June 2023

BEACON WIND PROJECT:
Beacon Wind 1 and Beacon Wind 2

Construction and Operations Plan

VOLUME 2B: Biological Resources

Prepared for

Beacon Wind LLC

Submitted to

Bureau of Ocean Energy Management

Prepared by

AECOM

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5.0 Biological Resources and Habitats

The following sections provide an assessment of the terrestrial, coastal, and marine biological resources and habitats in the vicinity of the Project Area. Terrestrial systems assessed include those areas between the potential submarine export cable landfalls in New York and Connecticut, the potential onshore substation facility locations, and each respective potential POI location. The complete onshore Project will ultimately consist of a configuration that includes a single landfall location, onshore substation, and POI. Upgrades and improvements by port facilities that may be utilized by Beacon Wind as construction and staging areas for the Project are not assessed within this section. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Beacon Wind expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Beacon wind will comply with in using the facilities.

Beacon Wind proposes to develop the entire Lease Area with up to two individual wind farms for BW1 and BW2, with a submarine export cable route for BW1 to Queens, New York, and a submarine export cable route for BW2 to either Queens, New York or to Waterford, Connecticut. Two locations are under consideration in Queens, New York (NYPA and AGRE [which includes the AGRE East and AGRE West sites]) for the single proposed BW1 landfall and onshore substation facility. The Queens, New York onshore substation facility sites that are not used (NYPA, AGRE East, or AGRE West) for BW1 will remain under consideration, in addition to the Waterford, Connecticut site, for the single proposed BW2 onshore substation facility.

The following sections include a discussion of the existing vegetation community composition as it relates to the presence and quality of habitat, a review of sensitive habitats including wetlands and waterbodies, and an evaluation of avian and bat species along with other rare or protected species and natural communities. Coastal and marine systems reviewed include those areas located within and adjacent to the Lease Area and the submarine export cable route and include a characterization of benthic resources, finfish and invertebrate communities, and designated Essential Fish Habitat (EFH), as well as marine mammals and sea turtles. Along with the characterization of the affected environment, potential Project-related impacts to terrestrial, coastal and marine biological resources and habitats as a result of the construction, operation, and decommissioning of the Project are discussed. Resources reviewed as part of these biological resources and habitats assessment include a combination of publicly available data sources, resource-specific agency consultations, and targeted field surveys. These resources are referenced throughout the following sections.

5.1 Terrestrial Vegetation and Wildlife

This section describes terrestrial vegetation and wildlife resources that have been observed, or have the potential to occur, in the vicinity of the onshore portions of the Project Area. Potential impacts to terrestrial vegetation and wildlife resources resulting from construction, operation, and conceptual decommissioning of the Project are discussed. Proposed Project-specific measures adopted by Beacon Wind are also described, which are intended to avoid, minimize, and/or mitigate potential impacts to terrestrial vegetation and wildlife.

Other resources and assessments detailed within this COP that are related to terrestrial vegetation and wildlife include:

- Wetlands and Waterbodies (**Section 5.2**);
- Avian Species (**Section 5.3**);
- Bat Species (**Section 5.4**);
- USFWS IPaC and State Listed Species (**Appendix M**);
- Wetlands Delineation Reports (**Appendix N**);
- Avian Impact Assessment (**Appendix P**);
- Offshore Bat Survey Report (**Appendix Q**); and
- Bat Impact Assessment (**Appendix R**).

Data Relied Upon and Studies Completed

For the purposes of this section, the Study Areas include the two onshore portions of the Project Area (Queens, New York and Waterford, Connecticut) as well as a 1 mi (1.6 km) buffer area from the Onshore Project Areas. These Study Areas (Queens, New York Study Area [**Figure 5.1-1**] and Waterford, Connecticut Study Area [**Figure 5.1-2**]) are designed to encompass the coastal areas that may be directly and/or indirectly impacted by the onshore components, including the onshore export and interconnection cable routes, and two onshore substation facilities, associated with the construction, operations and decommissioning of the Project. The onshore Project Areas (Queens, New York Project Area and the Waterford, Connecticut Project Area) include potential landfall locations, onshore substation facilities (including the converter station and substation), onshore export and interconnection cable routes, and proposed POIs, though this component does not include the 1 mi (1.6 km) Study Area buffer area. As presented on **Figure 5.1-1** and **Figure 5.1-2,** potential landfall locations under consideration for BW1 and BW2 and onshore substation facilities in Queens, New York include the NYPA, AGRE East, and AGRE West sites and a landfall location and onshore substation facility in Waterford, Connecticut at property near the Dominion Millstone Power Station.

For BW1 and BW2 in Queens, New York, onshore export and interconnection cable routes between the onshore substation facility sites under consideration and the 138 kV substation, Astoria East POI and/or the 138 kV substation, Astoria West POI will consist of an underground electric transmission line from NYPA to Astoria West POI and aboveground electric transmission from AGRE East and AGRE West to both Astoria West and East POIs. The approximate location of proposed routes is presented on **Figure 5.1-1**.

At the BW2 Waterford, Connecticut landfall, installation techniques for the submarine export cable will be trenchless (e.g., HDD, jack and bore, or micro-tunnel). The landfall would traverse an area of rocky shoreline on the western edge of the Waterford, Connecticut Project Area then connect to the onshore substation facility located in the central portion of the Waterford, Connecticut Project Area. The site is mostly developed with gravel and aboveground appurtenances with an area of undeveloped forest. The Waterford, Connecticut Project Area also includes a proposed overhead interconnection from the onshore substation facility to the existing POI and will require two potential temporary staging areas. Further details depicting the Waterford, Connecticut Project Area are presented in **Figure 5.1-2.**

In order to determine the baseline terrestrial vegetation and wildlife conditions within the Study Areas, a desktop review was conducted with respect to the onshore electrical system for each of the onshore export and interconnection cable routes and associated onshore substation facilities, using the following resources:

- 2019 National Land Cover Dataset (NLCD): Land Cover Conterminous United States (USGS 2019); and
- 2020 Half-Foot 4 Band Long Island Zone New York City (NYC) Aerial Ortho-Photography (NYSDEC 2021d).

Consultation with state and federal agencies was conducted as part of a preliminary review of biological resources documented within and in the vicinity of the Study Areas. At the state level, maps of the Connecticut Department of Energy and Environmental Protection's (CTDEEP) Natural Diversity Database (NDDB) were searched to identify areas of the Waterford, Connecticut Study Area that would require consultation with the CTDEEP for rare plants and animals. The Environmental Resource Mapper (ERM 2021) was used to check the Queens, New York Study Area for the presence of Rare Plants and Animals, and Significant Natural Communities. In addition, the New York Nature Explorer digital database (NYSDEC 2021a) was used to obtain a list of rare plants and animals known to occur within Queens County.

According to the NYSDEC (NYSDEC 2021b), if a project is located within an area displayed in the Rare Plants and Rare Animals layer or in the Significant Natural Communities layer as shown on the ERM, then a project screening request to New York Natural Heritage is necessary. The onshore portions of the Queens, New York Project Area are not located within either of these mapped areas, however, portions of the Queens, New York Study Area **Section 5.1.1.2** below.

A review of the USFWS IPaC online project planning tool was also conducted for the Study Areas on June 09, 2022 (Queens, New York) and April 05, 2022 (Waterford, Connecticut). The planning tool provides lists of threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may be present within or in the immediate vicinity of the Study Area, and directly or indirectly affected by the Project.

FIGURE 5.1-1. TERRESTRIAL VEGETATION AND WILDLIFE STUDY AREA - QUEENS, NEW YORK

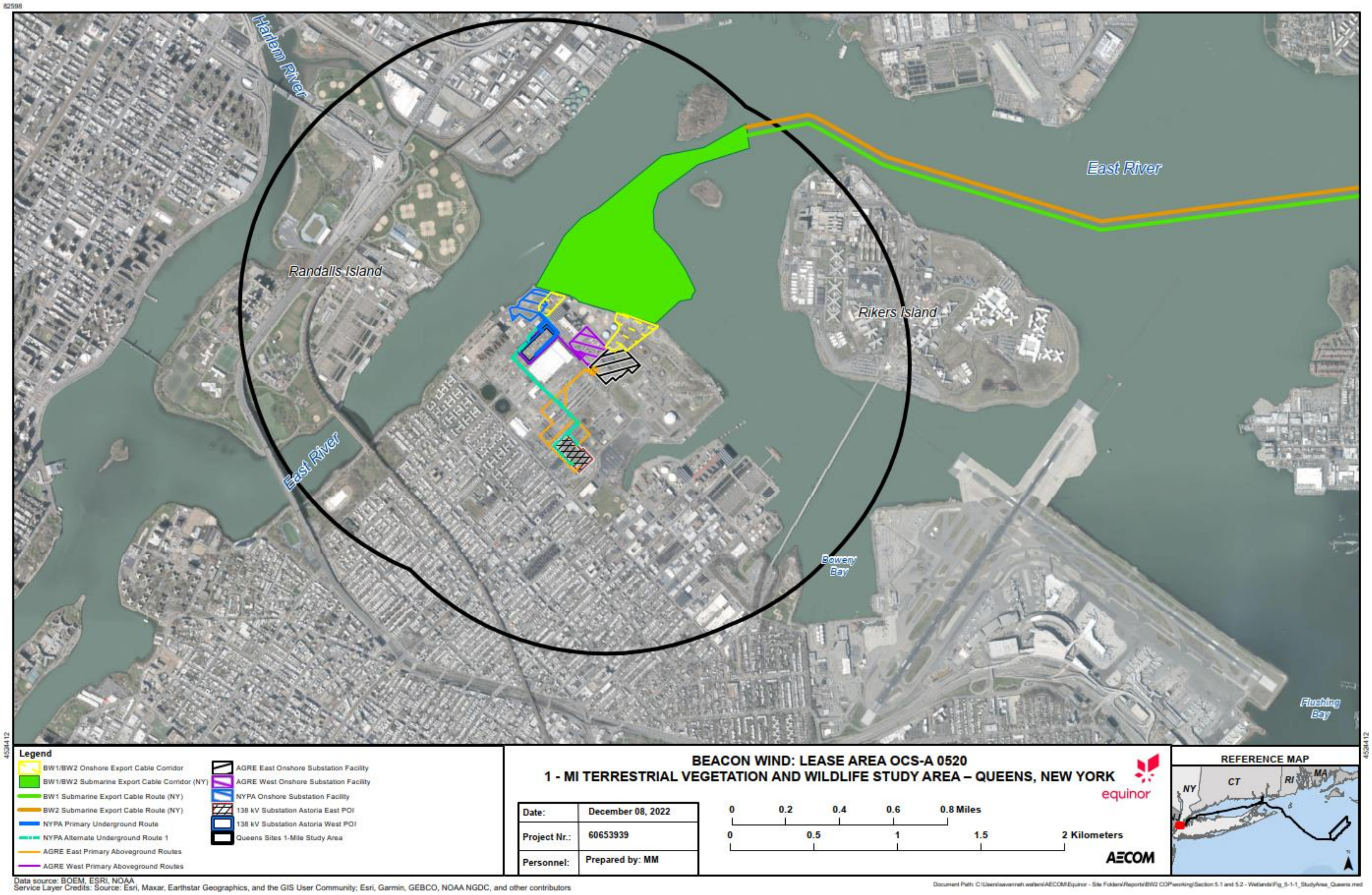
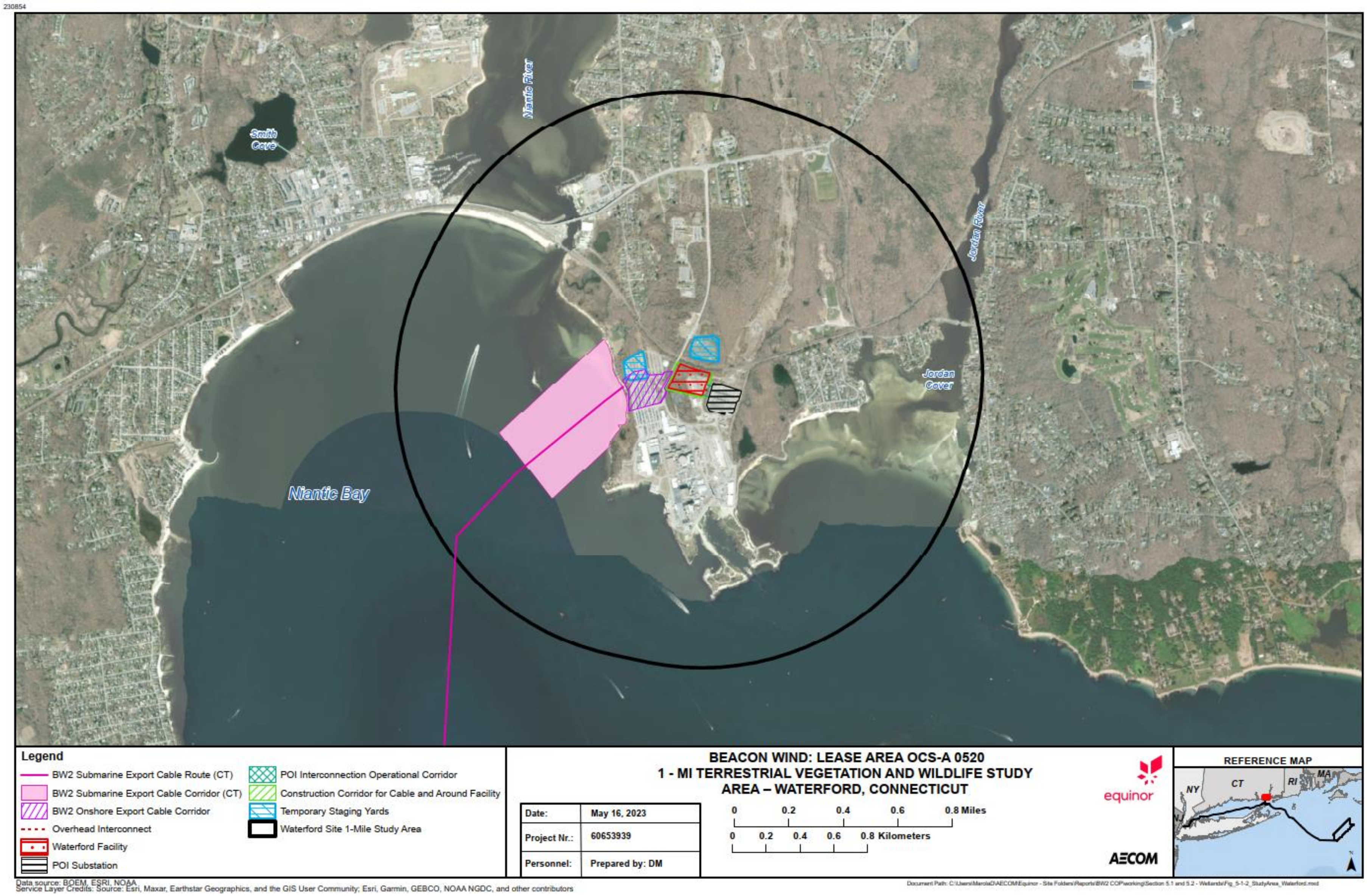


FIGURE 5.1-2. TERRESTRIAL VEGETATION AND WILDLIFE STUDY AREA - WATERFORD, CONNECTICUT



Where access permitted, a preliminary reconnaissance of the onshore portion of the Project Areas including the onshore export and interconnection cable routes, all onshore substation facilities under consideration (NYPA, AGRE East, AGRE West, and Waterford) and 138 kV substations (Astoria East POI, and/or Astoria West POI, and Waterford POI) was conducted on May 17, 2021 and September 15, 2022 in Queens, New York and March 17, 2022 in Waterford, Connecticut, to verify the presence of mapped wetland and waterbody resources identified during desktop analysis, and to assess the potential presence of unmapped wetland and waterbody resources. Field collected data were also used to support the assessment for terrestrial vegetation and wildlife. As final selection of Project landfall locations, Project siting, and transmission routes are refined and are complete, additional field reviews and delineations will be conducted, as necessary. See **Section 5.2 Wetlands and Waterbodies** and **Appendix N1 Wetland Delineation Report** – **Queens, New York** and **Appendix N2 Wetland Delineation Report – Waterford, Connecticut** for additional information.

5.1.1 Affected Environment

The affected environment is defined as the coastal wetlands (including the intertidal zone, tidal wetlands and associated adjacent areas) and onshore wetlands and waterbody areas, naturally vegetated areas and wildlife resources that have the potential to be directly or indirectly affected by the construction, operation, and conceptual decommissioning of the Project. This includes the onshore export and interconnection cable routes, and corridors from landfall to the onshore substation facilities. Upgrades and improvements made by port facilities that may be utilized by Beacon Wind as construction and staging areas for the Project are not assessed within this section. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Beacon Wind expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Beacon Wind will comply with in using the facilities.

5.1.1.1 *Land Use and Wildlife Habitat*

According to the NLCD (Wickham et al. 2021) land cover mapping, the Queens, New York Study Area is dominated by urbanized landscapes of the New York City metropolitan area. Aside from open waters of the East River, the NLCD maps primarily high and medium intensity developed lands with few areas of low intensity development and developed open space, see **Figure 5.1-3**. The only natural areas are associated with South Brother and North Brother Islands located approximately 2,700 ft (820 m) and 3,600 ft (1,100 m) northeast of the onshore portion of the Project Area, respectively. South Brother Island consists of approximately 6 ac (2.4 ha) of undeveloped emergent herbaceous and woody wetlands (Wickham et al. 2021) while North Brother consists of approximately 20 ac (8 ha) of woody wetlands and deciduous forest (Wickham et al. 2021) with scattered abandoned buildings (i.e., the former Riverside Hospital).

Reviews of the NLCD (Wickham et al. 2021) for the Waterford, Connecticut Study Area concluded that that majority of the surrounding terrestrial environment consists of developed land (including Open Space, Low Intensity, Medium Intensity, and High Intensity), with Medium Intensity Development making up the largest portion of developed land within the Waterford, Connecticut Study Area. Large areas classified as Deciduous Forests and Mixed Forests make up the majority of natural communities within the Study Area and are predominantly located to the north and northeast of the Waterford, Connecticut Project Area, see **Figure 5.1-4**. Field reviews of the Study Area identified these forested areas as historic farms undeveloped forestland, and large areas of maintained electric transmission rights-of-way (ROW).

FIGURE 5.1-3. REGIONAL LAND COVER MAPPING – QUEENS, NEW YORK

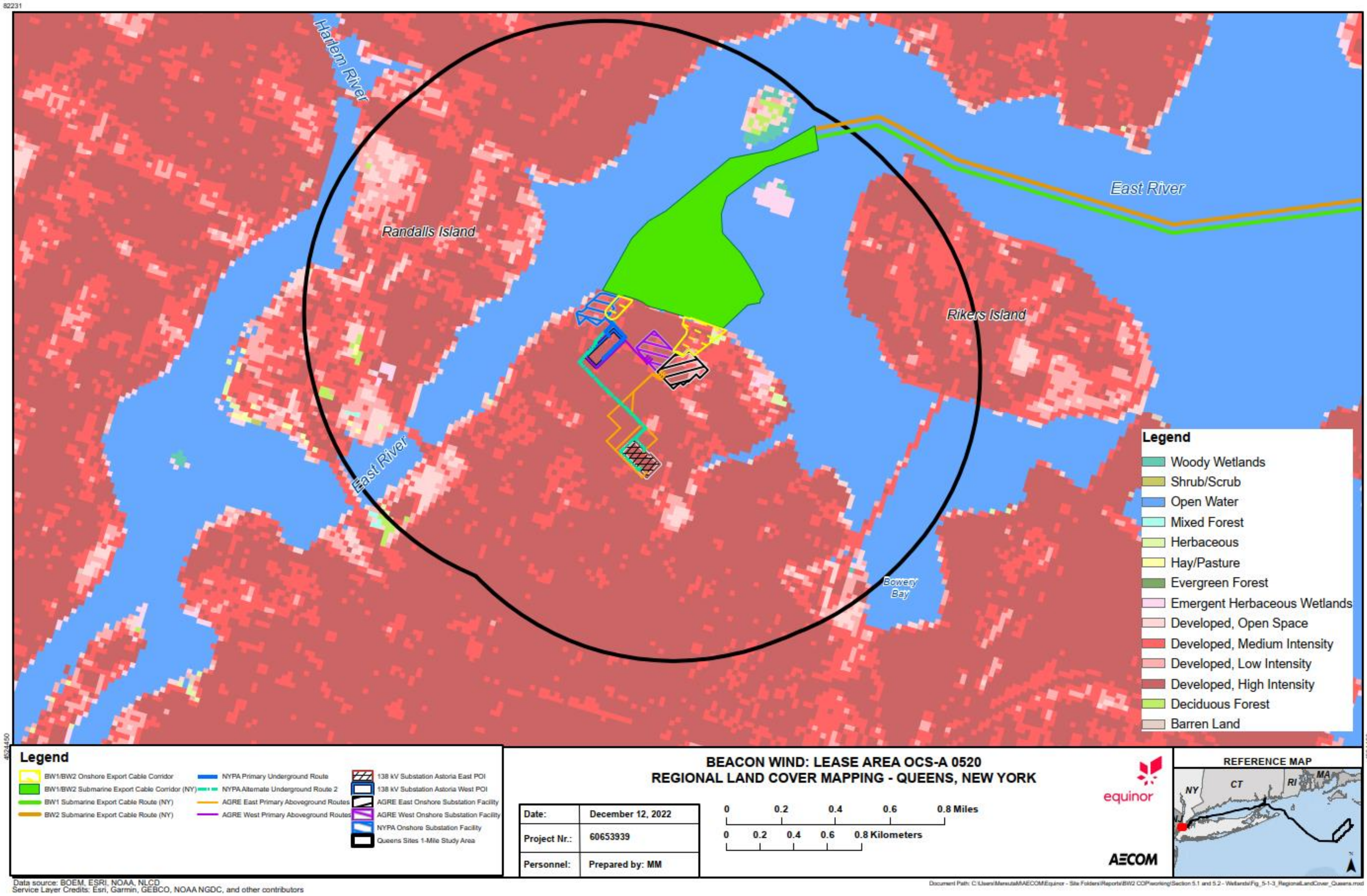
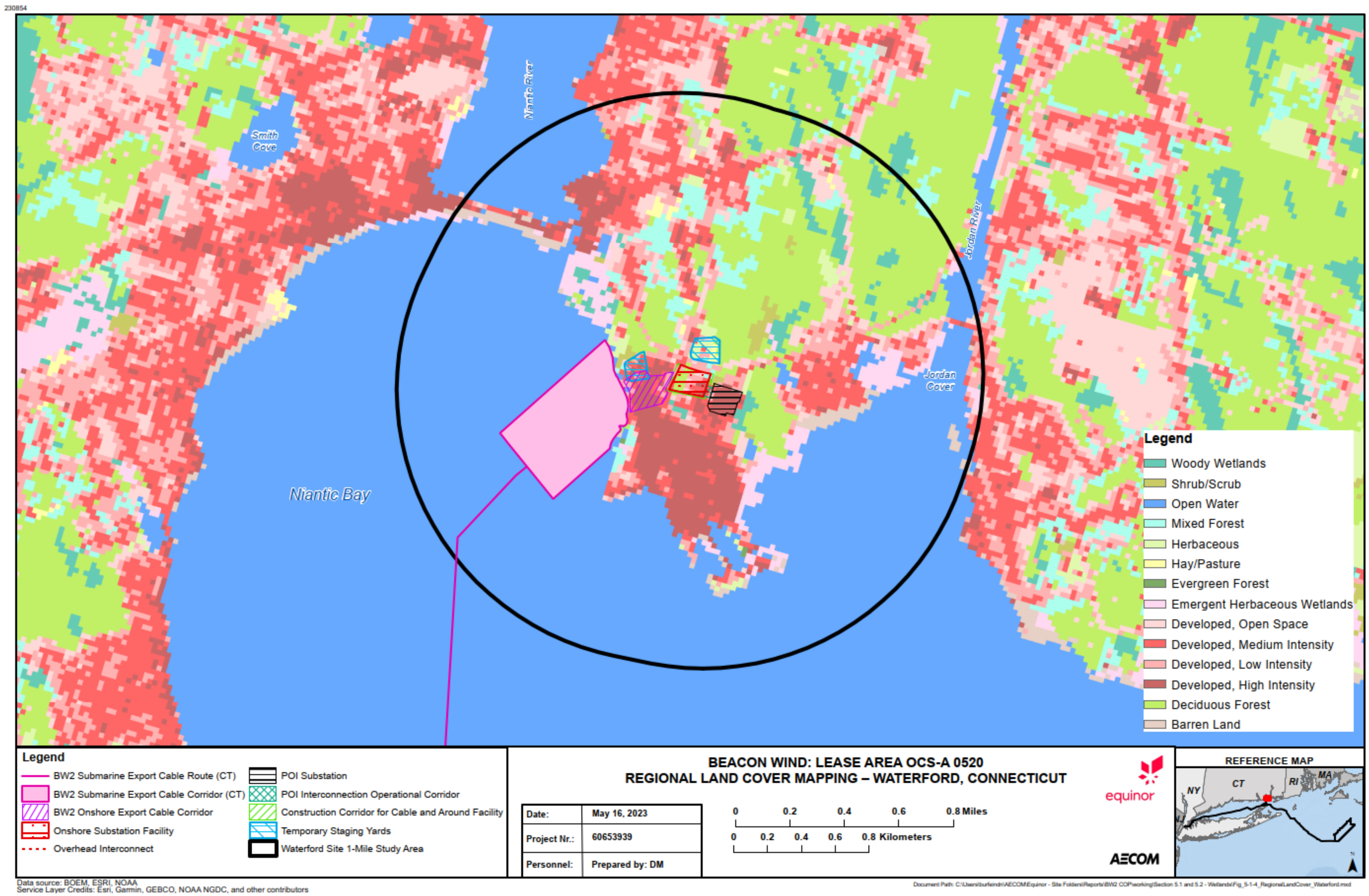


FIGURE 5.1-4. REGIONAL LAND COVER MAPPING – WATERFORD, CONNECTICUT



The onshore portions of the Queens, New York Project Area, which includes the two potential landfall locations, and two potential onshore substation facilities is densely developed with commercial and industrial properties including NYPA, Consolidated Edison of New York (ConEd), and Astoria Generating Co. This includes extensive impervious areas comprised of buildings, paved roads, and parking lots accounting for approximately 80 percent of the total area. The remaining land use includes some areas of maintained lawns (ten percent), disturbed open space (e.g., dirt parking lots, unpaved equipment storage yards; six percent) and semi-natural areas vegetated with shrubs and small trees (two percent) (**Figure 5.1-5**). The shoreline areas adjacent to the East River and Luyster Creek consist primarily of concrete seawalls and sloping rip-rap revetments. Total areas are provided in **Table 5.1-1**.

TABLE 5.1-1. LAND USE COVER WITHIN THE ONSHORE PORTIONS OF THE QUEENS, NEW YORK PROJECT AREA

Land Use	Area (ac)	Area (ha)
Roads, Parking, Buildings and other Structures	237.1	96.0
Rip-rap	2.7	1.1
Maintained Lawn	29.0	11.7
Disturbed Open Space	17.1	6.9
Scrub-Shrub/Forest Mix	5.5	2.2
Open Water	3.8	1.5
Grand Total	**295.2**	**119.5**

Due to the intensely developed nature of the onshore portions of the Project Area, few areas of natural vegetation cover were observed. Interior portions of the Project Area are primarily maintained lawn with few scattered landscape tree and shrub species.

