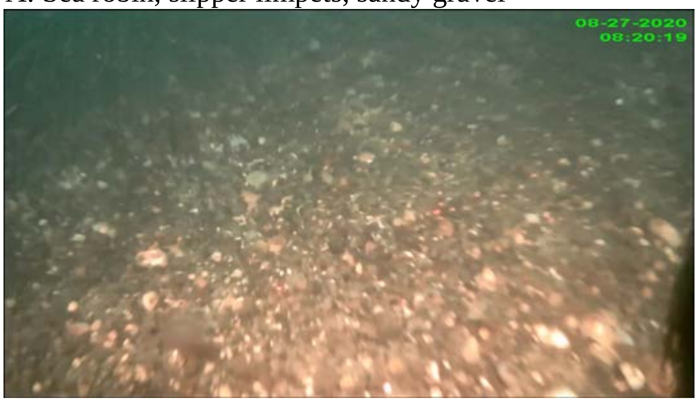
Plate SS-18. Shore Street Video Transect SS-18 Screen Captures

VIDEO TRANSECT SCREEN CAPTURES

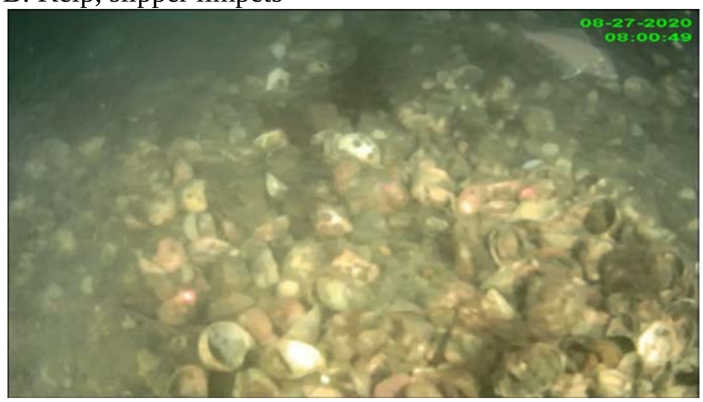
WORCESTER AVENUE LANDFALL

A: Sea robin, slipper limpets, sandy gravel

B: Kelp, slipper limpets



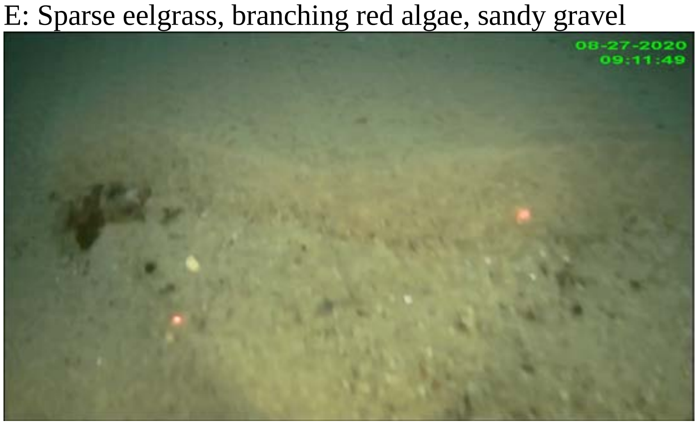
C: Slipper limpets, slightly sandy gravel