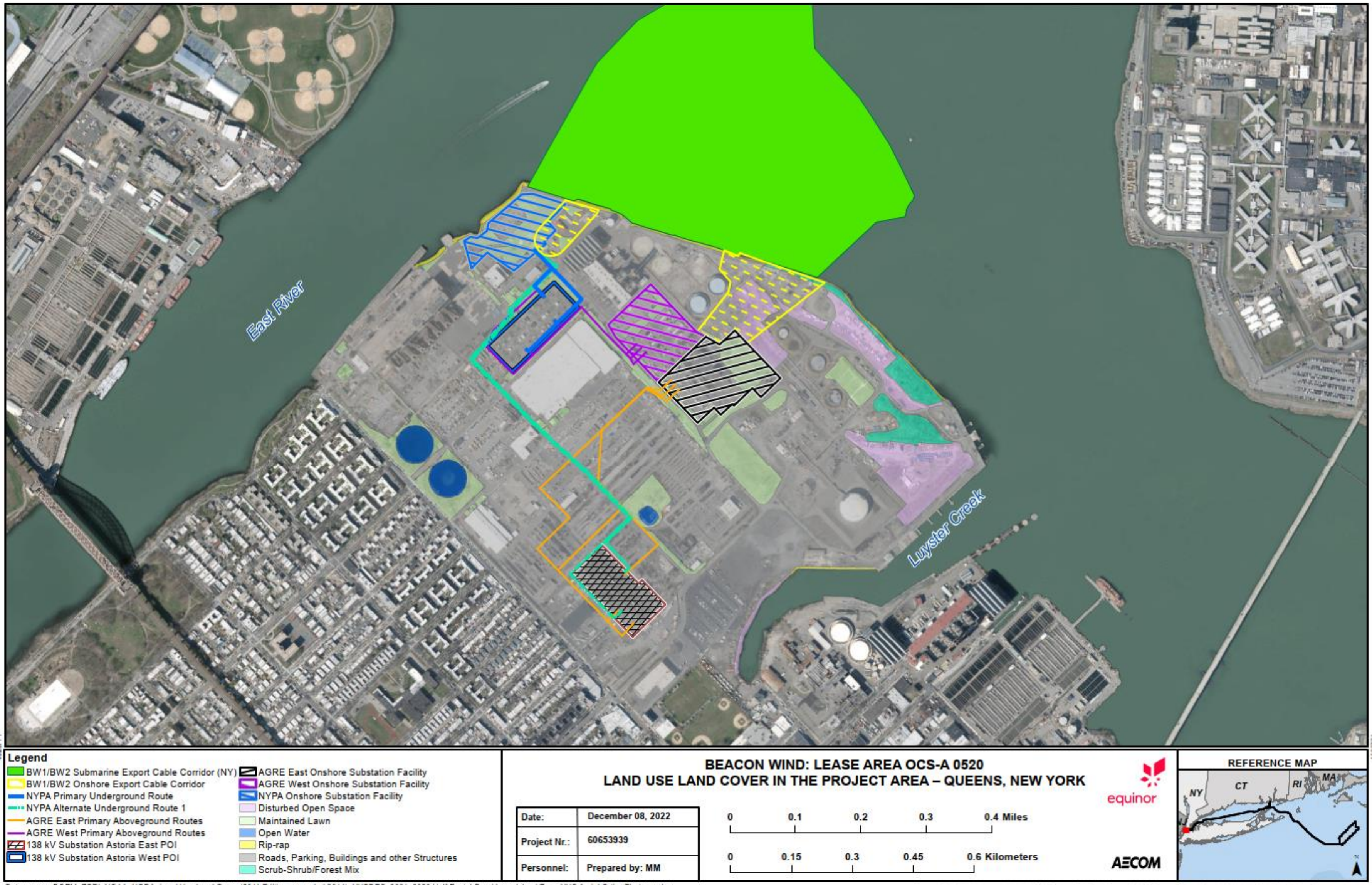
The NYPA parcel for onshore substation facilities is approximately 6.8 ac (2.8 ha) and located at the northwest corner of Astoria power complex adjacent to Lawrence Point and the East River (**Figure 5.1-5**). The onshore portions of the Project Area contain a mosaic of paved impervious surfaces (concrete pads, bituminous concrete driveways, and parking areas) with maintained lawn areas and a few scattered trees suggesting past commercial land use activities and development. However, several buildings are located along the southeastern limits of the NYPA parcel including storage sheds and a maintenance garage. The north and west sides of the perimeter of the NYPA parcel are bounded by the East River and a fenced security road.

The AGRE parcel (which includes both AGRE East and AGRE West) for onshore substation facilities is approximately 15.9 ac (6.4 ha) and located at the central portion of the Astoria power complex (**Figure 5.1-5**). Current conditions of the onshore Project Area are a mosaic of constructed buildings, and paved, concrete, gravel, and bituminous concrete ground material surfaces. There are several areas of maintained lawn and ornamental trees present within the parcel including an area in the northeastern portion of the parcel containing an area of maintained grasses over a gravel lot surrounded by mature trees. The onshore portions of the Waterford, Connecticut Project Area, which includes the potential landfall location, the potential onshore substation facility, as well as laydown and staging areas, consists of a highly disturbed environment including extensive paved and maintained areas. Disturbed areas, including developed, disturbed, and maintained areas as well as late successional scrub-shrub areas, consist of approximately 75 percent of the Waterford, Connecticut Project Area. The majority of areas considered late successional scrub-shrub are ROW for either transmission or distribution lines, or areas on the periphery of highly disturbed areas. The western extent of the Waterford, Connecticut Project Area is the potential landfall location which consists of a rocky shoreline with small areas of sandy beach and salt marsh. Further details on the land use and land cover of the Waterford, Connecticut Project Area can be found in **Table 5.1-2** and **Figure 5.1-6**.

TABLE 5.1-2. LAND USE COVER WITHIN THE ONSHORE PORTIONS OF THE WATERFORD, CONNECTICUT PROJECT AREA

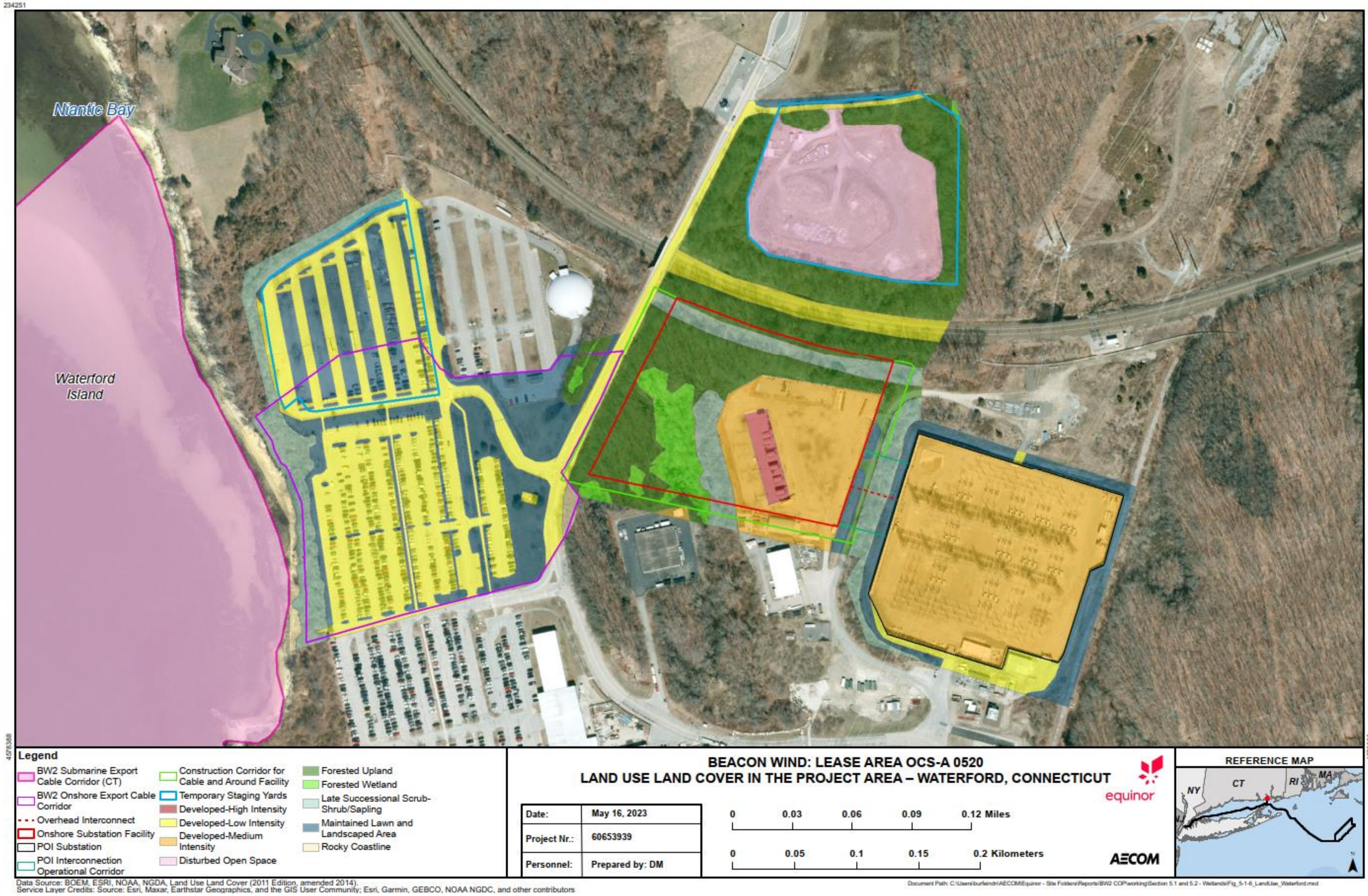
Land Use	Area (ac)	Area (ha)
Developed - High Intensity	0.3	0.1
Developed - Low Intensity	4.1	1.7
Developed - Medium Intensity	10.8	4.4
Maintained Lawn and Landscaped Area	9.5	3.8
Disturbed Open Space	8.6	3.5
Late Successional Scrub-Shrub/Sapling	1.1	0.4
Forested Upland	3.6	1.5
Forested Wetland	7.5	3.0
Grand Total	**45.5**	**18.4**

FIGURE 5.1-5. LAND USE COVER OF THE ONSHORE PORTIONS OF THE QUEENS, NEW YORK PROJECT AREA



Data source: BOEM, ESRI, NOAA, NGDA, Land Use Land Cover (2011 Edition, amended 2014), NYSDEC. 2021. 2020 Half-Foot 4 Band Long Island Zone NYC Aerial Ortho-Photography.
Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community; Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

FIGURE 5.1-6. LAND USE COVER OF THE ONSHORE PORTIONS OF THE WATERFORD, CONNECTICUT PROJECT AREA



Proposed as POIs within the Queens, New York Project Area (i.e., Astoria East POI and/or Astoria West POI) are already operational and no large-scale construction activities or vegetation removal will be necessary in these areas. Onshore export and interconnection cable routes are located within existing paved roadways or directly adjacent to them in maintained lawn and landscaped areas. Some examples of semi-natural vegetation cover types, freshwater or coastal wetlands, and intertidal zones are situated within the corridor between the landfall locations located at onshore substation facilities out to the offshore trenchless installation method exits. However, due to the planned trenchless installation method for landfall, it is expected that impacts to these areas will be avoided and/or minimized.

Semi-natural areas were observed during field reviews of the onshore Project Area and within a few small, isolated landscape patches, and were dominated by invasive plant species. Seven plant species listed in the New York State Prohibited and Regulated Invasive Plants list (NYSDEC 2014) were observed within the onshore portions of the Project Area during field reviews (**Table 5.1-3**). Invasive species are defined therein as a species that is nonnative to a particular ecosystem, and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

Invasive species can out-compete native species, reduce biological diversity, alter community structure and, in some cases, change entire ecosystems. Knowledge of invasive species present within the Project Area is important because they are capable of taking advantage of and thriving in disturbed soil conditions such as those typical of active construction sites. If site restoration is required upon coordination with state and federal agencies, restoration plans would encourage vigorous growth of native plants to prevent further spread of these species within the onshore Project Area.

TABLE 5.1-3. INVASIVE PLANT SPECIES OBSERVED WITHIN THE ONSHORE PORTIONS OF THE QUEENS, NEW YORK PROJECT AREA

Common Name	Scientific Name
Black locust	*Robinia pseudoacacia*
Garlic mustard	*Alliaria petiolata*
Japanese knotweed	*Reynoutria japonica*
Mugwort	*Artemisia vulgaris*
Common reed	*Phragmites australis*
Princess Tree	*Paulownia tomentosa*
Tree of heaven	*Ailanthus altissima*

Terrestrial wildlife within the onshore portions of the Project Area is expected to be limited to those species adapted to living in urban environments and living in association with human-influenced landscapes, disturbance, and noise. These may include gulls, pigeons, squirrels, and other small rodents or other commensal wildlife. Additionally, shorebirds may forage on exposed mudflats along Luyster Creek or within the wrack-lines deposited along the armored rip-rap shoreline. Small habitat patches of mixed cover types (i.e., open water, wetlands, shrubs and trees) may provide habitat for additional species. However, these areas are spatially isolated from other habitats and tend to be dominated by invasive plants. In addition, many of these areas show evidence of past disturbances including vegetation removal, cut and fill of soils and former structures.

The Waterford, Connecticut parcel for the onshore substation facility is approximately 7.1 ac (2.8 ha) and located in the central portion of the Waterford, Connecticut Project Area north of the existing Dominion Millstone Power Station and west of the Proposed POI, see **Figure 5.1-6**. Current conditions within this portion of the Waterford, Connecticut Project Area consist mainly of forested upland areas with a sizable portion of paved areas currently utilized in support of the Dominion Millstone Power Station. There are also portions of forested wetlands located in the central and southern portion of the proposed site.

A sizable portion of the site assessed for the onshore substation facility is currently paved and would not require any additional impacts to terrestrial vegetation or wildlife. However, the development of the remaining portion of the onshore substation facility would require tree clearing within forested uplands and a small portion of forested wetlands. The majority of the onshore portion of the Waterford, Connecticut Project Area is already developed and utilized in support of the Dominion Millstone Power Station. These areas include large areas of paved parking lots with sparsely vegetated parking dividers, maintained areas of lawn or low growing vegetation, and large paved areas for building and development.

Semi-natural areas identified during field reviews of the Waterford, Connecticut Project Area consisted of areas on the periphery of the site including a steep sloping area that divides the rocky shoreline to the west and the parking area to the east as well as the northern temporary staging area. This area consists of scrub-shrub vegetation and is dominated by invasive vegetation including mugwort, common reed, garlic mustard, multiflora rose (*Rosa multiflora*), buckthorn (*Rhamnus cathartica*), and spotted knapweed (*Centaurea stoebe*).

Natural areas observed during field reviews consisted of a swath of upland and wetland forests located within the central portion of the Waterford, Connecticut Project Area. This site consisted of a developed overstory of midsize trees dominated by northern red oak (*Quercus rubra*), American beech (*Fagus grandifolia*), red maple (*Acer rubrum*), and white birch (*Betula papyrifera*). The understory consisted of saplings and shrubs of northern spicebush (*Lindera benzoin*), musclewood (*Carpinus caroliniana*), and red maple with vines of greenbrier (*Smilax rotundifolia*).

5.1.1.2 *State-listed Species*

Queens, New York

According to the NYSDEC (NYSDEC 2021b), if a site does not fall within an area displayed in the Rare Plants and Rare Animals layer or in the Significant Natural Communities layer, then New York Natural Heritage has no records to report in the vicinity of the site and submitting a project screening request to New York Natural Heritage is not necessary.

Using the NYSDEC Environmental Resource Mapper (ERM 2021), two areas of Rare Plants and Rare Animals are identified within the Study Area (**Figure 5.1-7**). This includes an area located west of the onshore portions of the Queens, New York Project Area, which is in the vicinity of an Animals Listed as Endangered or Threatened and an area to the northeast of the onshore portions of the Queens, New York Project Area, which is in the vicinity of a Significant Colonial Waterbird Nesting Area. No Significant Natural Communities are identified within or adjacent to the onshore portions of the Queens, New York Project Area.

Although no onshore construction related activities are expected to occur within either of these mapped habitat areas, potential landfall locations, and portions of the submarine export cable route, are currently situated within the area mapped as a Significant Colonial Waterbird Nesting Area. No impacts to these nesting bird habitats are expected because the submarine export cable is located underwater and the HDD exits, jack and bore, micro-tunneling, direct pipe, or open trench landfalls, at the locations under consideration, are located in water depths of approximately 20 ft (6 m) and no closer than approximately 2,300 ft (700 m) from the closest point on South Brother Island.

Although no portions of the onshore Project will impact Rare Plants and Rare Animal polygons, the proximity of the polygons and the submarine export cable intersection with Rare Plants and Rare Animal polygons prompted consultation with the New York Natural Heritage Program (NYNHP). A Project Screening report for the Project Area within the jurisdiction of the State of New York, including state jurisdictional waters was submitted to the Natural Heritage Program on October 27, 2021, and the Natural Heritage Program responded on November 8, 2021 with a database report for onshore species potentially impacted by the Project. Please note that marine species are not included in this assessment.

Rare Plants and Animals are defined in the NYSDEC Fish and Wildlife Regulations (6 CRR-NY 182.2; NYSDEC 2022):

- Species of special concern are native species of fish and wildlife found by the department to be at risk of becoming threatened in New York.... Species of special concern do not qualify as either endangered or threatened... but have been determined by the department to require some measure of protection to ensure that the species does not become threatened.
- Threatened species are any species that:
  - are native species likely to become an endangered species within the foreseeable future in New York; or
  - are species listed as threatened by the federal government.
- Endangered species are species that:
  - are native species in imminent danger of extirpation or extinction in New York; or
  - are species listed as endangered by the federal government.

The Natural Heritage database report identified one state endangered species, peregrine falcon (*Falco peregrinus*), in the Project Area. The report identifies a breeding population in the area of the Throgs Neck Bridge. The peregrine falcon is a small raptor with strong distinguishing facial patterns that nests on ledges, rock outcrops, and tall structures such as buildings and bridges NYNHP (NYNHP 2021b). The Throgs Neck Bridge is located along the submarine export cable route approximately 5.5 mi (8.77 km) from the nearest portion of the onshore portion of the Queens, New York Project Area, and the potential landfall locations.

In addition to the peregrine falcon, the NYNHP identified five rare animals, one state-significant Colonial Waterbird Nesting Area, and one historic documented rare animal in the area of the submarine export cable route. The species identified by the NYNHP are detailed in **Table 5.1-4**.

TABLE 5.1-4. NYNHP TERRESTRIAL RARE SPECIES IDENTIFIED ALONG SUBMARINE CABLE ROUTES

Species Common Name	Species Scientific Name	New York State Listing	Heritage Conservation Status
Glossy Ibis	*Plegadis falcinellus*	Protected Bird	Imperiled in NYS
Cattle Egret	*Bubulcus ibis*	Protected Bird	Imperiled in NYS
Little Blue Heron	*Egretta caerulea*	Protected Bird	Imperiled in NYS
Snowy Egret	*Egretta thula*	Protected Bird	Imperiled in NYS
Yellow-crowned Night-Heron	*Nyctanassa violacea*	Protected Bird	Imperiled in NYS
Historic Identified Species			
Barn Owl	*Tyto alba*	Protected Bird	Critically Imperiled in NYS

The majority of the species identified by the NYNHP are avian species that prefer habitats including marshes, swamps, tidal flats, and shorelines. These species were identified along the submarine export cable route and it is therefore likely that these species were identified at or near North and South Brother Islands. The barn owl (*Tyto alba*) historic record was documented in 1984 nesting in the attics and upper stories of abandoned buildings on North Brother Island.

Waterford, Connecticut

Within the State of Connecticut, the NDDB provides reviews of environmental impacts and assessments of state listed species. The NDDB maintains a record of reported occurrences of state-listed species and distributes spatial data of general areas where state listed species may occur. The Waterford, Connecticut Project Area intersects two of these NDDB areas, see **Figure 5.1-8** for more details. Prior to construction, a notification would need to be sent to the NDDB detailing the location, extent, and type of alterations and construction occurring within the NDDB area. Additional site protection or site surveys may be required prior to construction in order to address the potential for state listed species within the Waterford, Connecticut Project Area.

A NDDB request was submitted to NDDB for the Waterford Project Area and a preliminary assessment was provided on August 05, 2022 (NDDB Preliminary Assessment No.:202205104). This preliminary NDDB Assessment provided details on state-listed species potentially occurring within the Project Area, as well as protected habitats. A copy of the NDDB assessment is attached in **Appendix M USFWS IPaC and State Listed Species**. The preliminary determination identifies 15 species within the NDDB areas including eight special concern species, four state threatened species, and two state endangered species. The State of Connecticut has specific definitions for each of these classifications (CTDEEP 2022):

- "Species of Special Concern" means any native plant species or any native non-harvested wildlife species documented by scientific research and inventory to have a naturally restricted range or habitat in the state, to be at a low population level, to be in such high demand by man that its unregulated taking would be detrimental to the conservation of its population or has been extirpated from the state.
- "Threatened Species" means any native species documented by biological research and inventory to be likely to become an endangered species within the foreseeable future

throughout all or a significant portion of its range within the state and to have no more than nine occurrences in the state, and any species determined to be a "threatened species" pursuant to the federal Endangered Species Act, except for such species determined to be endangered by the Commissioner

- "Endangered Species" means any native species documented by biological research and inventory to be in danger of extirpation throughout all or a significant portion of its range within the state and to have no more than five occurrences in the state, and any species determined to be an "endangered species" pursuant to the federal Endangered Species Act.

See **Table 5.1-5** below for a full list of the identified species.

TABLE 5.1-5. STATE PROTECTED SPECIES IDENTIFIED IN NDDB AREAS NEAR THE WATERFORD, CONNECTICUT PROJECT AREA

Species Common Name	Species Scientific Name	Connecticut State Protection Status
Plants		
Bush's sedge	Carex bushii	SC
Seabeach sandwort	Honckenya peploides	SC
Sickle-leaved golden aster	Pityopsis falcata	*E*
Reptiles		
Loggerhead	Caretta caretta	*T*
Atlantic green turtle	Chelonia mydas	*T*
Leatherback	Dermochelys coriacea	*E*
Atlantic ridley	Lepidochelys kempii	*E*
Northern diamondback terrapin	Malaclemys terrapin terrapin	*SC*
Eastern ribbon snake	Thamnophis sauritus	*SC*
Fish		
Sand tiger shark	Carcharias taurus	*SC*
Radiated shanny	Ulvaria subbifurcata	*SC*
Birds		
Piping plover	Charadrius melodus	*T*
Peregrine falcon	Falco peregrinus	*T*
Purple martin	Progne subis	*SC*
Invertebrates		
Atlantic seasnail	Liparis atlanticus	*SC*
Note: E=Endangered; T=Threatened; SC=Special Concern		

5.1.1.3 Federally-listed Species

Federally-listed threatened and endangered species were reviewed using the USFWS IPaC online tool. IPaC identified one mammal and three birds within the Queens, New York Project Area. The one mammal includes Northern long-eared bat (*myotis septrionalis*), and the three birds include piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and roseate tern (*Sterna dougallii dougallii*). In addition, IPaC identified one mammal, one bird, and one insect within the Waterford, Connecticut Project Area. These species include the Northern long-eared bat , roseate tern (*Sterna dougallii dougallii*), and the monarch butterfly (*Danaus plexippus*).

Section 3 of the Endangered Species Act of 1973 (USFWS 2022) defines threatened and endangered species as:

- The term “threatened species” means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
- The term “endangered species” means any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the provisions of this Act would present an overwhelming and overriding risk to man.

The USFWS also recognizes “candidate species” or species that the agency believes to be eligible for listing as threatened or endangered, but whose status has not yet been officially determined.

Piping plover (Threatened) is the first of the shorebirds to arrive on the breeding grounds, starting from early to mid-March. Piping plovers nest on open, sparsely vegetated beaches and sandflats between the primary dune and high tide line beaches, and primarily forage within wrack lines left by the high tide. Nest areas with ephemeral pools and bay tidal flats provide higher quality habitat. Within New York, this species breeds on Long Island's sandy beaches from Queens to the Hamptons, in the eastern bays and in the harbors of northern Suffolk County (NYSDEC 2021c).

FIGURE 5.1-7. NYSDEC RARE PLANTS AND RARE ANIMALS IN THE STUDY AREA

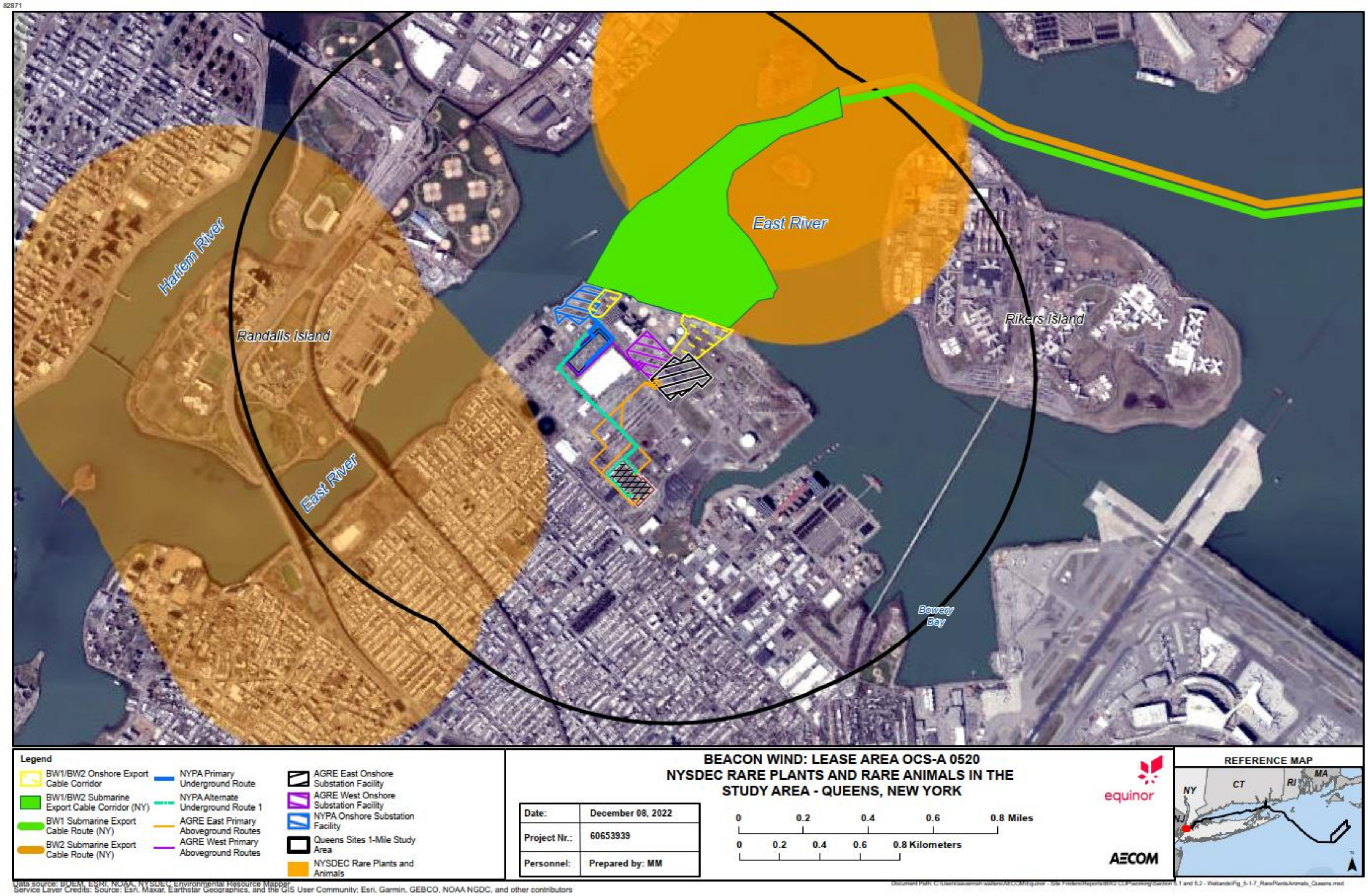
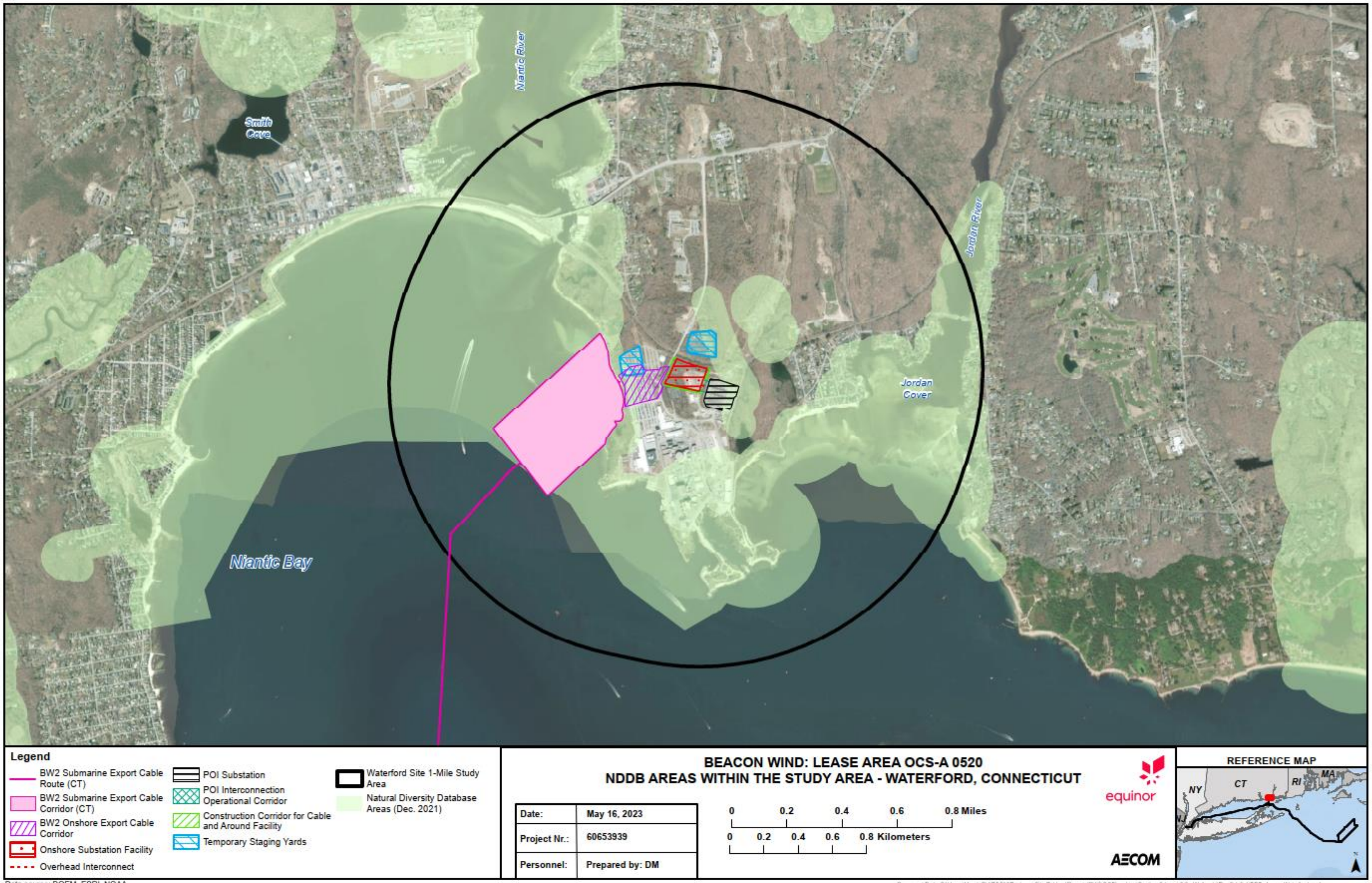


FIGURE 5.1-8. NDDB POLYGONS WITHIN THE STUDY AREA

230854



Data source: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community; Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Red knots (Threatened) are extreme long-distance migrators with some travelling more than 9,300 mi (14,967 km) south to north and back in a single season. Long-distance migrations require stopover habitats rich in easily digested foods, with thin or no shells, in order to gain enough weight to fuel the next flight. Rufa red knots, the subspecies found in the eastern U.S., feed on invertebrates, especially small clams, mussels, and snails, but also crustaceans, marine worms, and horseshoe crab (*Limulus polyphemus*) eggs. Red knot is a shorebird species and requires natural stretches of beaches and other coastal, marine and estuarine (partially enclosed tidal area where fresh and saltwater mixes) habitats with large areas of exposed intertidal sediments that are used for resting and refueling (USFWS 2021).

Roseate terns (Endangered) arrive on the breeding grounds in late April or early May and begin nesting one month later. The nest may be only a depression in sand, shell, or gravel, and may be lined with bits of grass and other debris. It is usually placed in dense grass clumps, or even under boulders or rip-rap. Typical breeding locations include salt marsh islands and beaches with sparse vegetation (NYSDEC 2021c). According to the NYNHP (NYNHP 2021a), roseate terns nest almost exclusively on rocky, barrier beach, and saltmarsh islands where predation pressure may be lower than on mainland sites. They feed primarily on small marine fish using an aerial plunge dive and submerge briefly.

During the winter months, the northern long-eared bat (Endangered) can be found hibernating in caves and mines. They use areas in various sized caves or mines with consistent temperatures, high humidity, and no air currents. During the summer, northern long-eared bats roost underneath bark, in cavities or in crevices of both live and dead trees. Individuals of the species have also been found rarely roosting in structures, like barns and sheds (USFWS 2015). According to data from the USFWS and the NDDB, there is no known hibernacula for the northern long-eared bat in Waterford, Montville, or any surrounding town (CTDEEP 2019). Due to the lack of hibernacula or known maternity roosts near the towns, tree clearing associated with the Project is likely to be permissible under the 4(d) rule.

Monarch butterflies are considered Candidate Species by the USFWS, and as such are not afforded the same protection status as either Threatened or Endangered species. While completion of consultations or surveys for monarch butterflies is not required, for planning purposes it is important to identify candidate species in the event that they are elevated to a listed status at any time during Project review. Monarch butterflies utilize open fields as well as any areas that contain milkweed (*Asclepias spp.*).

In addition to threatened and endangered species, certain birds are protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act (BGEPA). IPaC identified 49 species of migratory birds associated with the onshore Project Area. A copy of the IPaC report is provided in **Appendix M USFWS IPaC and State Listed Species**.

5.1.2 Impacts Analysis for Construction, Operations, and Decommissioning

The potential impacts resulting from the construction, operations, and conceptual decommissioning of the Project are based on the maximum design scenario from the PDE (see **Section 3 Project Description**). For terrestrial vegetation and wildlife, the maximum design scenario is the greatest amount of vegetation clearing and conversion, as described in **Table 5.1-6**. This design concept incorporates full build-out of the onshore structures including the onshore export and interconnection cable route, and the onshore substation facilities.

TABLE 5.1-6. SUMMARY OF MAXIMUM DESIGN SCENARIO PARAMETERS FOR TERRESTRIAL VEGETATION AND WILDLIFE RESOURCES

Parameter	Maximum Design Scenario	Rationale
Construction		
Submarine export cable landfalls onshore	Based on full build-out of the Project (BW1 and BW2): • BW1 to Queens, New York (HDD work area in a 246 ft x 246 ft [75 m x 75 m] area). • BW2: o To Queens, New York (HDD work area in a 246 ft x 246 ft [75 m x 75 m] area) or o To Waterford, Connecticut (HDD work area in a 328 ft x 164 ft [100 m x 50 m] area).	Representative of the maximum area to be utilized to facilitate the submarine export cable landfalls.
Onshore export and interconnection cables	Based on full build-out of the Project (BW1 and BW2): • BW1 to Queens, New York (0.93 mi [1.5 km]) • BW2: o To Queens, New York (0.93 mi [1.5 km]) or o To Waterford, Connecticut (0.55 mi [0.89 km])	Representative of the maximum length of onshore export and interconnection cables to be installed.
Onshore substation facilities	Based on full build-out of the Project (BW1 and BW2): • BW1 to Queens, New York (up to a 16 ac [6.5 ha] area). • BW2: o To Queens, New York (up to a 16 ac [6.5 ha] area) o To Waterford, Connecticut (up to a 16 ac [6.5 ha] area)	Representative of the maximum area to be utilized to facilitate the construction of the onshore substation facilities.
Staging and construction areas, including port facilities, work compounds, and lay-down areas	Based on BW1 and BW2. Maximum number of work compounds and lay-down areas required. Some ground disturbing activities may be anticipated at Queens, New York with grading and minor tree clearing at Waterford, Connecticut. Independent activities to upgrade or modify staging, construction areas, and ports prior to Project use will be the responsibility of the facility owner.	Representative of the maximum area required to facilitate the offshore and onshore construction activities.

As described in **Section 5.1.1.3** above, three federally-listed birds and one mammal were identified as potentially occurring within the Queens, New York Project Area and one mammal, one bird, and one insect within the Waterford, Connecticut Project Area by the USFWS IPaC online tool. During the May and June 2021 and March 2022 field surveys, habitat suitability for these species was assessed where access was unrestricted.

The three federally-listed birds are considered shorebird species that require natural stretches of beaches and other coastal, marine and estuarine habitats and the roseate tern nests almost exclusively on islands to avoid higher predation rates on the mainland. The seabeach amaranth occurs on wide sandy beaches above the HTL and adjacent to foredune areas.

In general, habitat quality for wildlife within the Queens, New York Project Area is very low with approximately 96 percent of the onshore portions of the Project Area consisting of impervious surfaces, maintained lawn, and disturbed open space. The entire shoreline along the onshore Queens, New York Project Area is disturbed and armored with concrete seawalls and rip-rap revetments that in most areas extend below the low tide line. No sandy beaches or natural shoreline habitats were observed. In addition, impacts to the shoreline and intertidal zones at the landfall locations may be avoided or minimized by using a trenchless installation method to connect the marine cable to the onshore substation facilities. Onshore substation facility locations, onshore export and interconnection cable routes, and POIs are situated within an intensely developed landscape of commercial/industrial buildings, roads and maintained lawns, which further discourages use of this area by bird species sensitive to human disturbance. The only forage habitat observed was along Luyster Creek where broad mudflats are situated between the low tide line and the toe of rip-rap revetments and possibly within the wrack-lines deposited along the sloping rip-rap revetments. No impacts to these habitats are anticipated from any part of the Project.

The Waterford, Connecticut Project Area IPaC review returned one mammal, one bird, and one insect. Of the three, habitat exists only for the Northern long eared bat, and that habitat is limited to loose bark on trees. At the Waterford, Connecticut location, some loss of bat habitat could occur as a result of construction of the onshore substation facility; however, the amount of lost habitat would be relatively small, and not likely to be of high quality due to the highly developed nature of the surrounding area. In addition, according to the CTDEEP (2022) there are no known northern long-eared bat hibernacula or maternity roost trees identified within the Town of Waterford or adjacent areas. Limited or no habitat for the roseate tern or monarch butterfly exist within the Waterford, Connecticut Project Area.

5.1.2.1 *Construction*

During construction, the potential impact-producing factors to terrestrial vegetation and wildlife resources may include:

- Installation of the submarine cable landfall (installation techniques may include trenchless (e.g., HDD, jack and bore, or micro-tunnel) and trenched (open cut trench) methods);
- Staging and construction activities and assembly of Project components at applicable facilities or areas; and
- Construction of a new onshore substation facility.

The following impacts may occur as a consequence of factors identified above:

- Short-term removal of vegetation;
- Short-term potential for an inadvertent return of drilling fluids during HDD activities;
- Short-term potential for accidental releases from construction vehicles or equipment;
- Short-term disturbance associated with soil stockpile areas;
- Short-term potential for erosion into adjacent vegetation and wildlife habitat resulting from construction activities;
- Short-term impedance to local migration of terrestrial biota as a result of placement of silt fencing;
- Short-term disturbance to terrestrial biota as a result of Project-related construction activities; and
- Long-term habitat alteration and tree clearing.

Short-term removal of vegetation. During construction and installation activities, including trench excavation, HDD/other trenchless work areas, and areas for staging of equipment and supplies, adjacent vegetation may be temporarily impacted. Activities at staging and construction facilities will be consistent with the established and permitted uses of these facilities, and Beacon Wind will comply with applicable permitting standards to limit environmental impacts from Project-related activities. Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Attempts have been made to avoid and minimize the permanent conversion of naturally vegetated areas and potential wildlife habitats by siting Project infrastructure within previously developed areas or areas surrounded by development, to the extent practicable;
- Trenchless methods (e.g., HDD, jack and bore, or micro-tunnel) may be used for installation of the export cable landfalls under consideration at NYPA, AGRE East, AGRE West, and Waterford to avoid surficial disturbances and impacts to naturally vegetated areas and wildlife resources; and
- Temporarily disturbed areas will be revegetated with appropriate native species, as needed and in compliance with applicable permits and mitigation plans. An invasive species control plan to prevent the introduction of invasive plant species is not anticipated to be required due to the highly developed nature of the onshore area and lack of natural vegetation.

Short-term potential for an inadvertent return of drilling fluids during HDD activities. HDD technologies may be implemented to avoid impacts to sensitive areas, such as the shoreline of the East River. In the event of an inadvertent frac-out, release of drilling mud/fluid, within a regulated area, drilling fluids have the potential to escape to the surface and impact adjacent vegetation, wildlife habitats, and the biota inhabiting such areas. Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Siting of onshore components in previously disturbed areas, existing roadways and/or rights-of-way to the extent practicable; and
- The implementation of an Inadvertent Return Plan that will be provided for agency review and approval, as applicable.

Short-term potential for accidental releases from construction vehicles or equipment. Construction vehicles and equipment may be accessing regulated areas during construction activities and will be refueled and potentially serviced within the Project site. While on the Project site, there is the potential for accidental releases onto the surrounding surfaces. Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Siting of onshore components in previously disturbed areas, existing roadways, and/or rights-of-way to the extent practicable; and
- Management of accidental spills or releases of oils or other hazardous wastes through an SPCC Plan, which will be provided for agency review and approval, as applicable.

Short-term temporary disturbance associated with soil stockpile areas. During construction activities, soil stockpile areas will be created as a result of the ground-disturbing activities. Soil stockpile areas will be placed on paved surfaces and previously disturbed areas to the extent practicable but have the potential to be located over existing vegetation. Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Siting of onshore components in previously disturbed areas, existing roadways, and/or rights-of-way to the extent practicable; and
- The implementation of soil erosion and sediment control plans for each landfall location satisfactory to the requirements detailed in the New York State Standards and Specifications for Erosion and Sediment Control (Blue Book) and in the Connecticut Guidelines for Soil Erosion and Sediment Control including development of a SWPPP, as applicable.

Short-term potential for erosion into adjacent vegetation and wildlife habitat resulting from construction activities. Excavation, soil stockpile, and grading associated with installation of the onshore export cable and construction of the onshore substation facility and supporting infrastructure will increase the potential for erosion and sedimentation to adjacent vegetation and wildlife habitat resources down gradient. Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Siting of onshore components in previously disturbed areas, existing roadways, and/or rights-of-way to the extent practicable; and
- The implementation of soil erosion and sediment control plans for each landfall location satisfactory to the requirements detailed in the New York State Standards and Specifications for Erosion and Sediment Control (Blue Book) and in the Connecticut Guidelines for Soil Erosion and Sediment Control including development of a SWPPP, as applicable.

Short-term impedance to local migration of terrestrial biota as a result of placement of silt fencing and Project-related construction. During construction and installation activities, silt fencing will be installed around ground disturbing activities. While installed, terrestrial biota will be restricted from passing through these areas. Due to the physically isolated and densely developed nature of the Project Area, and because the onshore construction related activities are expected to occur within previously developed areas, impacts to wildlife migration corridors are unlikely. However, should any unexpected circumstances arise Beacon Wind will consider the following measures to avoid, minimize, and mitigate impacts:

- Consideration of staggering silt fencing or other erosion control devices in sensitive areas to facilitate the passage of biota, if deemed effective and/or necessary. The strategy will be implemented on a site-specific basis and finalized during the permitting process;
- At the Waterford, Connecticut Project Area, some tree clearing would be required for the construction of the potential Waterford, Connecticut onshore substation facility. All other areas including the potential trenched landfall of the submarine export cable, and the overhead

interconnection cable from the onshore substation facility to the POI substation may require habitat conversion for Project siting; and
- At the Waterford, Connecticut Project Area, up to approximately 5 ac (2 ha) of forested habitat may be cleared, much of which would be permanently converted to industrial land use.

Long-term habitat alteration and tree clearing. Tree clearing and habitat conversion is not anticipated at the Queens, New York location, as the site is heavily developed. At the Waterford, Connecticut location, there may be a need to permanently convert an approximately 5 ac (2 ha) area to forest land, potentially including some areas of forested wetlands, for industrial use. This process will be fully permitted by applicable local, state, and federal agencies and will include all applicable BMPs associated with industrial development. Habitats that would be impacted consist of a small isolated forested area surrounded by existing industrial development, the conversion of which would not contribute significantly to habitat fragmentation in the area.

5.1.2.2 *Operations and Maintenance*

During operations, the potential impact-producing factors to terrestrial vegetation and wildlife resources may include:

- Operations and maintenance activities associated with the onshore export and interconnection cables, and onshore substation facility.

The following impacts may occur as a consequence of factors identified above:

- Long-term presence of permanent above-ground structures within or directly adjacent to previously undeveloped areas; and
- Long-term conversion of existing vegetation cover types.

Operations of permanent structures within previously undeveloped areas. The onshore substation facility, including concrete foundations, gravel lots, fencing, and associated structures, will remain on-site throughout the lifetime of the Project.

- Onshore export and interconnection cables are proposed to be located within or directly adjacent to existing paved roads and within maintained lawn areas. The Waterford, Connecticut site is surrounded by developed property; however, it would require a minimal amount of permanent terrestrial habitat conversion. The NYPA, AGRE East, and AGRE West sites are situated within previously developed areas with no existing natural vegetation cover types, and the two potential Queens, New York POIs (Astoria East POI and/or Astoria West POI) are already existing within the Project Area;
- The Project will utilize an existing O&M facility[1] and will not require construction of a new O&M facility in the State of New York, therefore avoiding additional potential impacts to terrestrial vegetation and wildlife as a result of new construction; and
- The BW1 and BW2 submarine export cables are expected to make landfall via either open trench or trenchless methods. Utilizing a trenchless method would have the effect of avoiding coastal resources including intertidal zones, coastal and freshwater wetlands, semi-natural

[1] The Project is considering leasing satellite O&M warehouse and port facilities, in addition to the O&M Base at SBMT.

vegetated areas along the coastline, and their associated wildlife resources. However, if inspection or repairs during the operation phase require excavation or other ground disturbance, short-term localized impacts to naturally vegetated areas and wildlife resources may occur; these activities are not anticipated to have long-term effects.

The permanent conversion of existing vegetation cover types. Limited conversion of wildlife habitat would be required for the construction and operation of the potential Waterford, Connecticut onshore substation facility. As previously stated, naturally vegetated lands are not present within the limits of disturbance for the Queens, New York Project Area therefore no permanent conversion of naturally vegetated lands is proposed within these areas of the Project, which minimizes the potential for impacts to wildlife resources. However, some semi-natural areas are present adjacent to the potential onshore substation facilities under consideration and as such:

- Protective measures will be installed around Project-components to restrict access to those natural areas present onsite during operation and maintenance activities;
- Revegetation monitoring will be conducted consistent with a Landscaping Restoration Plan and Invasive Species Control Plan, which will be provided for agency review and approval, as applicable, within naturally vegetated areas and wildlife habitats to ensure that functionality is restored in these areas satisfactorily; and
- The implementation of lighting reduction measures such as downward projecting lights, lights triggered by motion sensors, and limiting artificial light to the extent practicable, where safe.

5.1.2.3 Decommissioning

Impacts during decommissioning are expected to be similar or less than those experienced during construction, as described in **Section 5.1.2.1**. It is important to note that advances in decommissioning methods/technologies are expected to occur throughout the operations phase of the Project. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and potential impacts will be re-evaluated at that time. For additional information on the decommissioning activities that Beacon Wind anticipates will be needed for the Project, please see **Section 3 Project Description**.

5.1.3 Summary of Avoidance, Minimization, and Mitigation Measures

In order to mitigate the potential impact-producing factors described in **Section 5.1.2**, Beacon Wind is proposing to implement the following avoidance, minimization, and mitigation measures.

5.1.3.1 *Construction*

During construction, Beacon Wind will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in **Section 5.1.2.1**:

- Limiting lighting associated with construction vehicles and work zones to the extent practicable, to reduce the attraction of insect prey for wildlife species such as bats and insectivorous birds;
- The siting of onshore components in previously disturbed areas, existing roadways, and/or rights-of-way to the extent practicable;
- The implementation of soil erosion and sediment control plans, which will be provided for agency review and approval, as applicable, for each onshore component to the requirements

detailed in the New York State Standards and Specifications for Erosion and Sediment Control (Blue Book), and in the Connecticut Guidelines for Soil Erosion and Sediment Control, including development of a SWPPP, as applicable;

- The implementation of an Inadvertent Return Plan, which will be provided for agency review and approval, as applicable;
- The management of accidental spills or releases of oils or other hazardous wastes through a SPCC plan, which will be provided for agency review and approval, as applicable;
- During construction, access will be restricted to existing paved roads and approved access routes to avoid impacts to naturally vegetated areas and wildlife resources;
- The implementation of an invasive species control plan, which will be provided for agency review and approval, as applicable, to avoid the spread of invasive species and replant with native vegetation only; and
- Landscaping and restoration work will be completed with appropriate native species, per a Landscape Restoration Plan or other appropriate plan, and in compliance with an invasive species control plan to prevent the introduction of invasive plant species, which will be provided for agency review and approval, as applicable.

In addition, during construction, Beacon Wind will consider the following avoidance, minimization, and mitigation measures to mitigate the impacts described in **Section 5.1.2.1**:

- A trenchless method may be used for installation of the export cable landfalls under consideration at NYPA, AGRE East, AGRE West, or Waterford, to avoid surficial disturbances and impacts to coastal resources including the intertidal zone, freshwater and tidal wetlands, naturally vegetated areas and wildlife resources;
- Although not anticipated within the Project Area due to the highly developed nature of the onshore area and absence of suitable habitat, evaluation of seasonal restrictions will be conducted should sensitive species be detected prior to vegetation clearing or other construction related activities, to mitigate potential impacts to breeding individuals; and
- Consideration of staggering silt fencing or other erosion control devices in sensitive areas to facilitate the passage of biota, if deemed effective. The strategy will be implemented on a site-specific basis and finalized during the permitting process.

As the Project design is still preliminary, detailed mitigation strategies will be developed as part of the final design and conform to the requirements of state and federal permitting respective to wetlands and waterbody resources discussed in **Section 5.2**.

5.1.3.2 *Operations and Maintenance*

During operations, Beacon Wind will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in **Section 5.1.2.2**:

- Protective measures will be installed around Project-components to restrict access to wetlands, naturally vegetated areas, and wildlife resources during operation and maintenance activities;
- Revegetation monitoring will be conducted consistent with a Landscaping Restoration Plan and Invasive Species Control Plan, which will be provided for agency review and approval, as applicable, within freshwater and tidal wetlands, naturally vegetated areas, and wildlife resources to ensure that functionality is restored in these areas satisfactory to permit requirements;
- Mitigation monitoring, as required and defined during the regulatory process for any areas identified as mitigation sites as a result of long-term unavoidable impacts to freshwater and tidal wetlands, naturally vegetated areas, and wildlife resources; and
- The implementation of lighting reduction measures such as downward projecting lights, lights triggered by motion sensors, and limiting artificial light to the extent practicable, where safe.

5.1.3.3. Decommissioning

Avoidance, minimization, and mitigation measures proposed to be implemented during conceptual decommissioning are expected to be similar to those experienced during construction and operations, as described in **Section 5.1.3.1** and **Section 5.1.3.2**. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and avoidance, minimization, and mitigation measures for decommissioning activities will be proposed at that time.

5.1.4 References

TABLE 5.1-7. SUMMARY OF DATA SOURCES

Source	Includes	Available at	Metadata Link
MRLC	2019 National Land Cover Dataset	https://www.mrlc.gov/data/nlcd-2019-land-cover-conus	https://www.mrlc.gov/downloads/sciweb1/shared/mrlc/metadata/nlcd_2019_land_cover_l48_20210604.xml
NYSDEC	2020 Half-Foot 4 Band Long Island Zone NYC Aerial Ortho-Photography	https://orthos.dhses.ny.gov/	https://orthos.dhses.ny.gov/content/metadata/2020/2020-06-inch-4-Band-Orthoimagery-NYC.xml
NDDB	Natural Diversity Database (Dec. 2021)	https://ct-deep-gis-open-data-website-ctdeep.hub.arcgis.com/datasets/CTDEEP::natural-diversity-database/about	https://www.arcgis.com/sharing/rest/content/items/58c6d263e85647caaa82c466d5794227/info/metadata/metadata.xml?format=default&output=html

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USFWS. 2022. Endangered Species Act of 1973. https://www.fws.gov/sites/default/files/documents/endangered-species-act-accessible.pdf. Accessed April 15, 2022.

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Wickham, J., Stehman, S. V., Sorenson, D. G., Gass, L., and J. A. Dewitz. 2021. Thematic accuracy assessment of the NLCD 2016 land cover for the conterminous United States: Remote Sensing of Environment, v. 257: art. no. 112357. Available online at: https://doi.org/10.1016/j.rse.2021.112357. Accessed November 29, 2022.

5.2 Wetlands and Waterbodies

This section describes the wetland and waterbody resources within and surrounding the two potential BW1 and BW2 landfall sites located in Queens, New York and the one potential BW2 landfall site in Waterford, Connecticut. Potential impacts to wetlands and onshore waterbodies resulting from construction, operation, and conceptual decommissioning of the Project are discussed. Proposed Project-specific measures adopted by Beacon Wind are also described, which are intended to avoid, minimize, and/or mitigate potential impacts to wetlands and waterbodies. For the purposes of this section, the Study Areas are defined as the onshore portion of the Waterford, Connecticut Project Area and the Queens, New York Project Area as well as areas within 1 mi (1.6 km).

Other resources and assessments detailed within this COP that are related to wetlands and waterbodies include:

- Water Quality (**Section 4.2**);
- Terrestrial Vegetation and Wildlife (**Section 5.1**);
- Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat (**Section 5.5**);
- USFWS IPaC and State Listed Species (**Appendix M**);
- Wetland Delineation Report (**Appendix N**);
- Benthic Resources Characterization Reports and Mapbooks (**Appendix S**); and
- Essential Fish Habitat Technical Report (**Appendix T**).

The USACE is responsible for assessing permit applications for activities otherwise prohibited by Section 404 of the CWA and Section 10 of the Rivers and Harbors Act. Under Section 404 of the CWA and Section 10 of the 1899 Rivers and Harbors Act, the USACE has regulatory jurisdiction over navigable waters and waters of the U.S., including wetlands. Additionally, under Section 401 of the CWA, applicants for a federal license or permit must obtain certification from the state in which the discharge would originate to ensure that the project will not violate the state's water quality standards. The regulatory authority of the NYSDEC and CTDEEP, with respect to wetlands and waterbodies, is described in further detail, below.

5.2.1 State of New York Regulations

Tidal wetlands in New York State are protected under Article 25 of the Environmental Conservation Law, known as the Tidal Wetlands Act. Under this Act, New York regulates tidal wetlands and the associated adjacent area. Freshwater wetlands in the State of New York are jointly regulated by both the NYSDEC and the USACE. Under Article 24 of the Environmental Conservation Law, commonly referred to as the Freshwater Wetlands Act, New York regulates freshwater wetlands greater than 12.4 ac (5.0 ha) or freshwater wetlands of any size that possess unique qualities, such as a documented presence of a threatened or endangered species. For further details on regulated tidal and freshwater wetlands and waterbodies within the state of New York as well as adjacent areas and regulated setbacks, refer to **Appendix N1 Wetlands Delineation Report – Queens, New York**.

Activities subject to regulation within wetlands and adjacent areas include any form of draining, dredging, or excavation, either directly or indirectly; and any form of dumping, depositing, or placement of fill of any kind, either directly or indirectly. This includes the installation of structures and roads, the driving of pilings, or the placement of any other obstructions (whether or not changing the ebb and flow of the water), and any form of pollution, including, but not limited to running a sewer outfall and discharging sewage treatment effluent or other liquid wastes into or so as to drain into a freshwater wetland. Applicants that propose such activities are required to demonstrate that impacts to these resources are avoided or minimized to the maximum extent practicable and that temporary impacts will be restored to pre-existing conditions following construction activities. Permanent impacts associated with these activities may be subject to compensatory mitigation.

5.2.2 State of Connecticut Regulations

All federal regulations defined above, including Section 404 of the CWA and Section 10 of the Rivers and Harbors Act apply to wetlands and waterbodies in the State of Connecticut. In addition, Connecticut defines specific areas as state wetlands. Connecticut state wetlands include areas that meet the definition set out in Connecticut Inland Wetland and Watercourses Act (“IWWA”; Connecticut General Statutes [CGS] Section 22a-36 through 45) and its implementing regulations (Regulations of Connecticut State Agencies [RCSA] Section 22a-39-1 to 22a-39-15). Typically, the state statute is implemented through the Inland Wetlands and Watercourse Regulations as administered by individual municipalities. In addition, A portion of the parcel is located within the state’s Coastal Area and Coastal Boundary resource areas (as defined in CGS SS 22a-93 and described in CGS SS 22a-94), and therefore subject to the regulations of Connecticut’s Coastal Management Program. Further details on the specific regulations for Connecticut Inland Wetlands and Watercourses as well as Connecticut coastal regulations can be found in **Appendix N2 Wetlands Delineation Report – Waterford, Connecticut.**

In addition to wetlands and waterbodies, vernal pools are also regulated under federal and state laws in Connecticut. Vernal pools are unique seasonal depressional wetlands. They fill with shallow water in the early spring and typically dry out by late summer. Vernal pools are defined by a lack of fish and generally contain no inlet or outlet for water. Vernal pools are an important habitat for many native amphibians who utilize the pools for breeding in the spring. Vernal pools are considered watercourses under the IWWA, which affords these pools the same protection status on the state level as a traditional waterbody. The Waterford Inland Wetlands and Watercourses Regulations do not contain additional protection for vernal pools.

The USACE defines vernal pools based on the species present within these pools, including egg masses and larval stages. Species are classified as either obligate (presence confirms the location as a vernal pool), facultative (presence indicates the area may be a vernal pool), and predator species (presence indicates the area may be unsuitable for obligate species). **Table 5.2-1** for a list of vernal pool obligate, facultative, and predatory species. Under federal regulations, the USACE enforces additional regulations for actions impacting vernal pools and surrounding upland environments. USACE vernal pool BMPs (USACE 2015) suggest a concentric circle approach to vernal pool regulations, some of which impact the state Regional General Permitting (RGP) process. These concentric circles include the vernal pool depression (the area delineated as the interior portion of the vernal pool), vernal pool envelope (extending from the vernal pool boundary 100 ft (30.5m) laterally upland), and the critical terrestrial habitat (extending from the edge of the vernal pool envelope 750 ft (228.6 m) laterally).

In Connecticut, most USACE RGPs cannot be used to fill any area of vernal pool depressions. If fill within a vernal pool is required, a Pre-Construction Notification (PCN) would also be required. Connecticut WQC (Section 401) considers vernal pools as Special Wetlands and therefore subject to WQC permitting.