D: Kelp, slipper limpets, scup

E: Sparse eelgrass, branching red algae, sandy gravel


F: Sparse eelgrass, branching red algae

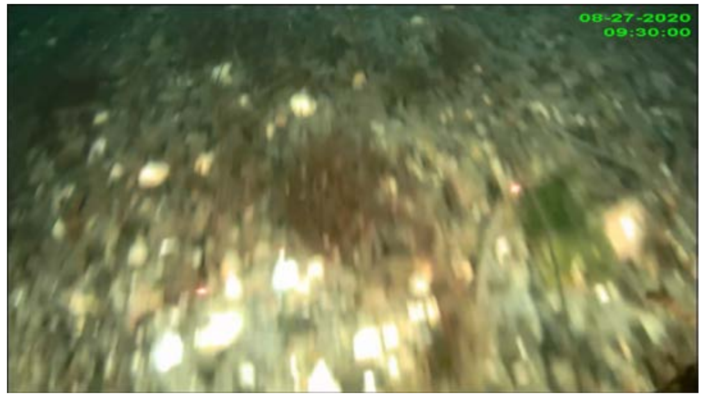


G: Kelp, migrating medium sand ripple


H: Sparse eelgrass, branching red algae, slight gravelly sand

Plate WA-2. Worcester Avenue Video Transect WA-2 Screen Captures

A: Branching red algae, gravelly sand



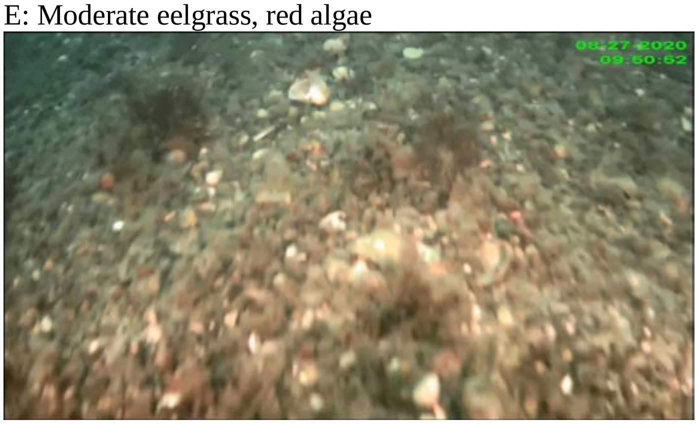
B: Red algae, sea lettuce, slipper limpets, sandy gravel

C: Moderate eelgrass, algae, gravelly sand

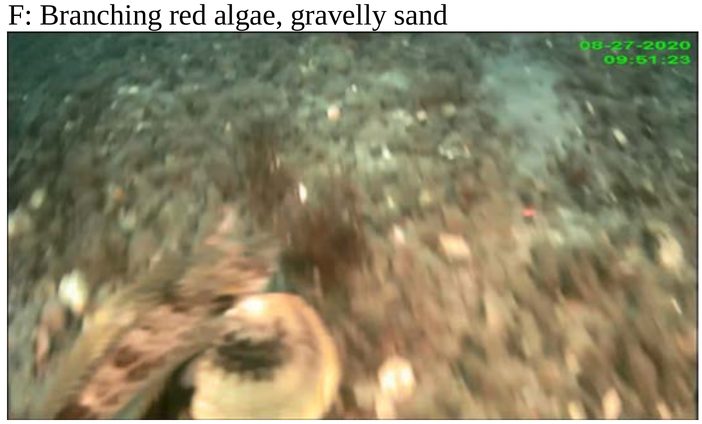
D: Moderate eelgrass, branching red algae, sandy gravel

E: Moderate eelgrass, red algae

F: Branching red algae, gravelly sand

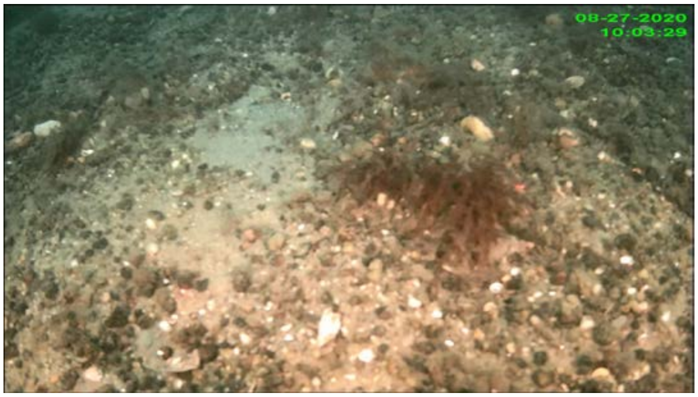


G: Slipper limpets, sandy gravel



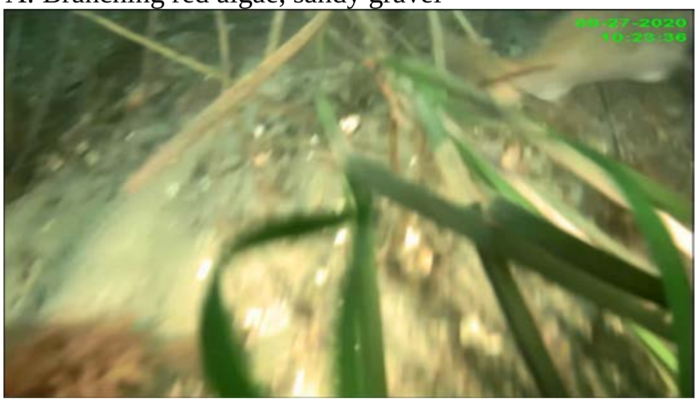
H: Sea robin, branching red algae, sandy gravel

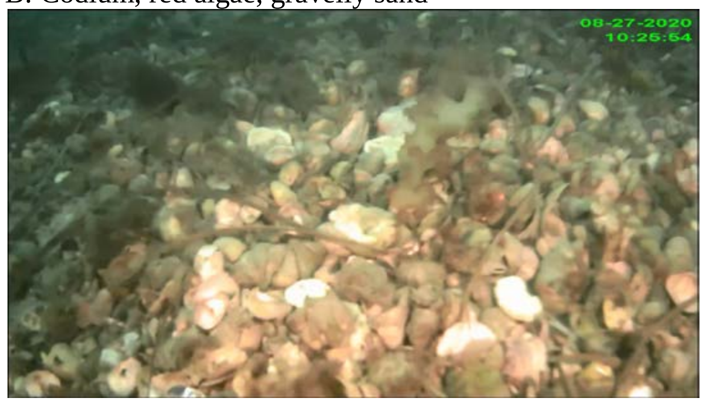
Plate WA-3. Worcester Avenue Video Transect WA-3 Screen Captures



A: Branching red algae, sandy gravel

B: Codium, red algae, gravelly sand


C: Sparse eelgrass, scup, gravelly sand



D: Kelp, slipper limpets

E: Sparse eelgrass, horseshoe crab, red algae, gravel


F: Sparse eelgrass, branching red algae, gravelly sand


G: Sparse eelgrass, branching red algae

H: Sparse eelgrass, branching red algae, gravelly sand

Plate WA-4. Worcester Avenue Video Transect WA-4 Screen Captures

A: Sparse eelgrass, epiphytic algae, sand

B: Moderate eelgrass, juvenile seabass, epiphytic algae, sand

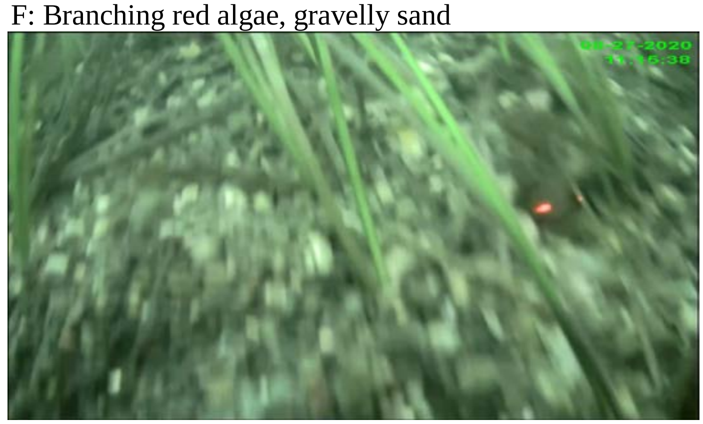
C: Moderate eelgrass, epiphytic algae, gravelly sand