TABLE 5.2-1. VERNAL POOL OBLIGATE, FACULTATIVE, AND PREDATORY SPECIES

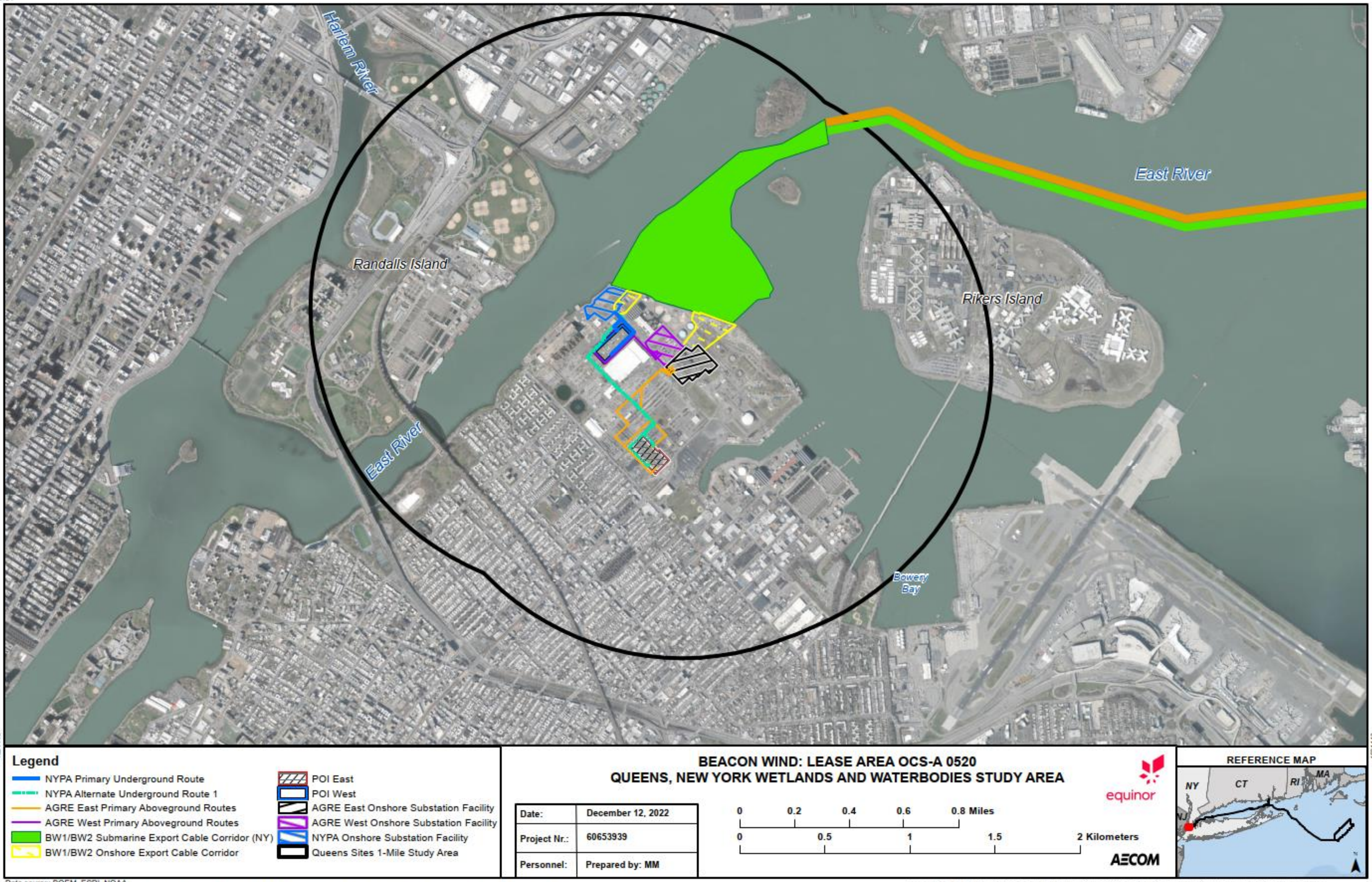
Indicator Status	Scientific Name	Common Name	Family
Obligate Species	*Lithobates sylvaticus*	Wood Frog	True Frogs (*Ranidae*)
	Ambystoma maculatum	Spotted Salamander	Mole Salamanders (*Ambystomatidae*)
	Ambystoma laterale	Blue-spotted Salamander	Mole Salamanders (*Ambystomatidae*)
	Ambystoma jeffersonianum	Jefferson's Salamander	Mole Salamanders (*Ambystomatidae*)
	Ambystoma opacum	Marbled Salamander	Mole Salamanders (*Ambystomatidae*)
	Eubranchipus spp.	Fairy shrimp	Fairy Shrimp (*Chirocephalidae*)
Facultative Species	*Hyla versicolor*	Gray Tree Frog	Tree Frogs (*Hylidae*)
	Limnephilidae spp. *Phryganeidae spp.*	Caddisflies	Caddisflies
	Anaxyrus americanusl	American Toad	True Toad (*Bufonidae*)
	Scaphiopus holbrookii	Eastern Spadefoot Toad	True Toad (*Bufonidae*)
	Anaxyrus fowleri	Fowler's Toad	True Toad (*Bufonidae*)
	Sphaerlidae spp. *Pisidiidae spp.*	Fingernail Clams	Various
Predator Species	*Lithobates catesbeianus*	Bullfrog	True Frogs (*Ranidae*)
	Rana clamitans	Green frog	True Frogs (*Ranidae*)
	Various	Ducks	Various
	Various	Turtles	Various

Data Relied Upon and Studies Completed

For the purposes of this section, the Study Area includes the coastal areas that may be directly and/or indirectly impacted by the onshore components, including the onshore export and interconnection cable routes, and the onshore substation facility associated with the construction, operations and decommissioning of the Project. The Study Area for wetlands and waterbodies includes up to a 1-mi (1.6-km) buffer around the onshore portion of the Project Area located in Queens, New York **Figure 5.2-1**), and Waterford, Connecticut **Figure 5.2-2**. The onshore portion of the Project Areas include potential landfall locations, onshore substation facilities (including the converter station and substation), onshore export and interconnection cable routes, and proposed POIs. As presented on **Figure 5.2-1** and **Figure 5.2-2** potential landfall locations include NYPA, AGRE East, AGRE West, and Waterford.

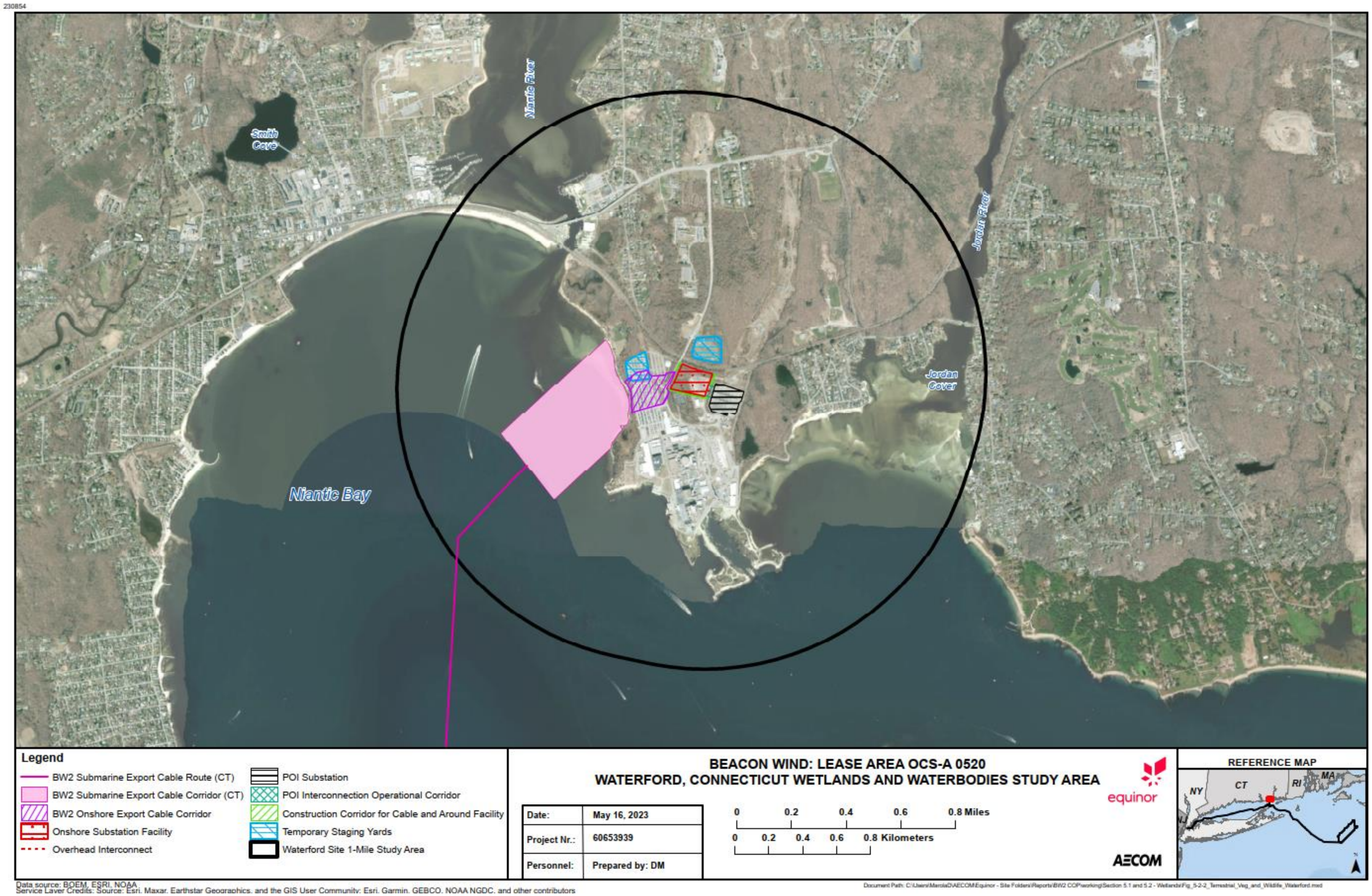
At Queens, New York the onshore export and interconnection cable routes between the onshore substation facilities under consideration and the 138 kV substation, Astoria East (hereafter Astoria East POI) and the 138 kV substation, Astoria West (hereafter Astoria West POI) will be underground electric transmission lines for NYPA and overhead for AGRE East and AGRE West. At the Waterford, Connecticut Project Area, the onshore export cables for the Waterford, Connecticut POI will consist of an underground interconnection to the substation facility and an overhead connection to the POI. Final locations for these routes are still being determined; however, the approximate location of preferred routes is presented on **Figure 5.2-1** and **Figure 5.2-2**.

FIGURE 5.2-1. WETLANDS AND WATERBODIES STUDY AREA - QUEENS, NEW YORK



Data source: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community; Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

FIGURE 5.2-2. WETLANDS AND WATERBODIES STUDY AREA - WATERFORD, CONNECTICUT



Existing coastal wetlands (including the intertidal zone, tidal wetlands and associated adjacent areas) and onshore wetland and waterbody resources in the Study Area were reviewed using a combination of desktop analysis of publicly available data and targeted field surveys. The following resources were reviewed as part of the desktop analysis:

- USFWS National Wetlands Inventory (NWI) (USFWS 2021);
- Natural Resource Conservation Service soils mapping, including Connecticut Inland Wetland Soils (NRCS 2021);
- NYSDEC:
  - Regulatory Freshwater Wetlands, Queens and Bronx Counties (NYSDEC 2013);
  - Tidal Wetlands (NYSDEC 2005); and
  - Water Quality Classifications (NYSDEC 2019);
- USGS National Hydrography Dataset (NHD) (USGS 2021);
- USGS topographic maps; and
- FEMA National Flood Hazard Layer (FEMA 2021b).

Where access was permitted, a preliminary reconnaissance of the onshore portion of the Project Area including the onshore export and interconnection cable routes, all onshore substation facilities (NYPA, AGRE East, AGRE West, and Waterford) and 138 kV substations (Astoria East POI and/or Astoria West POI, and Waterford) was conducted on May 17, 2021 and September 15, 2022 for the Queens, New York Project Area, and March 16, 2022 for the Waterford, Connecticut Project Area, to verify the presence of mapped wetland and waterbody resources identified during desktop analysis, and to assess the potential presence of unmapped wetland and waterbody resources. An additional visit to the eastern portion of the onshore Study Area on June 17, 2021 was conducted to field delineate and GPS locate the HTL adjacent to the site to help further define tidal wetland adjacent areas. Upper limits of the HTL adjacent to the NYPA site was located outside of a no-access security fence and could not be field delineated during site visits. As final selection of Project landfall locations, Project siting and transmission routes are refined and are complete, additional field reviews and delineations will be conducted as necessary.

The Queens, New York Project Area was assessed for the presence of wetlands in the field using the routine methodology outlined in the USACE Wetland Delineation Manual (USACE 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0) (USACE 2012) and the New York State Freshwater Wetlands Delineation Manual (Brown et.al. 1995). This method incorporates a three-parameter approach using vegetation, soils, and hydrology to identify the presence of freshwater wetlands. Cover classes for freshwater wetlands are based on the NWI classification hierarchy (Cowardin et al. 1979).

Landward limits of the HTL were determined as described by the USACE (i.e., by mapping a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide). Tidal wetlands are assigned an additional cover class corresponding the NYSDEC tidal wetland categories (NYSDEC 2021) based on the position in the tidal landscape of a given wetland along with the dominant vegetation community. Full details of the survey methodology and results of the wetland delineation are available in **Appendix N1 Wetlands Delineation Report – Queens, New York**.

The Waterford, Connecticut Project Area was delineated per the regulations governing the federal wetlands, Connecticut inland and tidal wetlands as regulated by USACE. In Connecticut, federal wetlands were delineated to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0) (USACE 2012). The Connecticut jurisdictional wetlands and watercourses delineation were delineated according to the requirements of the Connecticut Inland Wetlands and Watercourses Act (P.A. 155). Connecticut defines wetland areas as those areas consisting of poorly drained, very poorly drained, alluvial and floodplain soils as defined by the National Cooperative Soils Survey. In Connecticut, state and federal wetland boundaries can be different. Most frequently, Connecticut-only jurisdictional wetlands are located in areas of well-drained and moderately-well drained alluvial and floodplain soils, which may not support a wetland plant community and/or exhibit evidence of wetland hydrology which are required to qualify as a federal jurisdictional wetland. Full details of the survey methodology and results of the wetland delineation are available in **Appendix N2 Wetlands Delineation Report – Waterford, Connecticut.**

5.2.3 Affected Environment

The affected environment is defined as the coastal wetlands (including the intertidal zone, tidal wetlands and associated adjacent areas) and onshore wetlands and waterbody areas that have the potential to be directly or indirectly affected by the construction, operation, and decommissioning of the Project. This includes the onshore export and interconnection cable route corridors from landfall to the onshore substation facilities. Upgrades and improvements to port facilities that may be utilized by Beacon Wind as construction and staging areas for the Project are not assessed within this section. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Beacon Wind expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Beacon Wind will comply with in using the facilities.

The affected environment below the intertidal zone includes the submarine export cable routes. A description of the affected environment below the intertidal zone is provided in **Section 5.5 Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat** and **Appendix S Benthic Resources Characterization Reports and Mapbooks**.

5.2.3.1 *Surface Waterbodies*

Desktop review for Queens, New York of NHD and NYSDEC resources revealed that no mapped waterbodies exist within the onshore portion of the Project Area. However, the NYPA site, located in Queens, New York directly abuts the East River with other tidal rivers including the Harlem River and Bronx River located northeast and northwest of the Project Area, respectively. Portions of the Harlem River are located within the 1-mi (1.6-km) Queens, New York Study Area and the Bronx River is located outside of that, approximately 2 mi (3.2 km) away from the onshore portions of the Project Area. The nearest NHD mapped waterbody is the Hudson River (NHD reach code: 02030101005840), which is also located outside of the Study Area, approximately 3.7 mi (6 km) west of the onshore portions of the Project Area. No other streams, ponds, or lakes are identified.

The onshore portions of the Queens, New York Project Area are located within the Northern Long Island Hydrologic Unit (NYSDEC HC02030201) and has a NYSDEC water quality classification for tidal waterbodies of Class I. Class I waters are assessed for general recreation use and support of aquatic life, but not for water supply or for public bathing use. Class I waters may also be impaired by PCBs, other pollutants (floatable debris), nutrients (nitrogen), low D.O., oil and grease coming from urban/storm runoff, combined sewer overflows, toxic/contaminated sediment, and municipal discharges. More details on the water quality of East River out through Long Island Sound are provided in **Section 4.2 Water Quality**.

The Waterford, Connecticut Project Area directly abuts Niantic Bay, located to the west of the Waterford onshore substation facility; however, all onshore construction activities would be located on inland portions of the site. Within the 1-mi (1.6-km) Waterford, Connecticut Study Area, the Niantic River and the Long Island Sound (inclusive of several features such as Niantic Bay and Jordan Cove) make up the majority of this area. The nearest NHD mapped waterbody is mapped east of existing facilities, including the northern temporary staging area and the existing POI. At some locations of this mapped resource, this stream is less than 100 ft (30.5 m) from the edge of the Project Area. This stream was classified in the field as an intermittent stream which flows through a series of wetlands and ponded areas eventually flowing into Long Island Sound. North of the Project Area, but within the Waterford, Connecticut Study Area, there are several streams that flow through areas of undeveloped forestland. The onshore portions of the Waterford, Connecticut Project Area are located within the Thames River Hydrologic Unit (HUC: 01100003).

The surface waters along the BW2 submarine export cable route to Waterford, Connecticut are classified as SA with SB waters located along the coastline to the east and west of the landfall. Designated uses for SA waters in Connecticut are fishing, swimming and recreation, healthy marine habitat, direct shellfish consumption, and industrial supply. Designated uses for SB waters include fishing, swimming and recreation, healthy marine habitat, commercial shellfish harvesting, and industrial supply. Waterbodies that do not meet the criteria associated with their use classification are considered to be impaired. Based on the most recent Integrated Water Quality Report (CTDEEP 2020), the inner estuary, shore, and mid-shore Connecticut waters in the vicinity of the Waterford, Connecticut landfall are classified as impaired; most often based on water quality not supporting uses for shellfish consumption. The offshore waters along the submarine cable route were not identified as impaired.

5.2.3.2 *Floodplains*

FEMA data indicates that onshore portions of both of the Project Areas are situated within Special FHAs, including Zone VE, Zone AE, and Zone X. These zones are described below as taken from the FEMA website (FEMA 2021a).

- Zone VE, also known as a Coastal High Hazard Area, is where wave action and fast-moving water can cause extensive damage during a base flood event. To address the added wave hazard in these areas, more stringent building practices are required in Zone VE, such as elevating a home or buildings on pilings so that waves can pass beneath it, or a prohibition to building on fill, which can be easily washed away by waves. These practices are intended to improve the chance of a home safely weathering a flood event;
- Zone AE areas are subject to inundation by the 1-percent-annual-chance flood event but not subject to high velocity wave action and are considered high risk flooding areas. Due to the higher risk of damage from waves to homes and other structures in the Coastal A Zone, FEMA encourages the practice of building to V Zone standards within this area. Many local building codes require that buildings in the Coastal A Zone be built to V Zone standards;
- Zone X is defined as moderate FHAs between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood; and
- Unshaded areas are those areas at minimal flood hazard risk.

Mapped Special FHAs located on and proximal to the onshore portions of the Project Area are identified on **Figure 5.2-3** and **Figure 5.2-4,** and mapped Special FHAs within the potential onshore substation facility footprints in Queens, New York are provided below in **Table 5.2-2**. No portion of the Waterford, Connecticut onshore substation facility location is within FHAs.

TABLE 5.2-2. FEMA-MAPPED SPECIAL FHAS WITHIN THE POTENTIAL ONSHORE SUBSTATION SITES

Site	FEMA Flood Zone	Area (ac)	Percent Total Area
NYPA	VE (Coastal Hazard Area)	0.35	5.66
	AE (1% Chance Annual)	5.80	94.34
	X (0.2% Chance Annual)	0.00	0.00
	Total	**6.80**	**100.00**
AGRE West	X (Area of minimal flood Hazard)	3.52	49.90
	AE (1% Chance Annual)	2.90	41.04
	X (0.2% Chance Annual)	0.64	9.06
	Total	**7.06**	**100.00**
AGRE East	X (Area of minimal flood Hazard)	3.77	42.53
	AE (1% Chance Annual)	4.17	47.01
	X (0.2% Chance Annual)	0.93	10.46
	Total	**8.87**	**100.00**

5.2.3.3 *Wetlands*

No freshwater wetland resource areas were identified within the onshore portions of the Queens, New York Project Area during desktop review of NYSDEC Regulatory Freshwater Wetlands mapping or NRCS Soils data. Two small potential wetland areas were identified within the onshore portions of the onshore Project Area through inspection of NWI maps; however, only one of these wetlands was visible on the most recent aerial photographs (**Figure 5.2-5**).

One mapped wetland is an approximately 0.3-ac (0.1-ha) isolated wetland located on the eastern portion of the onshore Project Area that was mapped by the NWI as a freshwater forested/shrub wetland. Inspection of the most recent aerial photography and field reviews of the onshore portions of the Project Area conducted in May 2021 identified no jurisdictional freshwater wetland areas within the boundaries of this area. The other mapped wetland is an approximately 0.4-ac (0.16-ha) isolated wetland located in the central portion of the Project Area that was mapped by the NWI as a freshwater pond. This freshwater pond is situated approximately 715 ft (218 m) from the AGRE East and AGRE West site and more than 2,000 ft (610 m) from the NYPA site.

Based on inspection of the NYSDEC tidal wetlands mapping, most of the East River adjacent to the Project Area is mapped as littoral zone and an approximately 0.9-ac (0.4-ha) area of formerly connected tidal wetland, in which normal tidal flow is restricted by man-made causes, is mapped near the northern portion of the onshore Project Area. The formerly connected tidal wetland area was not field verified due to restricted access, however, based on interpretation of most recent aerial photography (2020) there does appear to be onshore wetlands in the vicinity of the NYSDEC mapped area. In addition, one area of coastal mudflats is mapped in Luyster Creek in the eastern portion of the Project Area. These tidal systems are regulated under the Tidal Wetlands Act and assigned a protected adjacent area as described in Article 25, 6 NYCRR 661.4. Limits of the adjacent area are discussed for the NYPA, AGRE East, and AGRE West sites.

No other freshwater wetland resource areas were identified along the Queens, New York onshore export cable interconnection routes or, on or near, the Proposed POIs (Astoria East POI and/or Astoria West POI). Additional details for areas of the Project located from the intertidal zone landward for each of the potential landfall sites and onshore substation facility locations in Queens, New York are described further in the following sections.

Desktop reviews of the Waterford, Connecticut Project Area did not return any NWI mapped wetland areas (**Figure 5.2-6** and **Figure 5.2-7**); however, a review of aerial imagery and mapped inland wetland soils identified several areas of potential wetlands. A review of aerial images identified dark signatures on ground cover using leaf-off images. These dark signatures often represent areas of standing water or saturated soils and are common in wetland areas. These dark signatures are concentrated in the southern portion of the potential onshore substation facility location and in the intermediate area east of the parking lots and west of Millstone Road.