D: Branching red algae, slightly gravelly sand

E: Sparse eelgrass, red algae, slightly gravelly sand

F: Branching red algae, gravelly sand

G: Dense eelgrass, gravel



H: Moderate eelgrass, gravel

Plate WA-5. Worcester Avenue Video Transect WA-5 Screen Captures

A: Dense eelgrass,- sandy gravel

B: Dense eelgrass, gravel

C: Codium, gravelly sand

D: Moderate eelgrass, branching red algae

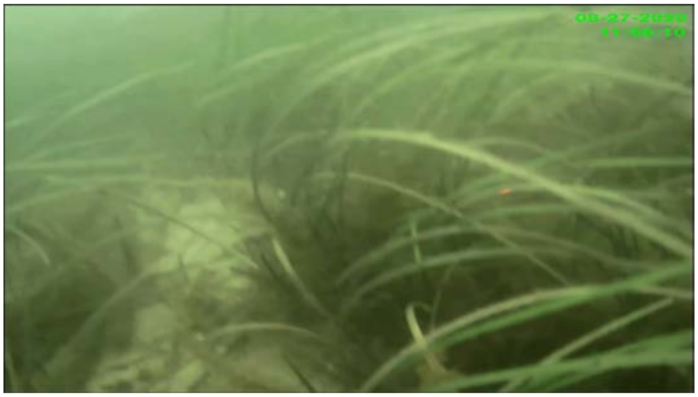
E: Sparse eelgrass, branching red algae, gravelly sand

F: Branching red algae, sandy gravel

G: Branching red algae, slightly gravelly sand

H: Dense eelgrass, bryozoans, epiphytic algae

Plate WA-6. Worcester Avenue Video Transect WA-6 Screen Captures



A: Dense eelgrass, sand

B: Dense eelgrass, bryozoans, branching red algae, sand

C: Moderate eelgrass, bryozoans, algae, gravelly sand

D: Moderate eelgrass, epiphytic algae, slightly gravelly sand

E: Sparse eelgrass, branching red algae, sand

F: Moderate eelgrass, branching red algae, sand

G: Sparse eelgrass, epiphytic algae, some shell, sand

H: Moderate eelgrass, red algae, slightly gravelly sand

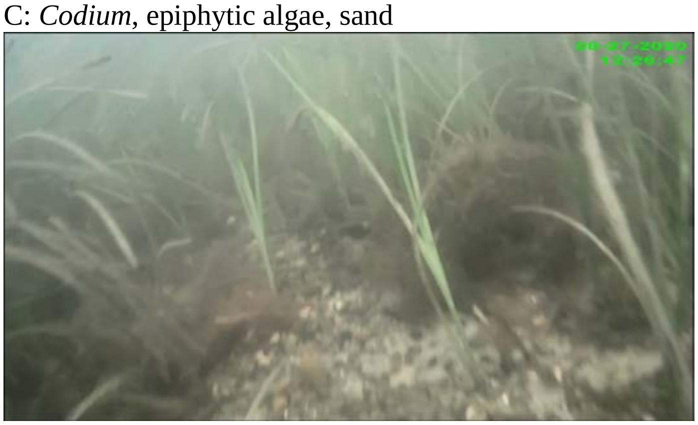
Plate WA-7. Worcester Avenue Video Transect WA-7 Screen Captures

A: *Sargassum*, sand

B: Moderate eelgrass, epiphytic algae, sand

C: *Codium*, epiphytic algae, sand

D: Moderate eelgrass, epiphytic algae, bryozoans, sand



E: Dense eelgrass, epiphytic algae, *Sargassum*, sandy gravel

F: Dense eelgrass epiphytic algae, bryozoans, gravelly sand

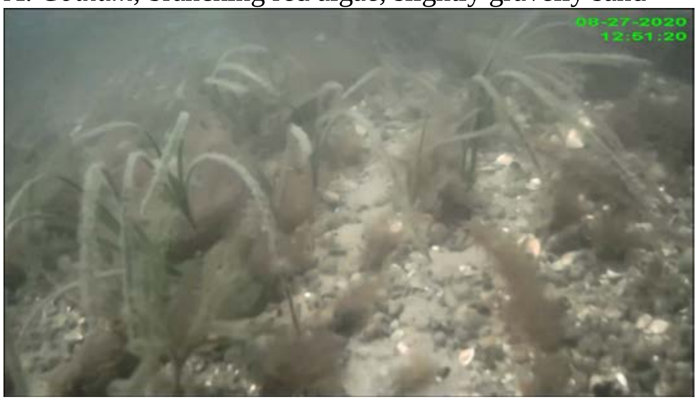
G: Moderate eelgrass, *Codium*, red algae, gravelly sand

H: Moderate eelgrass, branching red algae, gravelly sand

Plate WA-9. Worcester Ave. Video Transect Screen Captures

A: *Codium*, branching red algae, slightly gravelly sand

B: *Codium*, algae, juvenile seabass, slightly gravelly sand



C: Moderate eelgrass, epiphytic algae, gravelly sand

D: Dense eelgrass, epiphytic algae, gravelly sand

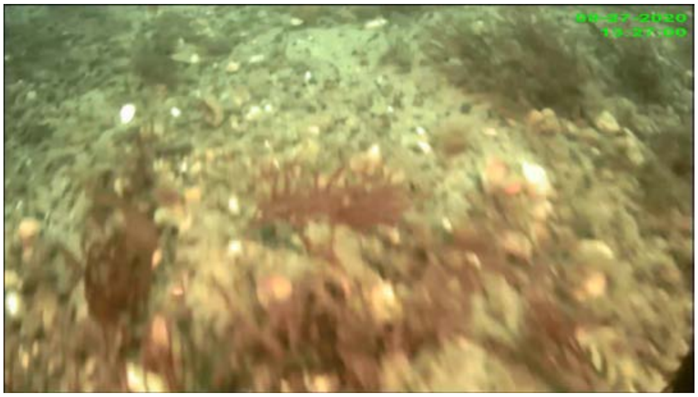
E: Moderate eelgrass, epiphytic algae, gravelly sand

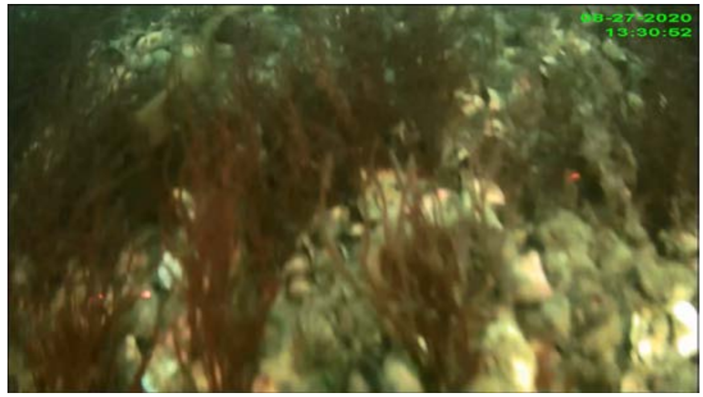
F: Moderate eelgrass, epiphytic algae, sandy gravel

G: Moderate eelgrass, *Codium*, algae, sandy gravel

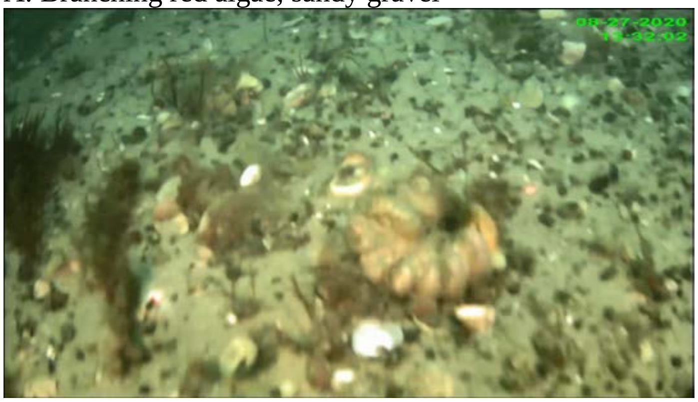
H: *Sargassum*, *Codium*, red algae, slightly gravelly sand

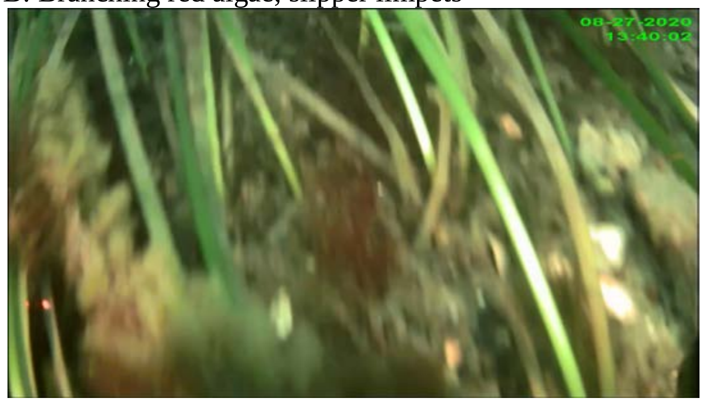
Plate WA-10. Worcester Avenue Video Transect WA-10 Screen Captures