FIGURE 5.2-3. FEMA FLOODPLAIN MAPPING STUDY AREA – QUEENS, NEW YORK

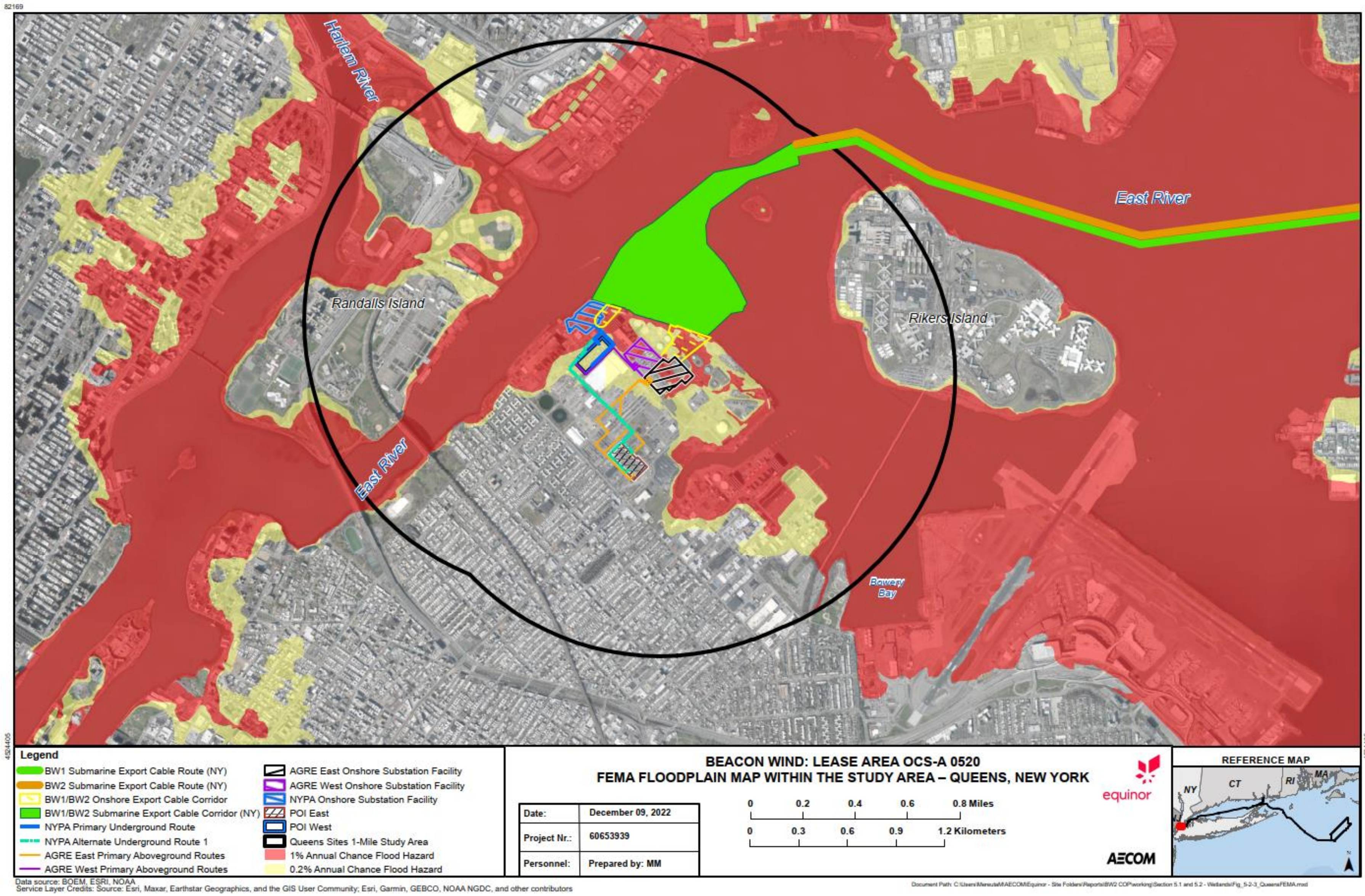


FIGURE 5.2-4. FEMA FLOODPLAIN MAPPING STUDY AREA – WATERFORD, CONNECTICUT

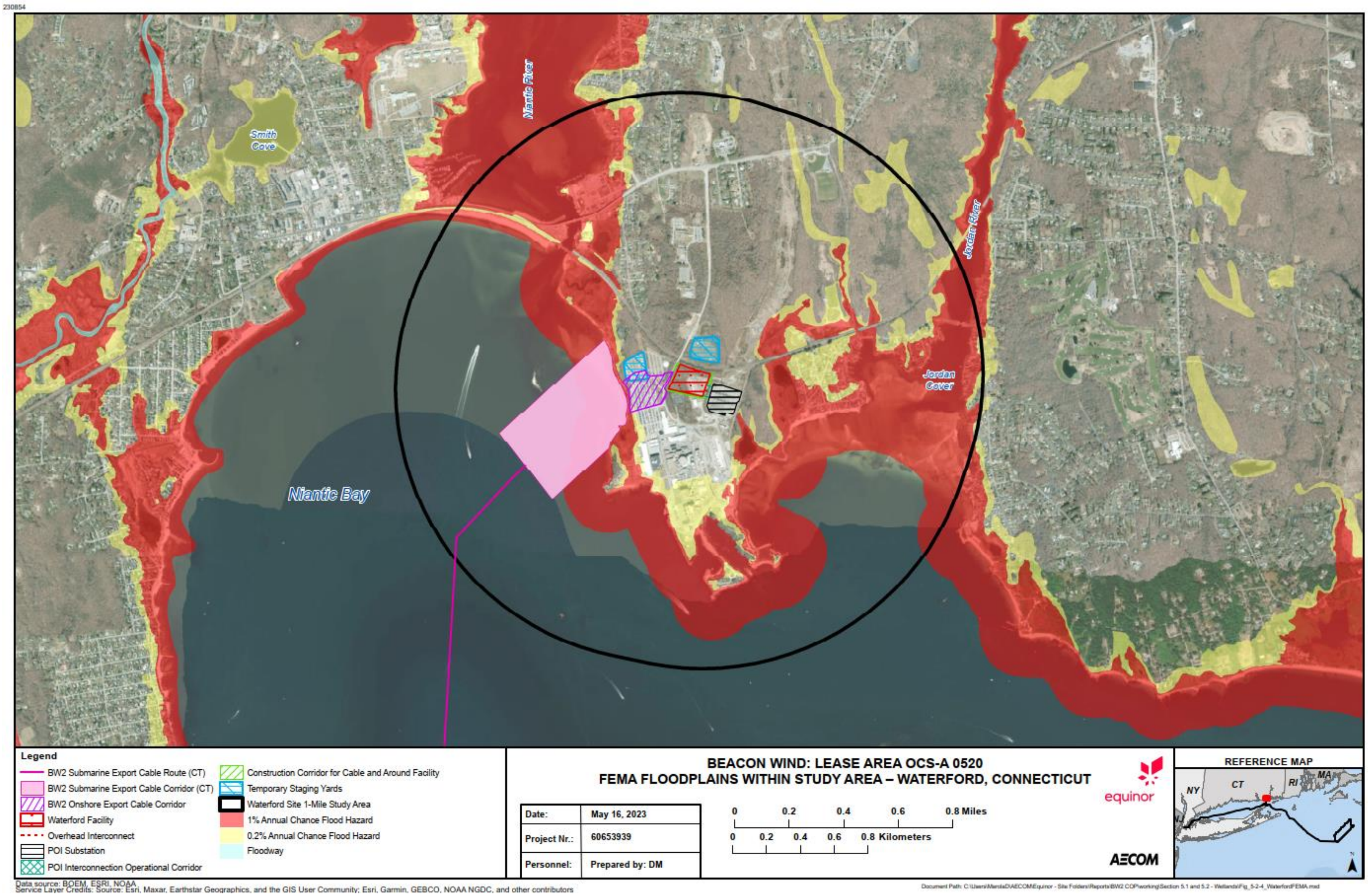


FIGURE 5.2-5. WETLAND RESOURCE AREAS IN THE QUEENS, NEW YORK STUDY AREA

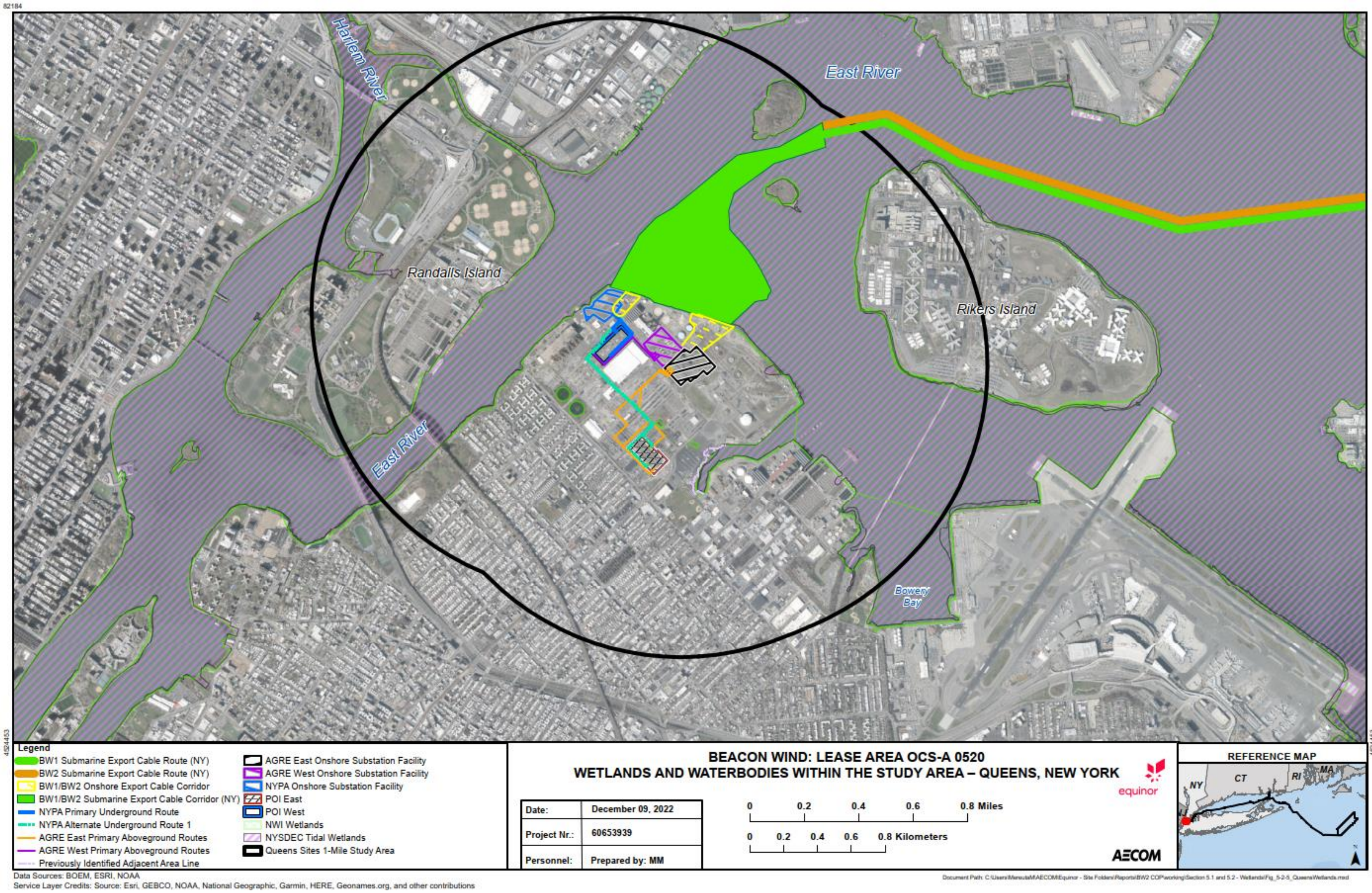
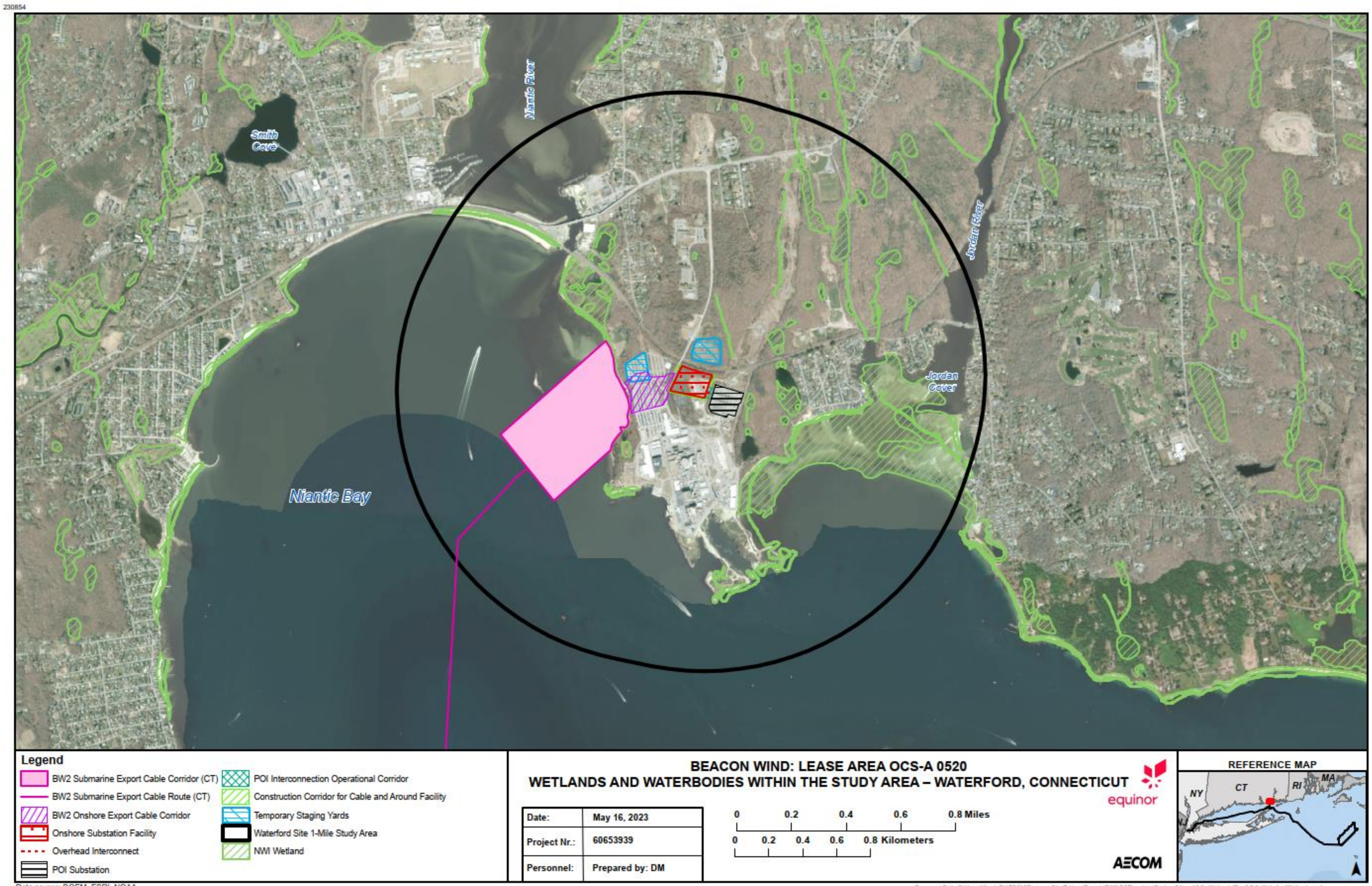
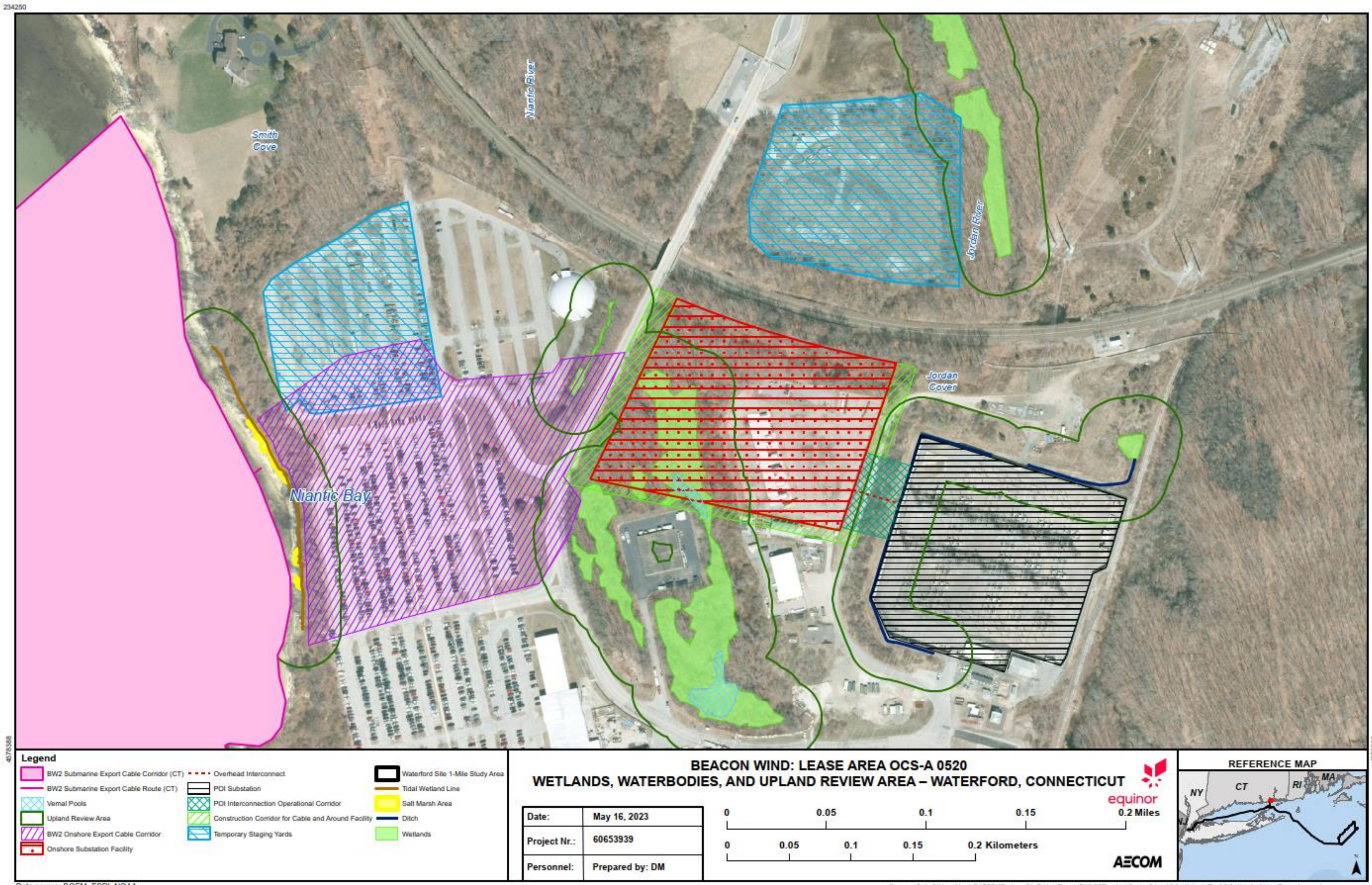


FIGURE 5.2-6. WETLAND RESOURCE AREAS IN THE WATERFORD, CONNECTICUT STUDY AREA



Data source: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community; Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

FIGURE 5.2-7. DELINEATED WETLAND RESOURCE AREAS IN THE WATERFORD, CONNECTICUT PROJECT AREA



Data source: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community; Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

There are several areas of classified inland wetland soils within the Waterford, Connecticut Study Area including a large swath of the central area, as well as the eastern fringes of the northern laydown yard and the Proposed POI. All inland wetland soils in this area are classified as Soil Mapping Unit (SMU) 3: Ridgebury, Leicester, and Whitman soils, extremely stony. This SMU is defined as poorly drained and very poorly drained soils and is a soil series complex of Ridgebury, Leicester, and Whitman soil series.

Field reviews of the site confirmed the presence of areas of forested wetlands located in the south-central portion of the Waterford, Connecticut Project Area (**Figure 5.2-7**). This wetland area connects to a larger wetland complex and drains south of the site via a culvert under Millstone Road. This wetland area would likely be subject to federal, state, and local (Town of Waterford) wetlands regulations. This would include a 100-ft (30.5 m) Upland Review Area assessed from the boundaries of any delineated wetlands. Proposed construction activities within this 100 ft (30.5 m) Upland Review Area would be subject to the approval of the Waterford, Connecticut Conservation Commission.

Coastal areas along the western portion of the Waterford, Connecticut Study Area consisted of a gently sloping rocky shoreline dominated by various species of rockweed. Small, isolated areas of sandy beach were identified as well as isolated clumps of cordgrass (*Spartina spp.)* associated with small areas of fringing tidal marsh. From the limit of the HTL, the coastal area rises sharply to an elevated level area where the Dominion Millstone Power Station parking area is located.

No additional wetland areas were identified during field reviews.

5.2.3.3.1 NYPA

The NYPA site is located at the northwest corner of the Astoria power complex adjacent to Lawrence Point and the East River. The NYPA site contains a mosaic of paved impervious surfaces (concrete pads, bituminous concrete driveways, and parking areas) with maintained lawn areas and a few scattered trees suggesting past commercial land use activities and development. However, several buildings are located along the southeastern limits of the NYPA site including storage sheds and a maintenance garage. The north and west perimeter of the NYPA site are bounded by the East River and a fenced security road. This area is only accessed via a security checkpoint where guard supervision is required by the property owner.

No federal or state jurisdictional freshwater wetlands or waterbodies were identified within the anticipated Project limits of this location during desktop review or field-based inspections. The onshore export cable corridor, included in this analysis, intersected some areas of NWI wetlands and associated adjacent area as shown in **Table 5.2-3**. State regulated adjacent areas to tidal wetlands are subject to the application of complex NYSDEC tidal wetlands regulations (6 NYCRR Part 661.4), along with the interpretation of these regulations by NYSDEC; however, aerial imagery taken on October 29, 1976 appears to show the existing rip-rap revetment in place at that time along the edge of the East River. This rip-rap revetment would likely qualify as a lawful, presently existing, functional, and substantial fabricated structure according to AECOM’s interpretation of 6 NYCRR 661.4(b)(1)(ii) and would likely limit the jurisdictional adjacent area to the most seaward edge of this rip-rap revetment.

TABLE 5.2-3. WETLAND AREAS IDENTIFIED WITHIN THE NYPA SITE

Wetland Type	Acres of Wetland Within the Project Area	Hectares of Wetland Within the Project Area
NWI Wetland Areas	0.07	0.03
NYSDEC Wetland Areas	none	none
Delineated Wetland Areas	none identified	none identified
Approximate Adjacent Area	0.4	0.16

The submarine export cable route is anticipated to make landfall via either a trenchless (e.g., HDD, jack and bore, or micro-tunnel) and trenched (open cut trench) methods. Landfall will occur via trenchless or trenched methods that would extend from the onshore substation facilities at the NYPA site northward into the East River, terminating in a water depth of approximately 20 ft (6 m). If a trenchless method is utilized, nearshore work would be completed by utilizing a goal post pipe which marks and keeps the borehole in place. Goalposts are installed along the established nearshore alignment of the HDD with the intent to support the large diameter casing pipe during drilling operations. Proper installation of casing pipe nearshore aids in the containment of drilling fluid by facilitating an open flow pathway from the HDD exit location to the marine support equipment and to the fluid collection barge. Marine support is needed (e.g., vessels, barges, divers) to support HDD drilling operations. If HDD, or other trenchless methods are used in this manner, it would avoid direct impacts to the intertidal zone located along the perimeter of the onshore portions of the Project Area.

Onshore export and interconnection cable routes will include 138 kV outgoing circuits from the onshore substation facilities to Astoria West POI, as underground transmission lines. As previously mentioned, no wetland resource areas were identified on or near this connector route.

5.2.3.3.2 AGRE East and AGRE West

The AGRE East and AGRE West sites are located on the same parcel in the central portion of the Astoria power complex. Field reviews of the onshore portions of the Project Area conducted in September 15, 2022 identified no jurisdictional freshwater wetland areas within the boundaries of the onshore portions of the Project Area. Current conditions at the onshore portions of the Project Area are a mosaic of paved, concrete, gravel, maintained lawn with some areas of ornamental trees, constructed buildings, and bituminous concrete grind material surfaces.

No freshwater wetlands were identified onsite. Several portions of the AGRE site consist of impervious surfaces or vegetation on top of semi-impervious surfaces (such as gravel) which supports the growth of invasive facultative vegetation and ponding water. These areas were investigated during onsite reviews and determined to not qualify as jurisdictional wetlands or waterbodies under federal, state, or local regulations.

The AGRE site is located in the central portion of the Study Area, approximately 440 ft (134 m) from the East River at its closest point. This distance places the AGRE site outside of most tidal regulations including adjacent area regulations. See **Appendix N1 Wetlands Delineation Report** for additional details. **TABLE 5.2-4** below details the summary of wetland resources reviewed for potential within anticipated work areas.

TABLE 5.2-4. WETLAND AREAS IDENTIFIED WITHIN THE AGRE EAST AND AGRE WEST SITE

Wetland Type	Acres of Wetland Within the Project Area	Hectares of Wetland Within the Project Area
NWI Wetland Areas	none mapped	none mapped
NYSDEC Wetland Areas	none mapped	none mapped
Delineated Wetland Areas	none identified	none identified
Approximate Adjacent Area	none	none

The submarine export cable route is anticipated to make landfall to the AGRE East and AGRE West site via trenchless methods (e.g., HDD, jack and bore, or micro-tunnel) that would extend from the onshore substation facility on the AGRE East and AGRE West site northward into the East River, terminating in a water depth of approximately 20 ft (6 m). The HDD would utilize the same goalpost and casing pipe components as detailed above, to facilitate the drill and containment of drilling fluid. Utilizing a trenchless installation method will avoid or minimize the potential for direct impacts to the intertidal zone located along the perimeter of the Study Area and to the onshore formerly connected tidal wetland area identified on NYSDEC mapping.

Onshore export and interconnection cable routes will include 138 kV outgoing circuits from the onshore substation facility to Astoria East POI and/or Astoria West POI as overhead transmission lines. As previously mentioned, no wetland resource areas were identified on or near these interconnection cable routes.

5.2.3.3.3 Waterford

The Waterford, Connecticut landfall area and onshore substation facility are located in the central portion of the Waterford, Connecticut Project Area. This site is bounded to the west and south by Millstone Road, to the north by an existing distribution line ROW and Amtrack railroad ROW, and to the east by the Proposed POI. The site is located north of the Dominion Millstone Power Station. Current site conditions include a large area of forested uplands, a sizable area of developed land currently supporting operations of the Dominion Millstone Power Station, and a small area of forested wetlands.

Field reviews of the site conducted on March 16, 2022, identified potentially jurisdictional wetland area within the south-central portion of the proposed substation facility consisting of the northern extent of a forested wetland complex that extends south to Millstone Road. This forested wetland area exhibited areas of standing water, saturated soils, and a high water table. Vegetation within the wetland was dominated by an overstory of red maple and gray birch (*Betula populifolia*), and contained an understory of common reed and skunk cabbage (*Symplocarpus foetidus*). Soils within the wetland consisted of a very dark gray (10YR 3/1) A horizon above a gray (10YR 5/1) Bg horizon which contained strong brown (7.5YR 5/6) redoximorphic features. Soils within wetland areas are most similar to Leicester Series soils.

Several mapped wetland areas intersect the anticipated work area for the Waterford, Connecticut landfall area and onshore substation facility. These potential impacts are detailed in **TABLE 5.2-5** below. These wetland areas include approximate wetlands as well as field delineated wetland areas and vernal pools.

TABLE 5.2-5. WETLAND AREAS IDENTIFIED WITHIN THE WATERFORD SITE

Wetland Type	Acres of Wetland Within the Project Area	Hectares of Wetland Within the Project Area
NWI Wetland	0.03	0.01
Connecticut Inland Wetland Soils	3.2	1.29
Delineated Wetland Areas	0.95	0.38
Delineated Vernal Pool Areas	0.07	0.03
Waterford Upland Review Areas	8.06	3.26

Upland portions of the potential onshore substation facility consisted of an oak/beech mid successional forest with a sparsely vegetated understory. Topography within the area was highly undulating with pockets of uplands and wetlands located along distinct but highly localized rises and depressions. The northern portion of the potential onshore substation facility shows signs of historic development including an elevated tiered area delineated by stone walls and large boulders.

Onshore export and interconnection cable routes will connect the potential onshore substation facility with the Waterford POI via overhead cables and supporting towers. No wetlands or waterbodies were identified by desktop or field reviews along the interconnection route to the Waterford POI. One wetland will be traversed by the onshore export cable prior to entering into the onshore substation facility. See **Appendix N2 Wetlands Delineation Report – Waterford, Connecticut** for additional details.

5.2.4 Impacts Analysis for Construction, Operations, and Decommissioning

The potential impacts resulting from the construction, operations, and conceptual decommissioning of the Project are based on the maximum design scenario from the PDE (see **Section 3 Project Description**). For wetlands and waterbodies, the maximum scenario is the greatest footprint resulting from the full build-out of the onshore Project components, as described in **Table 5.2-6**. This design concept incorporates the BW1 and BW2 onshore export cable landfalls, onshore substation facilities, and onshore export and interconnection cable routes.

TABLE 5.2-6. SUMMARY OF MAXIMUM DESIGN SCENARIO PARAMETERS FOR WETLANDS AND WATERBODIES

Parameter	Maximum Design Scenario	Rationale
Construction		
Submarine export cable landfalls onshore	Based on full build-out of the Project (BW1 and BW2): • BW1 to Queens, New York (HDD work area in a 246 ft x 246 ft [75 m x 75 m] area). • BW2: o To Queens, New York (HDD work area in a 246 ft x 246 ft [75 m x 75 m] area) or o To Waterford, Connecticut (HDD work area in a 328 ft x 164 ft [100 m x 50 m] area).	Representative of the maximum area to be utilized to facilitate the export cable landfalls.

Parameter	Maximum Design Scenario	Rationale
Onshore export and interconnection cables	Based on full build-out of the Project (BW1 and BW2): • BW1 to Queens, New York (0.93 mi [1.5 km]). • BW2: o To Queens, New York (0.93 mi [1.5 km]) or o To Waterford, Connecticut (0.55 mi [0.89 km]).	Representative of the maximum length of onshore export and interconnector cables to be installed.
Onshore substation facilities	Based on full build-out of the Project (BW1 and BW2): • BW1 to Queens, New York (up to a 16 ac [6.5 ha] area). • BW2: o To Queens, New York (up to a 16 ac [6.5 ha]) or o To Waterford, Connecticut (up to a 16 ac [6.5 ha] area).	Representative of the maximum area to be utilized to facilitate the construction of the onshore substation facilities.
Staging and construction areas, including port facilities, work compounds, and lay-down areas	Based on BW1 and BW2. Maximum number of work compounds and lay-down areas required. Some ground disturbing activities may be anticipated at Queens, New York with grading and minor tree clearing at Waterford, Connecticut. Independent activities to upgrade or modify staging, construction areas, and ports prior to Project use will be the responsibility of the facility owner.	Representative of the maximum area required to facilitate the offshore and onshore construction activities.

Table 5.2-7 below identifies potential temporary and permanent impacts to wetlands for Project components.

TABLE 5.2-7. BW1 AND BW2 TEMPORARY AND PERMANENT WETLAND IMPACTS

Component	Wetland Classification/Type	Temporary Impact (acres)	Permanent Impact (acres)
Submarine Export Cable Landfalls			
BW 1 to Queens, New York	Not Applicable	0	0
BW 2 to Queens, New York	Not Applicable	0	0
BW 2 to Waterford, Connecticut	E2EM/SS [a/,b/]	0	0
BW 2 to Waterford, Connecticut	M2US [a/,b/]	0	0
Onshore Export and Interconnection Cables			
BW 1 to Queens, New York	Not Applicable	0	0
BW 2 to Queens, New York	Not Applicable	0	0
BW 2 to Waterford, Connecticut	PFO [a/]	0.019	0.025
Onshore Substation Facilities			
BW 1 to Queens, New York	Not Applicable	0	0
BW 2 to Queens, New York	Not Applicable	0	0
BW 2 to Waterford, Connecticut	PFO [a/]	0	0.785

Component	Wetland Classification/Type	Temporary Impact (acres)	Permanent Impact (acres)
BW 2 to Waterford, Connecticut	Vernal Pool	0	0.052
Staging and Construction Areas [c/]			
BW 1 to Queens, New York	Not Applicable	0	0
BW 2 to Queens, New York	Not Applicable	0	0
BW 2 to Waterford, Connecticut	PFO [a/]	0.068	0
BW 2 to Waterford, Connecticut	Vernal Pool	0	0.052

Notes:
a/ Based on Cowardin Classification of Wetlands and Deepwater Habitats of the United States.
E2EM/SS: Estuarine, Intertidal Emergent Scrub-Shrub wetland
M2US: Marine Intertidal Unconsolidated Shore
PFO: Palustrine Forested Wetland
b/ Impacts avoided using trenchless landfall options.
c/ Includes port facilities, work compounds and lay-down areas.

5.2.4.1 *Construction*

During construction, the potential impact-producing factors to coastal wetlands (including the intertidal zone, tidal wetlands and associated adjacent areas) and onshore wetlands and waterbodies may include:

- Installation of the submarine export cable landfall, onshore interconnection cable, (installation techniques may include trenchless (e.g., HDD, jack and bore, or micro-tunnel) and trenched (open cut trench) methods);
- Staging and construction activities and assembly of Project components at applicable facilities or areas; and
- Construction of a new onshore substation facility.

The following impacts may occur as a consequence of factors identified above:

- Disturbance to wetland resources and associated adjacent areas, and special FHAs due to the installation of permanent structures;
- Conversion of existing cover types within coastal and wetland resources;
- Short-term impacts to vegetation within coastal and wetland resources;
- Short-term potential for erosion from construction activities into adjacent coastal resources;
- Short-term potential for inadvertent return of drilling fluids during HDD activities;
- Short-term potential for accidental releases from construction vehicles or equipment;
- Short-term impedance to local migration of terrestrial biota as a result of placement of silt fencing; and
- Long-term permanent wetland and vernal pool conversion.

As the Project design is still preliminary, detailed mitigation strategies will be developed as part of the final design and will conform to the requirements of state and federal permitting respective to coastal and inland wetland resources.

Disturbance to wetland resources, and special FHAs due to the installation of permanent structures. The onshore substation facility will include concrete foundations, gravel lots, fencing, and associated structures. Every practical attempt will be made to avoid coastal and inland wetland resources, and minimize the permanent conversion of regulated areas by siting Project infrastructure within previously developed areas that are outside and away from jurisdictional wetlands, state open waters, and their corresponding protected adjacent areas.

The Waterford, Connecticut potential onshore substation facility will have no impact on tidal wetland resources, as the area is situated inland above any tidal areas, while the submarine export cable landfall will be installed via trenchless methodologies. However, the Waterford, Connecticut site would require the conversion of some areas of inland forested wetland for the construction of the onshore substation facility. The placement of structures within special FHAs is unavoidable throughout most of the Queens, New York Project Area due to its proximity to the coastline. However, construction will satisfy the design requirements governing the placement of structures within mapped floodplains and specific mitigation strategies with regard to special FHAs and stormwater management will be designed on a case-by-case basis during the regulatory process. Activities at staging and construction facilities will be consistent with the established and permitted uses of these facilities, and Beacon Wind will comply with applicable permitting standards to limit environmental impacts from Project-related activities. Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- The siting of onshore components in previously disturbed areas, existing roadways, and/or rights-of-way, to the extent practicable;
- The Project will utilize an existing O&M facility[2] and will not require construction of a new O&M facility in the State of New York, therefore avoiding additional potential impacts to terrestrial vegetation and wildlife as a result of new construction;
- The onshore substation facility's components (e.g., high-voltage insulators, control cabinets, and similar equipment) will be raised above the Design Flood Elevation (DFE) using reinforced concrete columns for compliance with the NYC Building Code and FEMA requirements; and
- A trenchless method may be used for installation of the submarine export cable landfalls, under consideration, at NYPA, AGRE East, AGRE West, or Waterford to avoid surficial disturbances and impacts to coastal resources including the intertidal zone, tidal wetlands and associated regulated adjacent areas.

Conversion of existing cover types within coastal and wetland resources. During construction, forested wetlands, intertidal zones, tidal wetlands, and adjacent areas could be converted to other cover types as a result of the Project construction footprint. An open trench option is being considered for landfall at the NYPA location, which would result in the temporary conversion of some coastal resources. The construction of the Waterford onshore substation facility would require conversion of limited forested wetlands. However, no impacts to coastal resources within the Project Area would result if trenchless (e.g., HDD, jack and bore, or micro-tunnel) methods are planned for connecting the submarine export cable to the onshore substation facility. The Queens, New York potential substation facility locations are situated outside of freshwater and coastal resource areas. Onshore export cable interconnection routes are proposed within previously developed upland areas.