A: Branching red algae, sandy gravel



B: Branching red algae, slipper limpets


C: Branching red algae, slipper limpets, gravelly sand

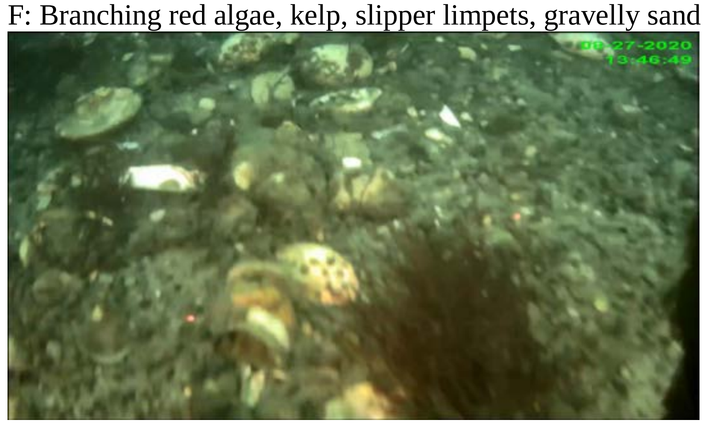


D: Moderate eelgrass, bryozoans, branching red algae


E: Sea robin, gravelly sand

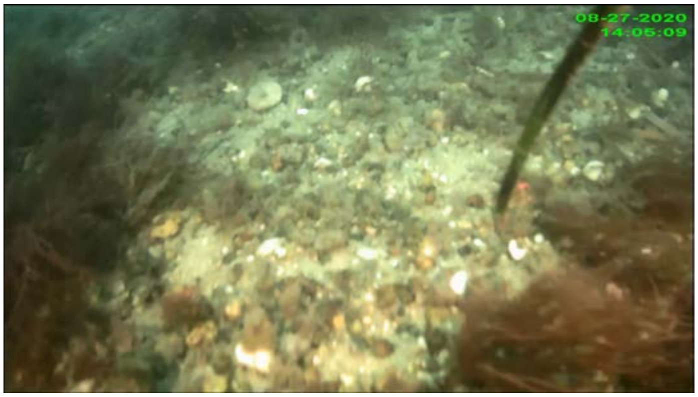

F: Branching red algae, kelp, slipper limpets, gravelly sand

G: Moderate eelgrass, algae, sand

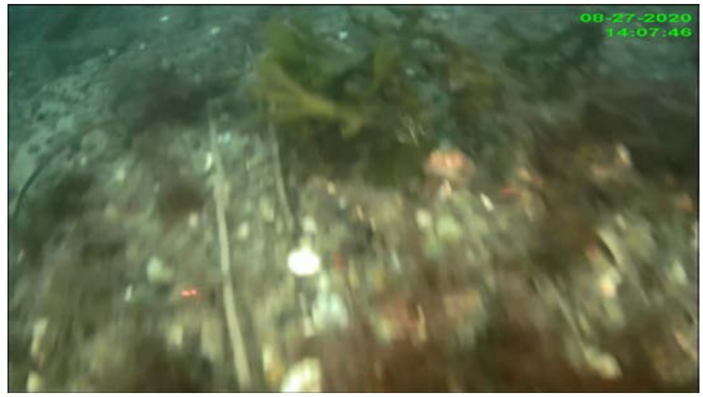


H: Branching red algae, shell hash, sandy gravel

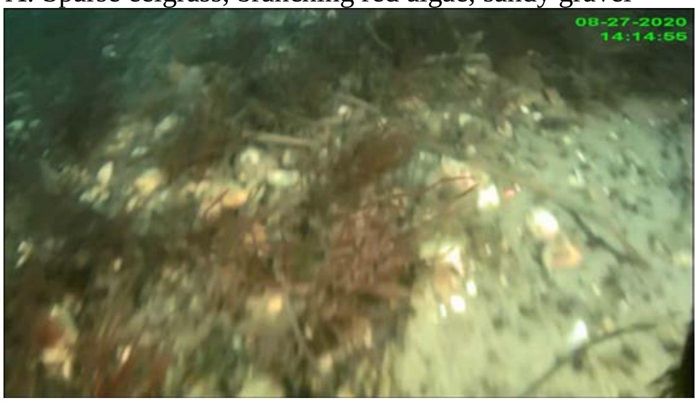
Plate WA-11. Worcester Avenue Video Transect WA-11 Screen Captures