[2] The Project is considering leasing satellite O&M warehouse and port facilities in addition to the O&M Base at SBMT

In addition, activities at staging and construction facilities will be consistent with the established and permitted uses of these facilities. Beacon Wind will comply with applicable permitting standards to limit environmental impacts from Project-related activities. Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- The siting of onshore components in previously disturbed areas, existing roadways, and/or rights-of-way, to the extent practicable;
- The installation of erosion controls around the limits of work for onshore construction activities;
- During construction, access will be restricted to existing paved roads and approved access routes to avoid impacts to sensitive areas;
- Due to the highly developed nature of the onshore area and lack of natural vegetation, implementation of an invasive species control plan may not be necessary. However, should the need for restoration efforts arise in any part of the intertidal zone, tidal wetland or regulated adjacent areas, an invasive species control plan to avoid the spread of invasive species and replant with native vegetation only will be implemented, which will be provided for agency review and approval, as applicable; and
- Landscaping and restoration work will be completed with appropriate native species, per a Landscape Restoration Plan or other appropriate plan, and in compliance with an invasive species control plan to prevent the introduction of invasive plant species, which will be provided for agency review and approval, as applicable.

Short-term impacts to vegetation within tidal coastal and wetland resources. During construction and installation activities, including onshore substation construction, trench excavation, trenchless work areas, and areas for staging of equipment and supplies, there is a potential to temporarily impact adjacent vegetation within these areas. Activities at staging and construction facilities will be consistent with the established and permitted uses of these facilities. Beacon Wind will comply with applicable permitting standards to limit environmental impacts from Project-related activities. Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- The siting of onshore components in previously disturbed areas, existing roadways, and/or rights-of-way, to the extent practicable;
- The installation of erosion controls around the limits of work for onshore construction activities.
- During construction, access will be restricted to existing paved roads and approved access routes to avoid impacts to sensitive areas;
- Due to the highly developed nature of the onshore areas and minimal lack of natural vegetation, implementation of an invasive species control plan may not be necessary. However, should the need for restoration efforts arise in any part of the intertidal zone, tidal wetland or regulated adjacent areas, an invasive species control plan to avoid the spread of invasive species and replant with native vegetation only will be implemented, which will be provided for agency review and approval, as applicable; and
- Landscaping and restoration work will be completed with appropriate native species, per a Landscape Restoration Plan or other appropriate plan, and in compliance with an invasive species control plan to prevent the introduction of invasive plant species, which will be provided for agency review and approval, as applicable.

Short-term potential for erosion from construction activities into adjacent coastal resources. Development of the onshore substation facility and supporting infrastructure may increase the potential for erosion and sedimentation to coastal resources down gradient. Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- The implementation of soil erosion and sediment control plans for each landfall location satisfactory to the requirements detailed in the New York State Standards and Specifications for Erosion and Sediment Control (Blue Book) and in the Connecticut Guidelines for Soil Erosion and Sediment Control, including development of a SWPPP, as applicable;
- During construction, access will be restricted to existing paved roads and approved access routes to avoid impacts to sensitive areas; and
- The installation of temporary matting at landfall location if access through tidal wetlands is required during construction activities to protect vegetation root systems, reduce compaction, and minimize ruts. This is not anticipated to be required at NYPA, AGRE East, AGRE West, and Waterford due to the absence of wetlands within the onshore area and due to the potential use of trenchless installation methods for connecting offshore submarine cable to the onshore substation.

Short-term potential for inadvertent return of drilling fluids during HDD. A base case of HDD installation technologies, or other trenchless technologies (e.g., jack and bore, or micro-tunnel) are planned to avoid sensitive areas such as the intertidal zone along the East River and adjacent areas. In the event of an inadvertent return within a regulated area, drilling fluids have the potential to escape to the surface and impact coastal resource habitats and the biota inhabiting such areas. Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- The implementation of an inadvertent return plan, which will be provided for agency review and approval, as applicable to avoid, minimize, and mitigate impacts.

Short-term potential for accidental releases from construction vehicles or equipment. Construction vehicles and equipment will be working adjacent to regulated areas during construction activities and will be refueled and potentially serviced within the Project Area. Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- The management of accidental spills or releases of oils or other hazardous wastes through a SPCC Plan, which will be provided for agency review and approval, as applicable; and
- During construction, access will be restricted to existing paved roads and approved access routes to avoid impacts to sensitive areas.

Short-term impedance to local migration of terrestrial biota as a result of placement of silt fencing. During construction and installation activities, silt fencing will be installed around ground disturbing activities. While installed, terrestrial biota will be restricted from passing through these areas. Beacon Wind will consider the following measures to avoid, minimize and mitigate impacts to terrestrial biota:

- Consideration of staggering silt fencing or other erosion control devices in sensitive areas to facilitate the passage of biota, if deemed effective. The strategy will be implemented on a site-specific basis and finalized during the permitting process.

Long-term permanent wetland and vernal pool conversion. During construction at the Onshore Project Areas in Waterford, Connecticut, there is a potential for permanent wetland conversion. Under the maximum design scenario, the Waterford, Connecticut onshore substation facility will require approximately 0.78 ac (0.31 ha) of wetland fill including fill within a single vernal pool area. The onshore export cable will also traverse a small forested wetland requiring 0.02 ac (0.008 ha) of conversion. These impacts will be fully permitted and coordination with local, state, and federal agencies will be completed to address the permanent loss of functions (e.g., aquatic and terrestrial habitat, surface water infiltration) at those locations resulting in a permanent fill in order to accommodate the onshore substation facility and onshore export cable construction. Beacon Wind will consider the following measures to avoid, minimize and mitigate impacts to terrestrial biota:

- Avoidance of wetlands during planning and design and construction will be incorporated wherever possible;
- Completion of permitting, and if necessary, mitigation for loss of wetland and vernal pool functions; and
- Wetland crossings for construction access will be avoided wherever practicable and temporary wetland construction matting will be used where access is required during construction.

5.2.4.2 Operations and Maintenance

During operations, no new impacts to coastal wetlands (including the intertidal zone and tidal wetlands) and onshore wetlands and waterbodies are anticipated, as Project-related activities are expected to utilize existing permitted access roads and entry points. Temporary workspaces will be restored to pre-construction conditions to the extent possible; however, permanent aboveground structures associated with the onshore substation facility will remain. Stormwater management and sediment control features approved and installed during Project construction, such as infiltration ponds, will avoid soil erosion to coastal resource areas during Project operations. Accidental releases into coastal resource areas will be avoided, minimized, or mitigated to the extent practicable by the development and implementation of a SPCC plan.

When onshore export cable inspection or repairs require excavation or other ground disturbance, short-term localized impacts to wetland and waterbody resources (or adjacent areas) may occur; these activities are not anticipated to have long-term effects. In this instance, mitigation strategies similar to those detailed in **Section 5.2.2.1** will be implemented on a case-by-case basis and would be defined through the regulatory process, as applicable, including:

- Protective measures will be installed around Project-components to restrict access to wetlands during operation and maintenance activities;
- Revegetation monitoring will be conducted consistent with a Landscaping Restoration Plan and Invasive Species Control Plan, which will be provided for agency review and approval, as applicable, within tidal wetlands and regulated adjacent areas to ensure that functionality is restored in these areas satisfactory to permit requirements;
- Mitigation monitoring, as required and defined during the regulatory process for any areas identified as mitigation sites as a result of long-term unavoidable impacts to tidal wetlands and protected adjacent areas; and

- Stormwater control features will be routinely inspected and cleaned to remove debris or excess vegetation that may impede the designed functionality. The inspection schedule will be detailed in the SWPPP and/or SPCC plan.

5.2.4.3 Decommissioning

Impacts during decommissioning are expected to be similar or less than those experienced during construction, as described in **Section 5.2.2.1**. It is important to note that advances in decommissioning methods/technologies are expected to occur throughout the operations phase of the Project. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and potential impacts will be re-evaluated at that time. For additional information on the decommissioning activities that Beacon Wind anticipates will be needed for the Project, please see **Section 3 Project Description**.

5.2.5 Summary of Avoidance, Minimization, and Mitigation Measures

In order to mitigate the potential impact-producing factors described in **Section 5.2.4**, Beacon Wind is proposing to implement the following avoidance, minimization, and mitigation measures.

5.2.5.1 *Construction*

During construction, Beacon Wind will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in **Section 5.2.4.1**:

- The siting of onshore components in previously disturbed areas, existing roadways, and/or rights-of-way to the extent practicable;
- The implementation of soil erosion and sediment control plans, which will be provided for agency review and approval, as applicable, for each onshore component to the requirements detailed in the New York State Standards and Specifications for Erosion and Sediment Control (Blue Book), and in the Connecticut Guidelines for Soil Erosion and Sediment Control, including development of a SWPPP, as applicable;
- The implementation of an Inadvertent Return Plan, which will be provided for agency review and approval, as applicable;
- The management of accidental spills or releases of oils or other hazardous wastes through a SPCC plan, which will be provided for agency review and approval, as applicable;
- Completion of necessary federal, state and local permitting for impacts related to the Waterford onshore substation facility;
- During construction, access will be restricted to existing paved roads and approved access routes to avoid impacts to sensitive areas;
- The implementation of an invasive species control plan, which will be provided for agency review and approval, as applicable, to avoid the spread of invasive species and replant with native vegetation only; and
- Landscaping and restoration work will be completed with appropriate native species, per a Landscape Restoration Plan or other appropriate plan, and in compliance with an invasive species control plan to prevent the introduction of invasive plant species, which will be provided for agency review and approval, as applicable.

In addition, during construction, Beacon Wind will consider the following avoidance, minimization, and mitigation measures to mitigate for potential impacts:

- Trenchless methods (e.g., HDD, jack and bore, or micro-tunnel) may be used for installation of the export cable landfall at NYPA, AGRE East, AGRE West, or Waterford to avoid surficial disturbances and impacts to coastal resources including the intertidal zone, tidal wetlands, and associated regulated adjacent areas;
- Although not anticipated within the Queens, New York Project Area due to the highly developed nature of the onshore area and absence of suitable habitat, evaluation of seasonal restrictions will be conducted should sensitive species be detected prior to vegetation clearing or other construction related activities, to mitigate potential impacts to breeding individuals; and
- Consideration of staggering silt fencing or other erosion control devices in sensitive areas to facilitate the passage of biota, if deemed effective. The strategy will be implemented on a site-specific basis and finalized during the permitting process.

As the Project design is still preliminary, detailed mitigation strategies, as required, will be developed as part of the final design and conform to the requirements of all state and federal permitting respective to wetlands and waterbody resources.

5.2.5.2 *Operations and Maintenance*

During operations, Beacon Wind will commit to implementation of the following avoidance, minimization, and mitigation measures to mitigate for potential impacts as described in **Section 5.2.4.2**:

- Protective measures will be installed around Project-components to restrict access to wetlands during operation and maintenance activities;
- Revegetation monitoring will be conducted consistent with a Landscaping Restoration Plan and Invasive Species Control Plan, which will be provided for agency review and approval, as applicable, within tidal wetlands and regulated adjacent areas to ensure that functionality is restored in these areas satisfactory to permit requirements;
- Mitigation monitoring, as required and defined during the regulatory process for any areas identified as mitigation sites as a result of long-term unavoidable impacts to tidal wetlands and protected adjacent areas; and
- Stormwater control features will be routinely inspected and cleaned to remove debris or excess vegetation that may impede the designed functionality. The inspection schedule will be detailed in the SWPPP and/or SPCC plan.

5.2.5.3 Decommissioning

Avoidance, minimization, and mitigation measures proposed to be implemented during conceptual decommissioning are expected to be similar to those experienced during construction and operations, as described in **Section 5.2.5.1** and **Section 5.2.5.2**. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and avoidance, minimization, and mitigation measures for decommissioning activities will be proposed at that time.

5.2.6 References

TABLE 5.2-8. SUMMARY OF DATA SOURCES

Source	Includes	Available at	Metadata Link
FEMA	Flood Hazard Zones	https://www.fema.gov/flood-maps/national-flood-hazard-layer	N/A
NLCD	Land Cover	https://www.mrlc.gov/data/nlcd-2019-land-cover-conus	N/A
USFWS	NWI	https://www.fws.gov/wetlands/data/mapper.html	N/A
NYSDEC	Tidal Wetlands	https://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1328	N/A

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5.3 Avian Species

This section describes the avian species known or documented to occur within and surrounding the Project Area including the Lease Area, submarine export cable routes, onshore export and interconnection cable routes, and onshore substation facilities. Potential impacts to birds resulting from construction, operations, and decommissioning of the Project are discussed. Proposed Project-specific measures adopted by Beacon Wind are also described, which are intended to avoid, minimize, and/or mitigate potential impacts to avian species.

Other resources and assessments detailed within this COP that are related to birds include:

- Terrestrial Vegetation and Wildlife (**Section 5.1**);
- Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat (**Section 5.5**);
- USFWS IpaC and State Listed Species (**Appendix M**);
- Ornithological and Marine Faunal Aerial Survey – APEM Studies (**Appendix O**); and
- Avian Impact Assessment **(Appendix P**).

Data Relied Upon and Studies Completed

For the purposes of this section, the Study Area consists of two areas: those portions of the Project Area consisting of the offshore components, referred to as the Offshore Study Area and those portions of the Project Area consisting of the onshore components referred to as the Onshore Study Areas, which were assessed for potential impacts to avian species (**Appendix P Avian Impact Assessment**). The Offshore Study Area consists of the Lease Area and the offshore infrastructure components for BW1 and BW2, inclusive of an overlap area (**Figure 5.3-1**). The offshore infrastructure addressed for the Offshore Study Area includes the wind turbines, offshore substation facilities, foundations, interarray cables, and the portions of the submarine export cables within the Lease Area. Two Onshore Study Areas are under consideration for the BW2 submarine export cable route to either Queens, New York or to Waterford, Connecticut. The Onshore Study Area for Queens, New York consists of the area identified within the Astoria power complex, where two locations are under consideration (NYPA and, AGRE which includes AGRE East and AGRE West) for the single proposed landfall (**Figure 5.3-2**). The onshore infrastructure addressed for the Queens, New York Onshore Study Area includes the two options for BW1 landfall, onshore export and interconnection cables, onshore substation facility, and POI options. The Queens onshore substation facility sites that are not used (NYPA, AGRE East, or AGRE West) for BW1 will remain under consideration, in addition to the Waterford, Connecticut site, for the single proposed BW2 onshore substation facility. The Onshore Study Area for Waterford, Connecticut consists of the area identified within and around the proposed onshore substation facility, north of the Dominion Millstone Power Station (**Figure 5.3-3**). The submarine export cables are addressed in a similar approach as used by risk assessments for other offshore wind projects (e.g., Vineyard Wind) and with BOEM's conclusions derived from environmental assessments that the installation of submarine export cable would not result in potential effects to avian species (BOEM 2021). The exception to this approach is for the roseate tern (*Sterna dougallii*) which is addressed due to its status as an ESA-listed species and/or its use of resources during critical time periods (e.g., breeding) within or near the area where the submarine export cable will be installed (**Appendix P Avian Impact Assessment**).

This section was prepared in accordance with:

- BOEM's site characterization requirements in 30 CFR § 585.626(3); and
- BOEM's Guidelines for Providing Avian Survey Information for Renewable Energy Development on the Outer Continental Shelf Pursuant to 30 CFR Part 585 (BOEM 2020).

In accordance with BOEM's avian guidelines (BOEM 2020), this section relies upon data collected from multiple sources relevant to avian species in the offshore and onshore portions of the Project Area designated as the Offshore Study Area and the Onshore Study Area(s), respectively. The following paragraphs describe the data that were compiled and used.

For the Offshore Study Area, birds listed in the IPaC Report from the USFWS (**Appendix M USFWS IPaC and State Listed Species**), survey-based studies (boat and aerial), and tracking or movement studies were used to account for the occurrence, distribution, abundance, and movement of seabirds. Sources included the Northwest Atlantic Seabird Catalog, Marine Bird Abundance Models (Marine-life Data and Analysis Team [MDAT]), and movement tracking data for rufa red knots (*Calidris canutus rufa*), roseate terns, common terns (*Sterna hirundo*), piping plovers (*Charadrius melodus*), and diving birds (Loring et al. 2018; Loring et al. 2019; Spiegel et al. 2017). Survey data were also obtained for sand lance (*Ammodytes spp.*), a primary prey source for the roseate tern. Sand lance data sources included bottom trawl surveys for adults (Ribera et al. 2019), bottom trawl and Ecosystems Monitoring (EcoMon) surveys for larval stage (NEFSC, 2021), and nearshore bottom trawl surveys (Northeast Area Monitoring and Assessment Program [NEAMAP]).

In addition to the data sources collected for the Offshore Study Area, Project-specific marine wildlife surveys were conducted for Beacon Wind. High-resolution digital aerial surveys were conducted by APEM, Inc. (APEM) within a defined Study Area between December 2019 and November 2020. The Study Area defined included the Lease Area and a 1.1-nautical mile (nm) (2-kilometer [km]) buffer surrounding it with an approximately 1.1–2.1-nm (2–4-km) buffer towards the northeast end. The data collected during these first-year studies consisted of sightings of avian and other marine species and are summarized in **Appendix O Ornithological and Marine Faunal Aerial Survey – APEM Studies** (Normandeau-APEM 2020).

For the Onshore Study Areas, a combination of information received through formal inquiries and reports obtained from agencies and publicly available resources was analyzed. Formal inquiries were submitted to the New York State Department of Environmental Conservation, Division of Fish and Wildlife, Natural Heritage Program (NYSDEC-DFW NHP), as well as CTDEEP Natural Diversity Data Base (NDDB), and an IPaC report was obtained from the USFWS web portal (**Appendix M USFWS IPaC and State Listed Species**). The NYSDEC and CTDEEP responses identified species documented in the Onshore Study Area and vicinity and their respective statuses designated under state wildlife code. The IPaC report included an official species list that was used to identify threatened, endangered, proposed species, and candidate species listed under the ESA, as well as and species protected under the (MBTA) and the BGEPA; no critical habitat for these species was designated in the Onshore Study Areas.

Data obtained from publicly available resources to identify species occurrence or presence in the Onshore Study Areas included the New York Breeding Bird Atlas (BBA) (New York Breeding Bird Atlas, 2000), New York Wildlife Action Plan (NYSDEC 2015), Connecticut BBA (The Atlas of Breeding Birds of Connecticut, 1994; Connecticut Bird Atlas. 2022), Connecticut Wildlife Action Plan (CTDEEP

2015a), eBird data (Sullivan et al. 2009; eBird 2021), and Audubon Important Bird Areas (IBA) (Bird Life International 2014). The Audubon IBAs are part of a global network of sites (Important Bird and Biodiversity Areas) identified by conservation partners (Bird Life International) as significant for the global persistence of biodiversity and the conservation of the world's birds and other species (Bird Life International 2014). BBA blocks are approximately 9 mi^2 (24 km^2), which comprises up to approximately 3.5 mi (5.5 km) from the onshore substation facility in Queens, New York, and up to 2.5 mi (3.5 km) from the proposed onshore substation facility in Waterford, Connecticut. Data on possible bird species present was compiled from eBird citizen science data (Sullivan et al. 2009) within an approximately 1.2 nm^2 (4 km^2) polygon around the potential onshore landfalls and onshore substation facility sites (up to approximately 1 mi [4 km] from the onshore substation facilities) and was temporally constrained to 10 years (2012-2021). Google Earth satellite and street views were used to identify the existing habitat available or likely to be used by birds within the Onshore Study Areas and vicinity.

Preliminary reconnaissance of the onshore portions of the Project Area, including the NYPA, AGRE, and Waterford sites, was conducted on May 17, 2021, June 17, 2021, March 17, 2022, and September 15, 2022, respectively. Current site conditions were documented for the assessment of terrestrial vegetation and wildlife (**Section 5.1 Terrestrial Vegetation and Wildlife**) and will be revisited upon final selection of the location of the onshore infrastructure components.

Beacon Wind contracted AECOM Technical Services, Inc. (AECOM) to conduct an avian impact assessment for both offshore and onshore birds known to occur in the Project Area. Potential risk to avian species was assessed using a risk assessment framework to identify the potential effects associated with construction, operations, and decommissioning of the Project. A quantitative weight-of-evidence approach was used to evaluate exposure (likelihood of occurrence in the offshore area) and behavioral vulnerability to establish the potential for risk (**Appendix P Avian Impact Assessment**). Avoidance, minimization, and mitigation measures for other offshore wind projects were reviewed and may be considered for Beacon Wind based on applicability and agency acceptance.

FIGURE 5.3-1. AVIAN SPECIES OFFSHORE STUDY AREA WITHIN BEACON WIND OCS-A 0520

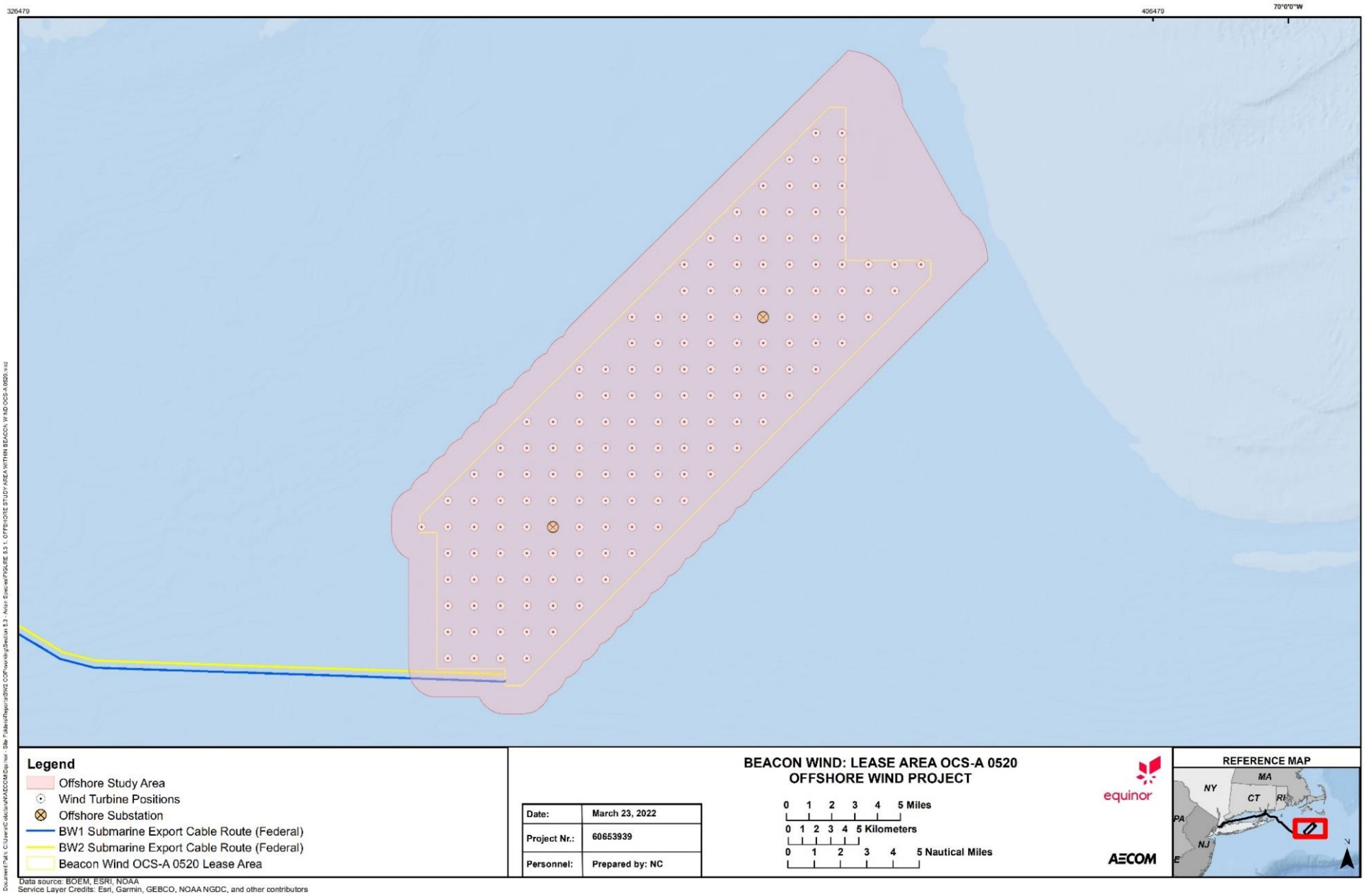


FIGURE 5.3-2. AVIAN SPECIES ONSHORE STUDY AREA - QUEENS, NEW YORK

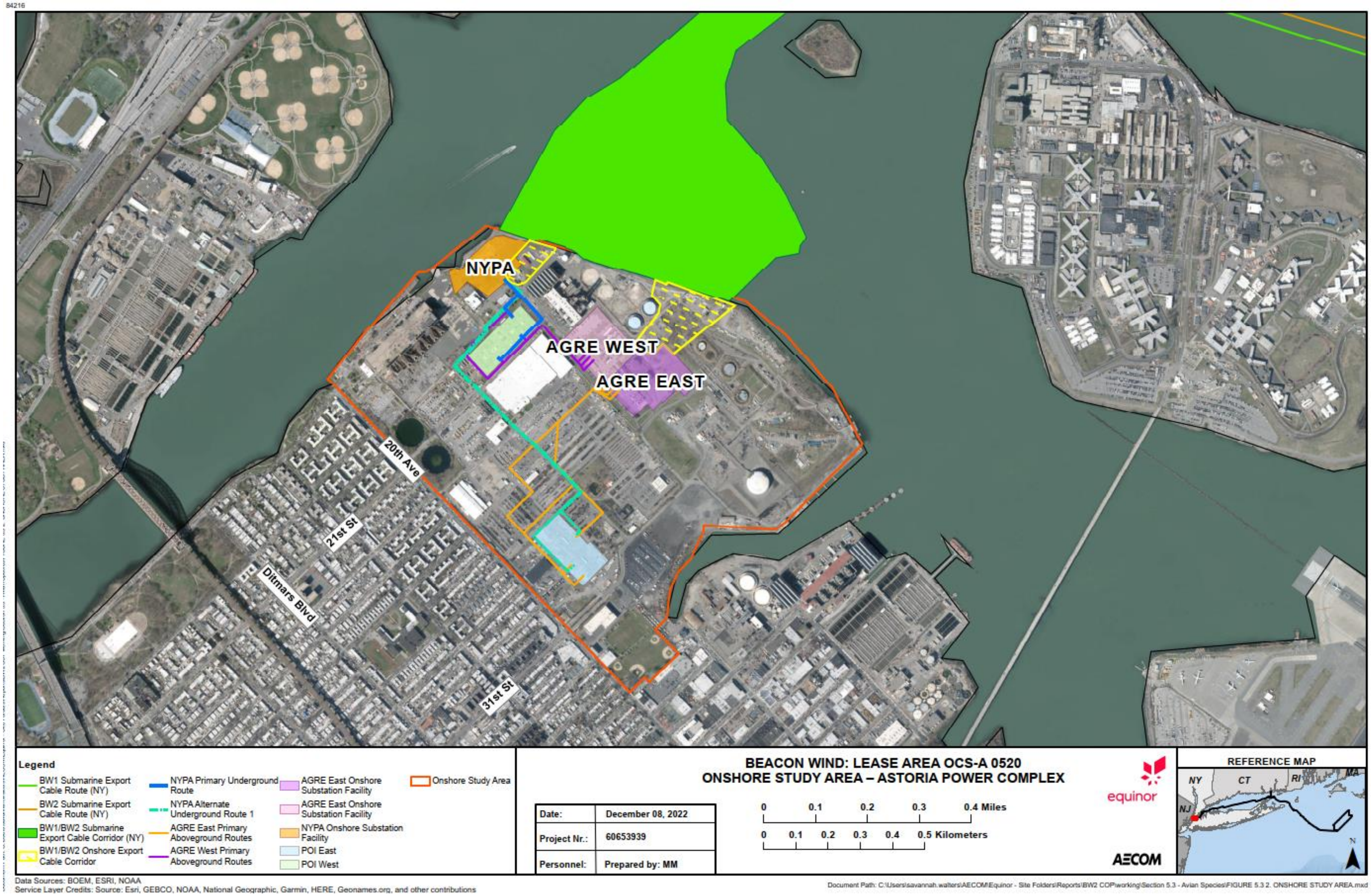
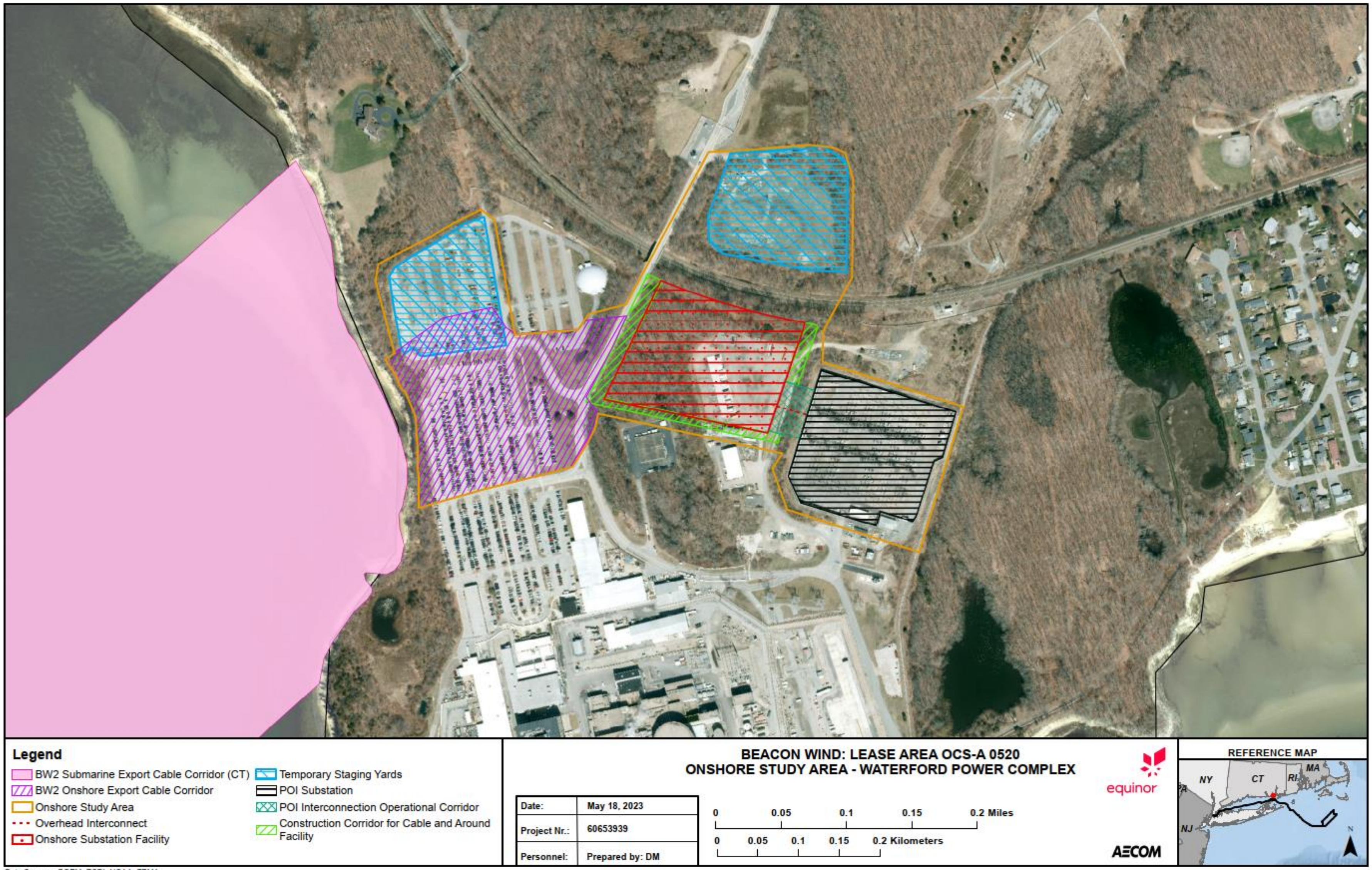


FIGURE 5.3-3. AVIAN SPECIES ONSHORE STUDY AREA - WATERFORD, CONNECTICUT



Data Sources: BOEM, ESRI, NOAA, FEMA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

5.3.1 Affected Environment

The affected environment is defined as the offshore and onshore areas where birds are known to be present, traverse, or incidentally occur, and have the potential to be directly and/or indirectly affected by the construction, operation, and decommissioning of the Project. This includes the Lease Area, (BW1, BW2, and the overlap area), BW1 and BW2 submarine export cable routes , the onshore export and interconnection cable routes, and onshore substation facilities. Two locations (NYPA and , AGRE which includes AGRE East and AGRE West) are under consideration for the onshore substation facility and are considered together as the Queens, New York Onshore Study Area for the purposes of this section. The onshore substation facility sites in Queens, New York that are not used for BW1 (NYPA and AGRE) will remain under consideration, in addition to the Waterford, Connecticut site, for the single proposed BW2 onshore substation facility. The submarine export cables are addressed in one area where they may pass by Great Gull Island, an Audubon IBA of Global Importance known as habitat for the largest nesting colony for the ESA-listed roseate tern (*Sterna dougallii*) in North America (Bird Life International 2014).

Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Beacon Wind expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Beacon Wind will comply with in using the facilities.

5.3.1.1 *Baseline Characterization: Offshore*

The MDAT models were used in conjunction with Project Area surveys (**Appendix O Ornithological and Marine Faunal Aerial Survey – APEM Studies**) to characterize the marine bird species assemblages in the Lease Area and within the larger region. The MDAT models indicate marine bird abundance is greater closer to shore than in the Lease Area (**Figure 5.3-4**). **Table 5.3-1** lists bird species potentially exposed to the offshore components of the Project identified through the MDAT abundance model and APEM surveys (**Appendix O Ornithological and Marine Faunal Aerial Survey – APEM Studies**), and any included in the USFWS IPaC report obtained for the Lease Area (**Appendix M USFWS IPaC and State Listed Species**).

5.3.1.1.1 Shorebirds

Most shorebirds breed in the northern regions or are Arctic breeders. Migration and stopover occur along the U.S. East Coast, but typically not over the deeper waters. Two shorebirds considered to be pelagic and documented in the offshore environment as migrants are the red phalarope and the red-necked phalarope. Two ESA-listed shorebird species, the piping plover and the rufa red knot, are also given consideration due to their status.

Piping Plover: Piping plover was listed as "Threatened" under the U.S. ESA in 1985 (USFWS n.d.a). Piping plovers are migratory shorebirds that breed along the U.S. Atlantic coast, occur from Florida to Maine, and overwinter in the southeastern U.S. and Caribbean (Loring et al. 2019). They may occur in the Lease Area during migration (Burger et al. 2011), particularly during fall (Loring et al. 2019).

Loring et al. (2019) recorded fall migratory tracks of piping plovers that neared the Beacon Wind Lease Area showing low exposure probability density in the Lease Area. Model-estimated flight altitudes ranged within the upper limits of the Rotor Swept Zone (RSZ) 86 ft (26 m) – 1,083 ft (330 m) and above. Piping plovers were not modeled by MDAT nor observed during APEM surveys. Therefore, piping plovers were assigned a conservative exposure score of 3 (Medium) during fall.

Robinson Willmott et al. (2013) estimated piping plovers to have “Medium” collision sensitivity and “Lower” displacement sensitivity. Therefore, final vulnerability scores resulted as Low collision risk and Minimal displacement risk.

Rufa Red Knot: Rufa red knot was listed as "Threatened" under the U.S. ESA in 2015 (USFWS n.d.b). Red Knots are long-distance migratory shorebirds that breed in the Canadian Arctic, occur along the U.S. Atlantic coast from Florida to Maine, and overwinter in South America (Burger et al. 2011). They may occur in the Lease Area during spring and fall migration (Burger et al. 2011; Loring et al. 2019).

Loring et al. (2018) recorded spring and fall migratory tracks of red knots that neared the Beacon Wind Lease Area, showing low exposure probabilities in the Lease Area. Model-estimated flight altitudes ranged within the upper limits of the RSZ 86 ft (26 m) – 1,083 ft (330 m) and above. Red knots were not modeled by MDAT nor observed during APEM surveys. Therefore, red knots were assigned a conservative exposure score of 3 (Medium) during spring and fall.

Robinson Willmott et al. (2013) estimated red knots to have “Medium” collision sensitivity and “Lower” displacement sensitivity. Therefore, final vulnerability scores resulted as Low collision risk and Minimal displacement risk.

Phalaropes: Phalaropes are pelagic shorebirds that glean plankton off the sea surface in offshore marine environments (De Graaf 1985; Shealer 2001). They breed in the Canadian Arctic, migrate and forage across the U.S. Atlantic Outer Continental Shelf (AOCS), and overwinter in the tropical Atlantic (Nisbet et al. 2013). They may occur in the Lease Area during spring, summer, and fall migration (Winship et al. 2018). Red and red-necked phalaropes scored Minimal to Medium exposure to activity in the Lease Area during spring, summer and fall according to MDAT model quantiles. Unidentified phalaropes (i.e., either species) were observed during summer APEM surveys and red phalaropes were observed during fall.

Robinson Willmott et al. (2013) estimated phalaropes to have “Higher” collision sensitivity and “Lower” (red-necked phalarope) or “Medium” (red phalarope) displacement sensitivity. Therefore, final vulnerability scores resulted as Minimal (red-necked phalarope), Low (both), and Medium (both species) collision risk and Minimal (red-necked phalarope) to Low (red phalarope) displacement risk. Collision risk resulted as Medium for red phalaropes in spring and as Medium for red-necked phalaropes in summer.

5.3.1.1.2 Marine Birds

Gannets: Northern gannets are piscivorous aerial plunge divers that breed in Canada and overwinter along the U.S. Atlantic coast and across the AOCS (Nisbet et al. 2013; Spiegel et al. 2017; Stenhouse et al. 2020). They may occur in the Lease Area throughout the year, particularly during migration and the overwintering, nonbreeding season (Spiegel et al. 2017; Winship et al. 2018).

Spiegel et al. (2017) estimated migratory and overwintering utilization distributions of Northern gannets that showed low exposure probability to the Lease Area in fall and winter, as well as medium in fall and spring, and high in the northern portion of the Lease area in spring. Northern gannets scored Medium exposure to activity in the Lease Area during winter, spring and summer, and High exposure during fall, according to MDAT modelling. Northern gannets were observed throughout the year during APEM surveys.

Robinson Willmott et al. (2013) estimated gannets to have “Higher” collision sensitivity and “Higher” displacement sensitivity; note that both of these scores incorporated population sensitivity. Therefore, final vulnerability scores for collision and displacement risk were Medium for Northern gannets in winter, spring and summer, and High in fall.

Grebes: Horned grebes are inland breeders that nest in western Canada and overwinter along the U.S. Atlantic coast, usually in shallow water, to dive from sitting for invertebrates or small fish (De Graaf 1985; Nisbet et al. 2013). They are uncommon in pelagic environments; therefore, they may occur incidentally but are not likely in the Lease Area.

Horned grebes scored Minimal exposure to activity in the Lease Area in winter, according to MDAT model quantiles. Grebes were not observed during APEM surveys.

Cormorants: Double-crested cormorants are pursuit-diving piscivores that breed in the U.S. from Florida to Canada, forage and migrate across the AOCS, and overwinter in the southern U.S. (Nisbet et al. 2013). They may occur in the Lease Area during the summer breeding season and migration (Winship et al. 2018).

Double-crested cormorants scored Medium exposure to activity in the Lease Area in spring, summer and fall and Minimal exposure in winter, according to MDAT model quantiles. Cormorants were observed during spring and fall APEM surveys.

Robinson Willmott et al. (2013) estimated double-crested cormorants to have “Higher” collision sensitivity and “Medium” displacement sensitivity; note that these scores incorporated population sensitivity. Therefore, final vulnerability scores resulted as Medium collision risk in spring, summer and fall, Low displacement risk in spring, summer and fall, and Minimal risk in winter for cormorants.

Pelicans: Brown pelicans are surface-seizing and plunging piscivores that breed in the U.S. from Florida to New Jersey and overwinter near their breeding range (De Graaf 1985; Nisbet et al. 2013; Shealer 2001). They are uncommon in the Northeast U.S.; therefore, they may occur incidentally but are not likely in the Lease Area.

Brown pelicans scored Low exposure to activity in the Lease Area in summer, fall and winter, and Minimal exposure in spring, according to MDAT model quantiles. Pelicans were not observed during APEM surveys.

Robinson Willmott et al. (2013) estimated brown pelicans to have “Higher” collision sensitivity and “Medium” displacement sensitivity; note that these scores incorporated population sensitivity. Therefore, final vulnerability scores resulted as Low collision and displacement risk for brown pelicans in summer, fall and winter, and Minimal risk in spring.

Loons: Common loons and red-throated loons are summer breeders in inland areas but occur in the OCS in the winter and during spring and fall migration. Spiegel et al. (2017) estimated migratory and overwintering utilization distributions of red-throated loons that showed low exposure probability to the Lease Area in fall, winter, and spring, except for medium exposure probability in the northeast portion of the Lease Area during spring. Exposure scores were calculated for both loon species during the

Avian Impact Assessment. Red-throated and common loons scored Medium exposure to activity in the Lease Area during spring and winter, and Low exposure during fall, according to MDAT model quantiles; common loons additionally scored Medium exposure in summer. Loons were observed in fall, winter and spring APEM surveys.

Robinson Willmott et al. (2013) estimated loons to have “Higher” collision sensitivity and “Higher” displacement sensitivity; note that both of these scores incorporated population sensitivity. Therefore, final vulnerability scores for collision and displacement risk were Medium for red-throated and common loons in winter, spring and summer (common loons only), and Low in fall.

Seaducks: Seaducks include long-tailed duck, white-winged scoter, black scoter, red-breasted merganser, and common eider. The ducks listed are northern or Arctic breeders present in the nearshore and offshore waters in the Mid-Atlantic region in the winter. Seaducks use shallow waters to forage on mussels, invertebrates, and other prey. The seaduck exposure scores were calculated during the Avian Impact Assessment (**Appendix P Avian Impact Assessment**) for the species listed here. Surf scoters scored Medium exposure to activity in the Lease Area during fall, winter and spring, according to MDAT modeling. Other seaducks scored Minimal to Medium exposure in spring, summer, fall, and/or winter, except long-tailed ducks and white-winged scoters, which scored High exposure in winter. Seaducks were observed in fall, winter and spring APEM surveys.

Robinson Willmott et al. (2013) estimated seaducks to have “Higher” collision sensitivity and “Higher” displacement sensitivity, except red-breasted mergansers which scored “Medium” displacement sensitivity; note that both of these scores incorporated population sensitivity. Therefore, final vulnerability scores for collision and displacement risk were High for long-tailed ducks and white-winged scoters in winter, and Minimal to Medium for other seasons and seaducks.

Shearwaters, Petrels, and Fulmars: Shearwaters, petrels, and fulmars are pelagic seabirds that scavenge for fish by surface-seizing (De Graaf 1985; Powers et al. 2020; Shealer 2001). Northern fulmars and a small colony of manx shearwaters breed along the Atlantic coast of Canada, manx and Cory’s Shearwaters breed along the eastern North Atlantic, Audubon’s and black-capped petrels breed in the Caribbean, and Great and Sooty Shearwaters breed in the Southern Oceans (Nisbet et al. 2013). They may occur in the Lease Area throughout the year, particularly spring, summer, and fall (Winship et al. 2018).

Cory’s shearwater scored Very High exposure to activity in the Lease Area during summer, and High exposure during fall; sooty shearwater scored High exposure in summer; and other season and species scored Minimal to Medium exposure, according to MDAT modelling. Shearwaters and fulmars were observed during all seasons of APEM surveys.

Robinson Willmott et al. (2013) estimated shearwaters, petrels, and fulmars to have “Higher” collision sensitivity, and “Higher” (black-capped petrel, manx shearwater), “Medium” (Cory’s shearwater, Northern fulmar, great shearwater, Audubon’s shearwater) or Low (sooty shearwater) displacement sensitivity; note that these scores incorporated population sensitivity. Therefore, final vulnerability scores for Cory’s shearwater resulted as Very High collision risk in summer, High collision risk in fall, and High displacement risk in summer. Sooty shearwaters scored High collision risk in summer and other seasons and/or species scored Minimal to Medium risk.

Storm-Petrel Group: Storm-petrels are pelagic planktivores that forage by "pattering" with their feet over the sea surface (De Graaf 1985; Shealer 2001). Wilson's and band-rumped storm-petrels breed in the tropical and/or Southern Oceans and Leach's Storm-petrels breed along the North Atlantic coast from Massachusetts to Canada (Nisbet et al. 2013). They forage across the U.S. AOCS and may occur in the Lease Area during spring, summer, and fall (Nisbet et al. 2013; Winship et al. 2018).

Wilson's Storm-petrel scored High exposure to activity in the Lease Area during summer and Low exposure during spring and fall; Leach's storm-petrel scored Medium exposure in fall and low exposure in spring and summer, according to MDAT model quantiles. Band-rumped storm-petrel scored Minimal exposure in summer. Unidentified Storm-petrels (i.e., likely Wilson's or Leach's) were observed during spring, summer, and fall APEM surveys and Wilson's Storm-petrels were observed during spring.

Robinson Willmott et al. (2013) estimated storm-petrels to have "Higher" collision sensitivity and "Medium" (band-rumped, Leach's) or Low (Wilson's) displacement sensitivity; note that these scores incorporated population sensitivity. Therefore, final vulnerability scores resulted as High collision risk for Wilson's storm petrel in summer, Medium collision risk for Leach's storm-petrel in fall, and Minimal to Low risk for other seasons and species.

Gulls: Gulls are aerial surface-seizing seabirds that scavenge for fish and invertebrates on the sea surface in offshore marine environments (De Graaf 1985; Shealer 2001). They breed along the U.S. Atlantic coast and Canada and migrate, forage, and overwinter across the U.S. AOCS (Nisbet et al. 2013). They may occur in the Lease Area throughout the year, particularly in the fall (Winship et al. 2018).

Gull species that scored High exposure to activity in the Lease Area were black-legged kittiwakes in spring and herring and great black-backed gulls in summer, according to MDAT model quantiles; other seasons and gull species scored Minimal to Medium. Lesser black-backed, Iceland, and Sabine's gulls were not modeled by MDAT, but were observed during fall APEM surveys. Therefore, they were assigned an exposure score of 3 (Medium) during fall and spring (lesser Black-backed gulls only). Gulls were observed throughout the year during APEM surveys.

Robinson Willmott et al. (2013) estimated most gulls to have "Higher" collision sensitivity, except ring-billed and Bonaparte's gulls. Iceland and great black-backed gulls scored "Higher" displacement sensitivity and the other gulls scored "Lower" or "Medium"; note that these scores incorporated population sensitivity. Therefore, final vulnerability scores resulted as High collision risk for Herring and great black-backed gulls in summer, and for black-legged kittiwakes in spring. Great black-backed gulls also scored High displacement risk in summer. Final risk scores for other seasons and gull species were Minimal to Medium.

Alcids: Alcids are pursuit-diving piscivores and/or crustaceovores that breed along the North Atlantic coast from Maine to Canada and migrate, forage, and overwinter across the U.S. AOCS (De Graaf 1985; Nisbet et al. 2013; Shealer 2001). They may occur in the Lease Area throughout the year, particularly during spring and winter (except black guillemots present in summer) (Winship et al. 2018).

Razorbills scored Very High exposure to activity in the Lease Area in spring and winter, and common murres scored High exposure during winter, according to MDAT modelling; other seasons and species scored Low to Medium. Razorbills, Atlantic puffins, and murres were observed during spring and winter APEM surveys and dovekies were observed in winter.

Robinson Willmott et al. (2013) estimated alcids to have “Higher” collision sensitivity and “Lower” displacement sensitivity, except for dovekies which scored “Medium” collision and displacement sensitivity; note that these scores incorporated population sensitivity. Therefore, final vulnerability scores resulted as Very High collision and displacement risk for razorbills in spring and winter, High collision and displacement risk for common murres in winter, and Low to Medium risk for other seasons and species.

Jaegers and Skuas: Jaegers and skuas are aerial kleptoparasitic scavengers that breed in Canada (except South Polar Skuas, which breed in Antarctica) and migrate across the U.S. AOCS (Nisbet et al. 2013; Shealer 2001). They may occur in the Lease Area in summer and fall (Winship et al. 2018).

Parasitic jaegers scored High exposure to activity in the Lease Area in summer, according to MDAT model quantiles; other seasons (excluding winter) and species scored Minimal to Low. Parasitic jaegers were observed during summer and fall APEM surveys.

Robinson Willmott et al. (2013) estimated jaegers and skuas to have “Higher” collision sensitivity and “Lower” displacement sensitivity; note that these scores incorporated population sensitivity. Therefore, final vulnerability scores resulted as High collision risk for parasitic jaegers in summer, and Minimal to Low for other seasons and species.

Terns: Arctic tern, bridled tern, common tern, Forster’s tern, least tern, roseate tern, royal tern, and sooty tern were documented in the Lease Area by MDAT and/or observed in Lease Area during APEM’s aerial digital surveys (**Table 5.3-1**). Terns are present in offshore waters primarily in the early spring or fall as migrants.

Raptors, Wading Birds, Coastal Waterbirds, and Songbirds: Raptors, wading birds, coastal waterbirds (e.g., dabbling ducks), and songbirds are seldom documented in the literature in offshore habitats. Falcons, such as merlins and peregrine falcons have been documented in offshore settings during migration. Bald eagles and golden eagles are not present far out to sea as their migratory pathways are along inland and coastal corridors (Mojica and Watts 2016). The wading birds, such as herons and egrets, breed and forage in inland and coastal waters and are typically not found in deeper waters (Kushlan and Hafner 2000). Coastal waterbirds, which include waterfowl (swans, geese, ducks), are found in terrestrial or coastal habitats such as rivers and reservoirs, wetlands, and shallow nearshore waters rather than offshore marine systems. Habitat is not present in the offshore environment for songbirds, which rely on terrestrial, freshwater, and coastal habitats. However, during migration, songbirds migrate over the waters of the Atlantic Ocean and have been detected in passage at night (Huppop and Hilgerloh 2012). Songbird species, such as the blackpoll warbler (*Setophaga striata*), which engage in longer, sustained flights, are documented to fly farther out over water (DeLuca et al. 2015), as well as thrushes and other songbird species detected by acoustic methods (Adams et al. 2015).

Exposure of raptors, wading birds, coastal waterbirds, and songbirds within the Lease Area is expected to be minimal due to the Lease Area’s distance from shore. Species in these groups were not observed during the APEM digital aerial surveys within the Lease Area and were not assessed further in the Avian Impact Assessment (**Appendix P Avian Impact Assessment**) for the Offshore Study Area.

FIGURE 5.3-4. MDAT ABUNDANCE MODEL FOR ALL BIRDS NEARSHORE/OFFSHORE

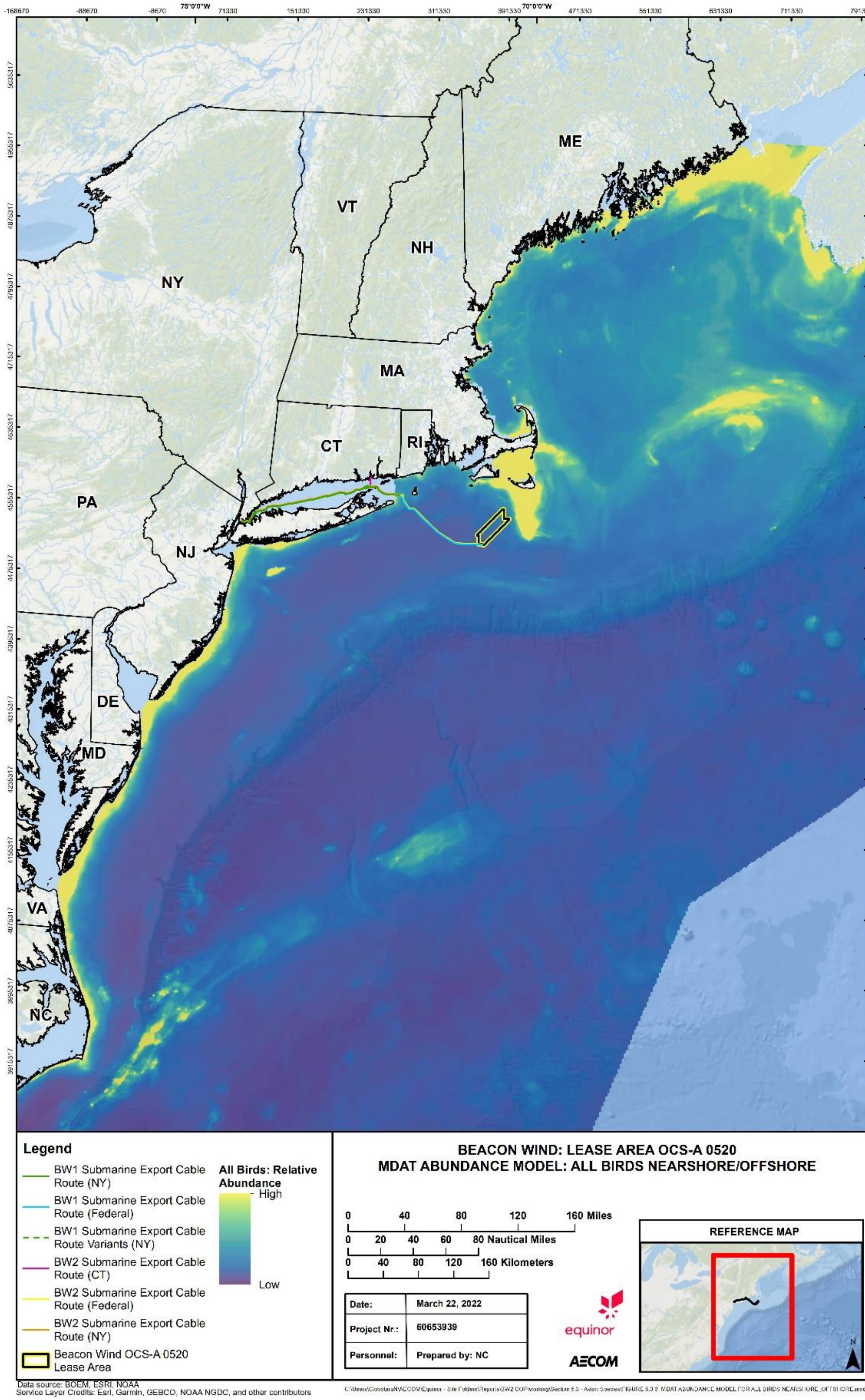


TABLE 5.3-1. SUMMARY OF AVIAN SPECIES POTENTIALLY EXPOSED TO THE OFFSHORE COMPONENTS

Common Name	Scientific Name	IPaC	NY Listed	MA Listed	ESA Listed	APEM	MDAT
Plovers	**Order Charadriiformes, Family Charadriidae**						
Piping plover	*Charadrius melodus*	X	E	T	T	-	-
Sandpipers	**Order Charadriiformes, Family Scolopacidae: Arenariinae**						
Rufa red knot	*Calidris canutus rufa*	X	T	T	T	-	-
Phalaropes	**Order Charadriiformes, Family Scolopacidae: Tringinae**						
Red phalarope	*Phalaropus fulicarius*		-	-	-	X	X
Red-necked phalarope	*Phalaropus lobatus*	X	-	-	-	XX	X
Terns	**Order Charadriiformes, Family Laridae: Sterninae**						
Roseate tern	*Sterna dougallii*	X	E	T	E	X	X
Forster's tern	*Sterna forsteri*		-	-	-	X	-
Common tern	*Sterna hirundo*	X	T	SC	-	X	X
Royal tern	*Sterna maxima*	X	-	-	-	-	X
Arctic tern	*Sterna paradisaea*	X	-	SC	-	XX	X
Least tern	*Sternula antillarum*	X	T	SC	-	-	X
Bridled tern	*Onychoprion anaethetus*		-	-	-	-	X
Sooty tern	*Onychoprion fuscatus*	X	-	-	-	-	X
Gulls	**Order Charadriiformes, Family Laridae: Larinae**						
Herring gull	*Larus argentatus*	X	-	-	-	X	X
Laughing gull	*Leucophaeus atricilla*		-	-	-	X	X
Ring-billed gull	*Larus delawarensis*	X	-	-	-	X	X
Lesser black-backed gull	*Larus fuscus*		-	-	-	X	-
Iceland gull	*Larus glaucoides*		-	-	-	X	-
Great black-backed gull	*Larus marinus*	X	-	-	-	X	X
Bonaparte's gull	*Chroicocephalus philadelphia*	X	-	-	-	X	X
Black-legged kittiwake	*Rissa tridactyla*	X	-	-	-	X	X
Sabine's gull	*Xema sabini*		-	-	-	X	-
Jaegers and Skuas	**Order Charadriiformes, Family Stercorariidae**						
South polar skua	*Stercorarius maccormicki*		-	-	-	-	X
Parasitic jaeger	*Stercorarius parasiticus*	X	-	-	-	X	X
Pomarine jaeger	*Stercorarius pomarinus*	X	-	-	-	-	X

Common Name	Scientific Name	IPaC	NY Listed	MA Listed	ESA Listed	APEM	MDAT
Great skua	*Stercorarius skua*		-	-	-	-	X
Alcids	**Order Charadriiformes, Family Alcidae**						
Razorbill	*Alca torda*	X	-	-	-	X	X
Dovekie	*Alle*	X	-	-	-	X	X
Black guillemot	*Cepphus grylle*	X	-	-	-	-	X
Atlantic puffin	*Fratercula arctica*	X	-	-	-	X	X
Common murre	*Uria aalge*	X	-	-	-	XX	X
Thick-billed murre	*Uria lomvia*	X	-	-	-	XX	X
Seaducks	**Order Anseriformes, Family Anatidae: Anatinae**						
Long-tailed duck	*Clangula hyemalis*	X	-	-	-	X	X
White-winged scoter	*Melanitta deglandi*	X	-	-	-	X	X
Black scoter	*Melanitta americana*	X	-	-	-	X	X
Surf scoter	*Melanitta perspicillata*	X	-	-	-	X	X
Red-breasted merganser	*Mergus serrator*	X	-	-	-	-	X
Common eider	*Somateria mollissima*	X	-	-	-	X	X
Loons	**Order Gaviiformes, Family Gaviidae**						
Common loon	*Gavia immer*	X	SC	SC	-	X	X
Red-throated loon	*Gavia stellata*	X	-	-	-	X	X
Pelicans	**Order Pelecaniformes, Family Pelecanidae**						
Brown pelican	*Pelecanus occidentalis*	X	-	-	-	-	X
Grebes	**Order Podicipediformes, Family Podicipedidae**						
Horned grebe	*Podiceps auratus*		-	-	-	-	X
Storm-Petrels	**Order Procellariiformes, Families Oceanitidae and Hydrobatidae**						
Wilson’s storm-petrel	*Oceanites oceanicus*	X	-	-	-	X	X
Band-rumped storm-petrel	*Hydrobates castro*		-	-	-	-	X
Leach’s storm-petrel	*Hydrobates leucorhous*	X	-	E	-	XX	X
Shearwaters, Petrels, and Fulmars	**Order Procellariiformes, Family Procellariidae**						
Cory’s shearwater	*Calonectris diomedea*	X	-	-	-	X	X
Northern fulmar	*Fulmarus glacialis*	X	-	-	-	X	X
Black-capped petrel	*Pterodroma hasitata*		-	-	-	-	X
Great shearwater	*Ardenna gravis*	X	-	-	-	X	X

Common Name	Scientific Name	IPaC	NY Listed	MA Listed	ESA Listed	APEM	MDAT
Sooty shearwater	*Ardenna grisea*		-	-	-	X	X
Audubon's shearwater	*Puffinus lherminieri*		-	-	-	XX	X
Manx shearwater	*Puffinus*	X	-	-	-	X	X
Cormorants	**Order Suliformes, Family Phalacrocoracidae**						
Double-crested cormorant	*Nannopterum auritum*	X	-	-	-	XX	X
Gannets	**Order Suliformes, Family Sulidae**						
Northern gannet	*Morus bassanus*	X	-	-	-	X	X

Notes:

Species assessed for exposure, grouped by taxonomic order and family (Chesser et al. 2021), included those listed in the Information for Planning and Consultation (IPaC) database, species listed as Endangered, Threatened, or Special Concern species in New York (NY), Massachusetts (MA) or under the Endangered Species Act (ESA), species observed in the APEM digital aerial surveys, and/or species modeled by the Marine-life Data and Analysis Team (MDAT). Some species were grouped with other species within the same genus by APEM, due to identifiability issues. Plovers and red knots are shorebirds, phalaropes are pelagic shorebirds, and the other species are marine birds.