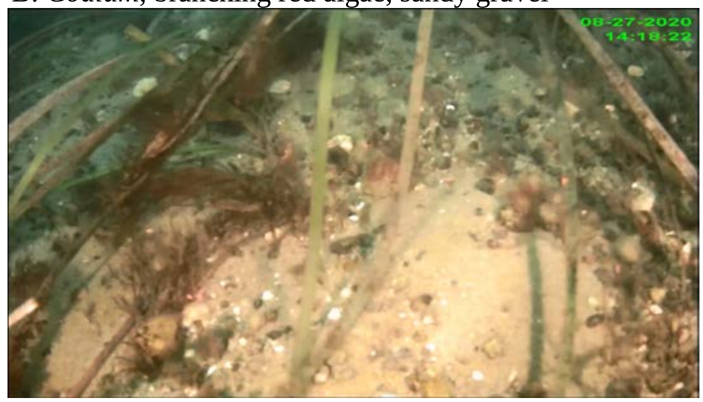
A: Sparse eelgrass, branching red algae, sandy gravel



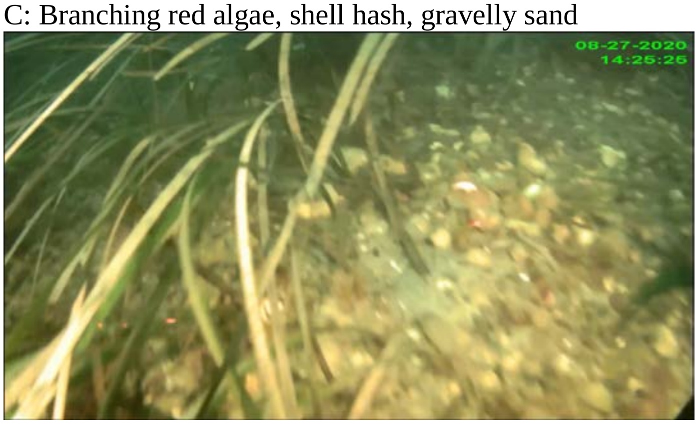
B: *Codium*, branching red algae, sandy gravel



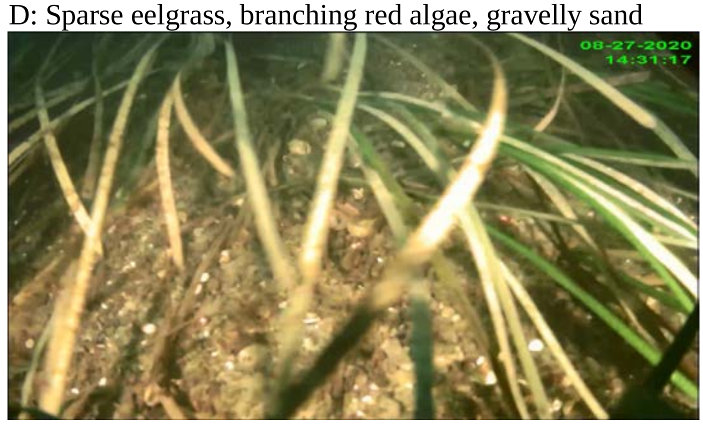
C: Branching red algae, shell hash, gravelly sand



D: Sparse eelgrass, branching red algae, gravelly sand



E: Moderate eelgrass, shell hash, sandy gravel



F: Moderate eelgrass, shell hash, sandy gravel

G: Branching red algae, kelp, gravelly sand

H: Branching red algae, slipper limpets, sandy gravel

Plate WA-12. Worcester Avenue Video Transect WA-12 Screen Captures