X - IPaC listed, XX - included in APEM group by genus, E - Endangered, T- Threatened, SC - Special Concern.

Sources: Chesser et al. 2021; IPaC Report; New York State Department of Environmental Conservation (NYSDEC) 2015; MassWildlife Natural Heritage & Endangered Species Program, Division of Fisheries and Wildlife [Internet]. 2020. Available from: https://www.mass.gov/info-details/list-of-endangered-threatened-and-special-concern-species; Normandeau-APEM 2020; Curtice et al. 2019

5.3.1.2 *Baseline Characterization: Onshore*

Habitats within the Queens, New York Onshore Study Area are minimal due to the industrialized, developed nature of the Astoria power complex and surrounding area. The onshore infrastructure location is in an ecological zone designated by the New York State Department of Environmental Conservation (NYSDEC) as coastal lowland (Zone I) known to be experiencing a rapid expansion of urban and suburban development. The closest habitat of note is located approximately 0.5 mile (mi) (0.78 km) to the northeast of the Queens, New York Onshore Study Area on two uninhabited islands known as the North Brother and South Brother Islands. The islands are designated as a New York State IBA since colonial wading birds and other birds (gulls, terns, cormorants) nest there as documented by the New York City Audubon's Harbor Herons Project Surveys (Winston 2019) as well as during the New York State BBA breeding bird surveys (New York State Breeding Bird Atlas 2000). Birds listed in the NYSDEC-DFW NHP response (**Appendix M USFWS IPaC and State Listed Species**) included the colonial nesting birds known to inhabit the two islands as well as identifying one State Endangered species, the peregrine falcon (*Falco peregrinus*). The peregrine falcon is documented as nesting on Throgs Neck Bridge, approximately six mi (9 km) to the northeast of the Queens, New York Onshore Study Area. The locations of data collection for assessing bird presence within the Onshore Study Areas are shown on **Figure 5.3-5**.

The Queens, New York Onshore Study Area does not provide important habitat for ESA, State-listed, or other species of conservation concern (**Table 5.3-2**). Some birds may pass over or through the area but the species most likely to be present within the Onshore Study Area are primarily common or introduced species with tolerance or affinity for heavily disturbed areas (**Table 5.3-3**); **Table 5.3-2** indicates the presence of species observed in BBA Atlas Blocks whereas **Table 5.3-3** provides a subsample of the federally- and state-listed species in **Table 5.3-2**, observed within the finer resolution eBird data. Common species often present in urban environments or present on construction sites include mourning dove, American robin, killdeer, and Canada goose. Introduced species, which are not protected species, that thrive in urban environments include rock pigeon, European starling and house sparrow. The exception to this is the peregrine falcon, an urban-adapted raptor that may pass through the area during hunting forays or during the time period after nesting has been completed and young have fledged and dispersed (post-dispersal).

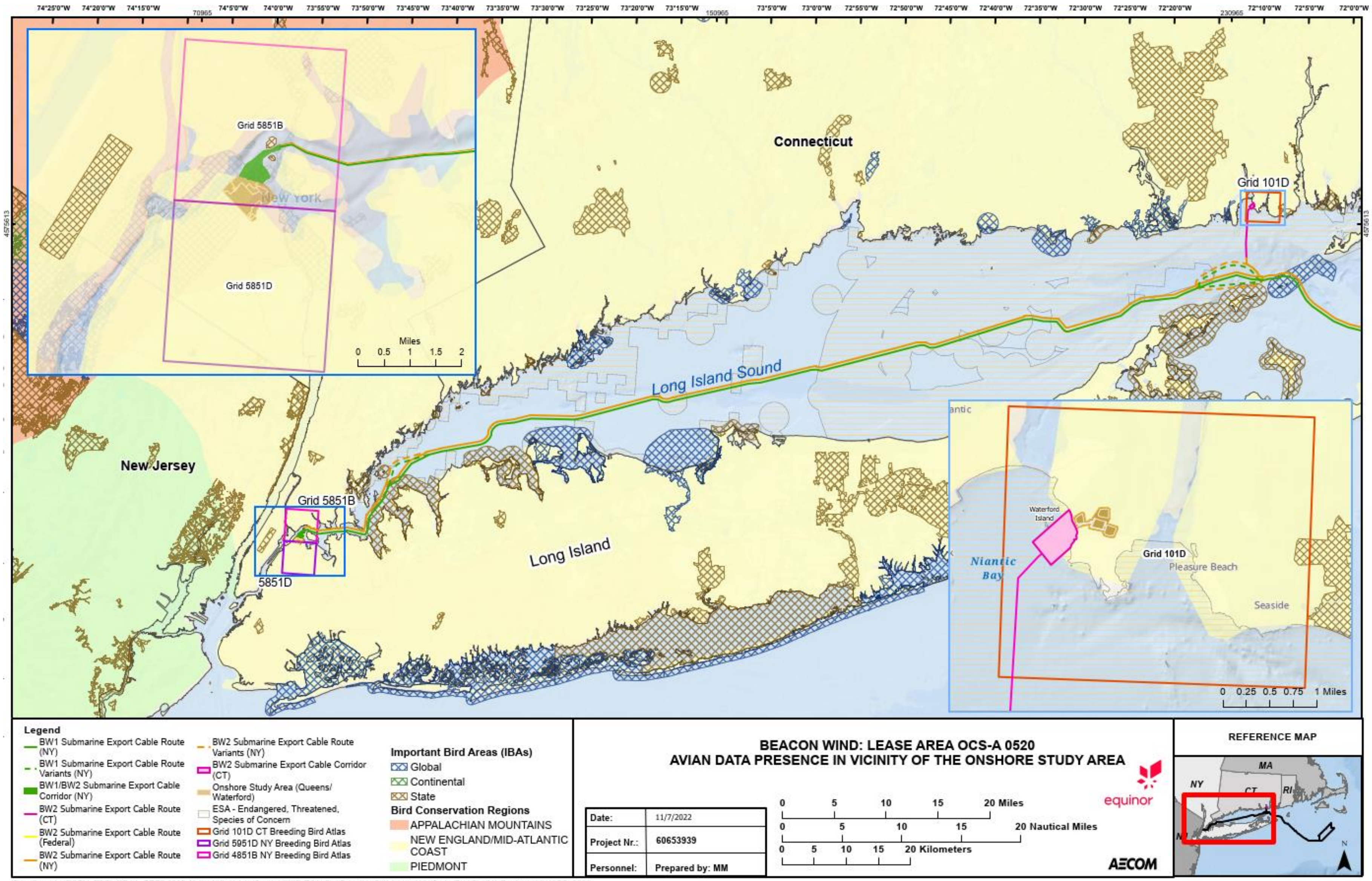
The Waterford, Connecticut Onshore Study Area is found within the Greater Hammonasset Complex, a 12 mi (19 km) long ecological zone identified in the Connecticut Coastal and Estuarine Land Conservation Program Plan (CTDEEP 2015b) for its tidal wetlands. The Dominion Millstone Power Station property is zoned by the Town of Waterford for industrial use, whereas waterfront development and an open space district is designated northwest of the Study Area, in the vicinity of wetlands between "the Gut" of the Niantic River and the Northeast Corridor railroad line (Connecticut Zoning and Wetlands Maps[3]). The land cover surrounding the proposed Waterford facility consists of disturbed open space, overhead electric transmission lines, maintained lawn and landscaped areas, forested upland, forested wetland, late succession scrub-shrub/sapling, and stream habitats (**Section 5.1 Terrestrial Vegetation and Wildlife**). The shoreline of the Dominion Millstone Power Station contains critical beachshore habitat along the Barrier North of Waterford Island, as designated by CTDEEP, and is bordered by late succession scrub-shrub/sapling habitat. A 400-ft (12- m) reef ledge feature is located approximately 1,500 ft (450 m) west of the Waterford shoreline, which historically hosted

[3] https://www.waterfordct.org/planning-development/pages/land-use-regulations-maps

roseate and common tern nests (Dutcher 1901; Nisbet 1989). The closest Audubon IBA is of state priority, Harkness Memorial State Park and Goshen Cove, located approximately two miles (3.2 km) to the east, in Waterford near its corporate boundary with New London. Pattagansett Marsh is the nearest global IBA, located in East Lyme, Connecticut, 2.5 mi (4 km) to the west of Waterford.

Birds listed in the preliminary CTDEEP response to the NDDB request on the Waterford, Connecticut Onshore Study Area (**Appendix M USFWS IPaC and State Listed Species**) included the peregrine falcon, piping plover and purple martin (*Progne subis*). A documented peregrine falcon nest site is located on the Gold Star Memorial Bridge, New London, Connecticut, which crosses the Thames River approximately 5.5 mi (8.5 km) to the northeast of the Waterford, Connecticut Onshore Study Area. Historically, the piping plover was recorded as a confirmed breeder in the Connecticut BBA Niantic/Waterford block (1982-1986; **Table 5.3-2**) but in the last 10 years of eBird data (2012-2021) was not recorded within approximately one mi (1.6 km) from the proposed onshore substation facility (**Table 5.3-3**). Of the 25 bird species listed as threatened or endangered in New London County, Connecticut, 10 of them were recorded in eBird data (2012-2021; **Table 5.3-3**). The entire eastern population of purple martin nests exclusively in artificial nesting cavities (human-designed houses or hollow gourds) actively managed by conservation organizations and/or landowners (CTDEEP 2015c).

FIGURE 5.3-5. AVIAN PRESENCE DATA IN THE VICINITY OF THE ONSHORE STUDY AREAS



Data Sources: BOEM, ESRI, NOAA, DEEP 2019, National Audubon Society 2013, ESA, 2nd Breeding Bird Atlas of NY State, Bird Studies Canada and NABCI 2014
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

TABLE 5.3-2. AVIAN PRESENCE DATA IN VICINITY OF THE ONSHORE STUDY AREAS

Common Name	Scientific Name	IPaC Report a/	NY Status (Listed and/or Conservation Need) b/	NY Breeding Bird Atlas c/	Habitat	CT Status (Listed, New London County) d/	CT Bird Atlas e/
ESA-Listed Species							
Roseate tern	*Sterna dougallii*	x	E/SGCN HP	-	Coastal	E	x
Piping plover	*Charadrius melodus*	x	E/SGCN HP	-	Coastal	T	x
Red knot	*Calidris canutus rufa*	x	T/SGCN HP	-	Coastal	-	-
Species (Not ESA-Listed)							
Acadian flycatcher	*Empidonax virescens*	-	-	-	Upland	-	x
Alder flycatcher	*Empidonax alnorum*	-	-	-	Upland	SC	-
American bittern	*Botaurus lentiginosus*	-	-	-	Coastal	E	-
American black duck	*Anas rubripes*	-	-	-	Aquatic	-	x
American crow	*Corvus brachyrhynchos*	-	-	x	Upland	-	x
American goldfinch	*Spinus tristis*	-	-	-	Upland	-	x
American kestrel	*Falco sparverius*	-	-	-	Upland	-	x
American oystercatcher	*Haematopus palliatus*	x	SGCN	-	Coastal	T	x
American redstart	*Setophaga ruticilla*	-	-	-	Upland	-	x
American robin	*Turdus migratorius*	-	-	x	Upland	-	x
American woodcock	*Scolopax minor*	-	-	-	Upland	-	x
Bald eagle	*Haliaeetus leucocephalus*	x	T/SGCN	-	Upland	T	-
Baltimore oriole	*Icterus galbula*	-	-	x	Upland	-	x
Barn owl	*Tyto Alba*	-	SGCN HP	-	Upland	E	-
Barn swallow	*Hirundo rustica*	-	-	x	Upland	-	x
Barred owl	*Strix varia*	-	-	-	Upland	-	x
Belted kingfisher	*Megaceryle alcyon*	-	-	-	Upland	-	x
Black-billed cuckoo	*Coccyzus erythropthalmus*	x	SGCN	-	Upland	-	x
Black-capped chickadee	*Poecile atricapillus*	-	-	-	Upland	-	x
Black-crowned night-heron	*Nycticorax*	-	-	x	Coastal	-	x

Common Name	Scientific Name	IPaC Report a/	NY Status (Listed and/or Conservation Need) b/	NY Breeding Bird Atlas c/	Habitat	CT Status (Listed, New London County) d/	CT Bird Atlas e/
Black scoter	*Melanitta nigra*	x	SGCN	-	Aquatic	-	-
Black skimmer	*Rynchops niger*	x	SC/SGCN HP	-	Coastal	-	-
Blue-gray gnatcatcher	*Polioptila caerulea*	-	-	-	Upland	-	x
Blue-winged warbler	*Vermivora cyanoptera*	x	-	-	Upland	-	x
Blue jay	*Cyanocitta cristata*	-	-	-	Upland	-	x
Bobolink	*Dolichonyx oryzivorus*	x	SGCN HP	-	Upland	SC	-
Bonaparte's gull	*Chroicocephalus philadelphia*	x	SGCN	-	Coastal	-	-
Brown-headed cowbird	*Molothrus ater*	-	-	x	Upland	-	x
Brown thrasher	*Toxostoma rufum*	-	-	-	Upland	SC	x
Buff-breasted sandpiper	*Calidris subruficollis*	x	-	-	Upland	-	-
Canada goose	*Branta canadensis*	-	-	x	Aquatic	-	(x)
Canada warbler	*Cardellina canadensi*	x	SGCN HP	-	Upland	-	-
Carolina wren	*Thryothorus ludovicianus*	-	-	-	Upland	-	x
Cattle egret	*Bubulcus ibis*	-	SGCN HP	-	Coastal	-	-
Cedar waxwing	*Bombycilla cedrorum*	-	-	-	Upland	-	x
Cerulean warbler	*Setophaga cerulea*	x	-	-	Upland	SC	-
Chimney swift	*Chaetura pelagica*	-	-	-	Upland	-	x
Chipping sparrow	*Spizella passerina*	-	-	-	Upland	-	x
Clapper rail	*Rallus crepitans*	x	-	-	Coastal	-	-
Common gallinule	*Gallinula galeata*	-	-	-	Coastal	E	-
Common grackle	*Quiscalus quiscula*	-	-	x	Upland	-	x
Common loon	*Gavia immer*	x	SC/SGCN	-	Aquatic	SC	-
Common tern	*Sterna hirundo*	x	SGCN	-	Coastal	SC	x
Common yellowthroat	*Geothlypis trichas*	-	-	-	Upland	-	x
Double-crested cormorant	*Phalacrocorax auritus*	x	-	x	Aquatic	-	x
Downy woodpecker	*Picoides pubescens*	-	-	x	Upland	-	x

Common Name	Scientific Name	IPaC Report a/	NY Status (Listed and/or Conservation Need) b/	NY Breeding Bird Atlas c/	Habitat	CT Status (Listed, New London County) d/	CT Bird Atlas e/
Dunlin	*Calidris alpina arcticola*	x	-	-	Coastal	-	-
Eastern kingbird	*Tyrannus*	-	-	x	Upland	-	x
Eastern meadowlark	*Sturnella magna*	-	-	-	Upland	T	x
Eastern towhee	*Pipilo erythrophthalmus*	-	-	-	Upland	-	x
Eastern whip-poor-will	*Antrostomus vociferus*	x	-	-	Upland	-	-
Eastern wood-pewee	*Contopus virens*	-	-	-	Upland	-	x
European starling	*Sturnus vulgaris*	-	-	x	Upland	-	x
Evening grosbeak	*Coccothraustes vespertinus*	x	-	-	Upland	-	-
Field sparrow	*Spizella pusilla*	-	-	-	Upland	-	x
Fish crow	*Corvus ossifragus*	-	-	-	Coastal	-	x
Glossy ibis	*Plegadis falcinellus*	-	SGCN	x	Coastal	SC	x
Golden-winged warbler	*Vermivora chrysoptera*	x	-	-	Upland	-	-
Golden eagle	*Aquila chrysaetos*	x	E/SGCN	-	Upland	-	-
Grasshopper sparrow	*Ammodramus savannarum*	-	-	-	Upland	E	-
Gray catbird	*Dumetella carolinensis*	-	-	x	Upland	-	x
Great black-backed gull	*Larus marinus*	x	-	x	Coastal	-	(x)
Great crested flycatcher	*Myiarchus crinitus*	-	-	-	Upland	-	x
Great egret	*Ardea alba*	-	-	x	Coastal	T	x
Green heron	*Butorides virescens*	-	-	-	Coastal	-	x
Gull-billed tern	*Gelochelidon nilotica*	x	-	-	Coastal	-	-
Hairy woodpecker	*Dryobates villosus*	-	-	-	Upland	-	x
Henslow's sparrow	*Ammodramus henslowii*	-	-	-	Upland	SC*	-
Herring gull	*Larus argentatus*	x	-	x	Coastal	-	(x)
Horned lark	*Eremophila alpestris*	-	-	-	Upland	E	-
House finch	*Carpodacus mexicanus*	-	-	x	Upland	-	x
House sparrow	*Passer domesticus*	-	-	x	Upland	-	x

Common Name	Scientific Name	IPaC Report a/	NY Status (Listed and/or Conservation Need) b/	NY Breeding Bird Atlas c/	Habitat	CT Status (Listed, New London County) d/	CT Bird Atlas e/
House wren	*Troglodytes aedon*	-	-	-	Upland	-	x
Hudsonian godwit	*Limosa haemastica*	x	-	-	Coastal	-	-
Indigo bunting	*Passerina cyanea*	-	-	x	Upland	-	-
Ipswich sparrow	*Passerculus sandwichensis*	-	-	-	Upland	SC	-
Kentucky warbler	*Geothlypis formosa*	x	-	-	Upland	-	-
Killdeer	*Charadrius vociferus*	-	-	x	Upland	-	x
King rail	*Rallus elegans*	-	-	-	Coastal	E	-
Least bittern	*Ixobrychus exilis*	-	-	-	Coastal	T	x
Least tern	*Sternula antillarum*	x	-	-	Coastal	T	-
Lesser yellowlegs	*Tringa flavipes*	x	-	-	Coastal	-	-
Little blue heron	*Egretta caerulea*	-	SGCN	x	Coastal	SC	-
Long-eared owl	*Asio otus*	x	-	-	Upland	E	-
Long-tailed duck	*Clangula hyemalis*	x	SGCN	-	Aquatic	-	-
Mallard	*Anas platyrhynchos*	-	-	x	Aquatic	-	x
Marsh wren	*Cistothorus palustris*	-	-	-	Upland	-	x
Mourning dove	*Zenaida macroura*	-	-	x	Upland	-	x
Mute swan	*Cygnus olor*	-	-	x	Aquatic	-	x
Nelson's sparrow	*Ammodramus nelsoni*	x	-	-	Coastal	-	-
Northern bobwhite	*Colinus virginianus*	-	-	-	Upland	-	x
Northern cardinal	*Cardinalis*	-	-	x	Upland	-	x
Northern flicker	*Colaptes auratus*	-	-	x	Upland	-	x
Northern goshawk	*Accipiter gentilis*	-	-	-	Upland	T	-
Northern harrier	*Circus hudsonius*	-	-	-	Upland	E	-
Northern mockingbird	*Mimus polyglottos*	-	-	x	Upland	-	x
Northern parula	*Setophaga americana*	-	-	-	Upland	SC	-

Common Name	Scientific Name	IPaC Report a/	NY Status (Listed and/or Conservation Need) b/	NY Breeding Bird Atlas c/	Habitat	CT Status (Listed, New London County) d/	CT Bird Atlas e/
Northern rough-winged swallow	*Stelgidopteryx serripennis*	-	-	-	Upland	-	x
Osprey	*Pandion haliaetus*	-	-	-	Coastal	-	x
Ovenbird	*Seiurus aurocapilla*	-	-	-	Upland	-	x
Peregrine falcon	*Falco peregrinus*	-	E/SGCN	x	Upland	T	(x)
Prairie warbler	*Dendroica discolor*	x	SGCN	-	Upland	-	x
Prothonotary warbler	*Protonotaria citrea*	x	-	-	Upland	-	-
Purple martin	*Progne subis*	-	-	-	Upland	SC	x
Purple sandpiper	*Calidris maritima*	x	-	-	Coastal	-	-
Red-bellied woodpecker	*Melanerpes carolinus*	-	-	-	Upland	-	(x)
Red-breasted merganser	*Mergus serrator*	x	-	-	Aquatic	-	-
Red-eyed vireo	*Vireo olivaceus*	-	-	-	Upland	-	x
Red-headed woodpecker	*Melanerpes erythrocephalus*	x	SGCN HP	-	Upland	E	-
Red-shouldered hawk	*Buteo lineatus*	-	-	-	Upland	-	x
Red-throated loon	*Gavia stellata*	x	-	-	Aquatic	-	-
Red-winged blackbird	*Agelaius phoeniceus*	-	-	x	Upland	-	x
Ring-billed gull	*Larus delawarensis*	x	-	-	Coastal	-	-
Ring-necked pheasant	*Phasianus colchicus*	-	-	x	Upland	-	-
Rock pigeon	*Columba livia*	-	-	x	Upland	-	x
Rose-breasted grosbeak	*Pheucticus ludovicianus*	-	-	-	Upland	-	x
Royal tern	*Thalasseus maximus*	x	-	-	Coastal	-	-
Ruddy turnstone	*Arenaria interpres*	x	-	-	Coastal	-	-
Rusty blackbird	*Euphagus carolinus*	x	SGCN HP	-	Upland	-	-
Saltmarsh sharp-tailed sparrow	*Ammodramus caudacutus*	-	-	-	Upland	SC	-
Savannah sparrow	*Passerculus sandwichensis*	-	-	-	Upland	SC	x
Scarlet tanager	*Piranga olivacea*	-	-	-	Upland	-	x

Common Name	Scientific Name	IPaC Report a/	NY Status (Listed and/or Conservation Need) b/	NY Breeding Bird Atlas c/	Habitat	CT Status (Listed, New London County) d/	CT Bird Atlas e/
Seaside sparrow	*Ammodramus maritimus*	x	SC/SGCN HP	-	Coastal	T	-
Sedge wren	*Cistothorus platensis*	-	-	-	Upland	E	-
Semi-palmated sandpiper	*Calidris pusilla*	x	SGCN HP	-	Coastal	-	-
Short-billed dowitcher	*Limnodromus griseus*	x	SGCN HP	-	Coastal	-	-
Short-eared owl	*Asio flammeus*	-	-	-	Upland	T	-
Snowy egret	*Egretta thula*	-	SGCN	x	Coastal	T	x
Snowy owl	*Bubo scandiacus*	x	-	-	Upland	-	-
Song sparrow	*Melospiza melodia*	-	-	x	Upland	-	x
Spotted sandpiper	*Actitis macularius*	-	-	-	Coastal	-	x
Tree swallow	*Tachycineta bicolor*	-	-	-	Upland	-	x
Tufted titmouse	*Baeolophus bicolor*	-	-	x	Upland	-	x
Upland sandpiper	*Bartramia longicauda*	-	-	-	Upland	E	-
Veery	*Catharus fuscescens*	-	-	-	Upland	-	x
Virginia rail	*Rallus limicola*	-	-	-	Coastal	-	x
Whimbrel	*Numenius phaeopus*	x	-	-	Coastal	-	-
Whip-poor-will	*Caprimulgus vociferus*	-	-	-	Upland	SC	-
White-breasted nuthatch	*Sitta carolinensis*	-	-	-	Upland	-	x
White-eyed vireo	*Vireo griseus*	-	-	-	Upland	-	x
Wild turkey	*Meleagris gallopavo*	-	-	-	Upland	-	(x)
Willet	*Tringa semipalmata*	x	-	-	Coastal	-	-
Willow flycatcher	*Empidonax traillii*	-	-	-	Upland	-	x
Wood thrush	*Hylocichla mustelina*	x	SGCN	-	Upland	-	x
Yellow-billed cuckoo	*Coccyzus americanus*	-	-	-	Upland	-	x
Yellow-breasted chat	*Icteria virens*	-	-	-	Upland	E	x
Yellow-crowned night-heron	*Nyctanassa violacea*	-	SGCN	x	Coastal	-	-
Yellow warbler	*Dendroica petechia*	-	-	x	Upland	-	x

Common Name	Scientific Name	IPaC Report a/	NY Status (Listed and/or Conservation Need) b/	NY Breeding Bird Atlas c/	Habitat	CT Status (Listed, New London County) d/	CT Bird Atlas e/

Notes:

ESA – Endangered Species Act

E - Endangered, T - Threatened, SC - Special Concern, SGCN - Species of Greatest Conservation Need, HP - High Priority, * - Believed Extirpated

Sources:

a/ IPaC Report (New York, Connecticut, and submarine cable route), **Appendix M**

b/ New York State Department of Environmental Conservation (NYSDEC). 2015. New York State Wildlife Action Plan. September 2015.

c/ New York State Breeding Bird Atlas 2000 [Internet]. 2000 - 2005. Release 1.0. Albany (New York): New York State Department of Environmental Conservation. [updated 2007 Jun 11; cited 2021 Oct 18]. Available from: http://www.dec.ny.gov/animals/7312.html.

d/ Connecticut Department of Energy and Environmental Protection (CTDEEP). 2015. Connecticut Wildlife Action Plan. August 2015.

e/ The Atlas of Breeding Birds of Connecticut 1994 [Internet]. 1982-1986. Hartford (Connecticut): CTDEEP. [Accessed 2022 Mar 15]. Available from: U.S. Geological Survey Patuxent Wildlife Research Center, Breeding Bird Atlas Explorer http://www.pwrc.usgs.gov/bba.
(x) - Confirmed breeding in the unpublished Connecticut Bird Atlas 2022. [Internet]. CTDEEP. North Franklin (Connecticut): CTDEEP. [Accessed 2022 Mar 15]. Available from: http://ctbirdatlas.org/lists/breeding/Breeding_101D.html

TABLE 5.3-3. LISTED AVIAN SPECIES RECORDED UP TO APPROXIMATELY ONE MI (1.6 KM) OF THE BW1 AND BW2 ONSHORE STUDY AREAS, WITHIN THE LAST 10 YEARS.

Common Name	Scientific Name	ESA Listed a/	NY Listed a/	NY eBird Count	CT Listed a/	CT eBird Count
American bittern	*Botaurus lentiginosus*	-	-	-	E	-
American oystercatcher	*Haematopus palliatus*	-	-	-	T	3
Bald eagle	*Haliaeetus leucocephalus*	-	T	-	T	34
Barn owl	*Tyto Alba*	-	-	-	E	-
Common gallinule	*Gallinula galeata*	-	-	-	E	-
Eastern meadowlark	*Sturnella magna*	-	-	-	T	-
Golden eagle	*Aquila chrysaetos*	-	E	-	-	-
Grasshopper sparrow	*Ammodramus savannarum*	-	-	-	E	-
Great egret	*Ardea alba*	-	-	3	T	33
Horned lark	*Eremophila alpestris*	-	-	-	E	8
King rail	*Rallus elegans*	-	-	-	E	-
Least bittern	*Ixobrychus exilis*	-	-	-	T	-
Least tern	*Sternula antillarum*	-	-	-	T	5
Long-eared owl	*Asio otus*	-	-	-	E	-
Northern goshawk	*Accipiter gentilis*	-	-	-	T	-
Northern harrier	*Circus hudsonius*	-	-	-	E	4
Peregrine falcon	*Falco peregrinus*	-	E	4	T	55
Piping plover	*Charadrius melodus*	T	E	-	T	-
Red knot	*Calidris canutus rufa*	T	T	-	-	-
Red-headed woodpecker	*Melanerpes erythrocephalus*	-	-	-	E	-
Roseate tern	*Sterna dougallii*	E	E	-	E	4
Seaside sparrow	*Ammodramus maritimus*	-	-	-	T	-
Sedge wren	*Cistothorus platensis*	-	-	-	E	-
Short-eared owl	*Asio flammeus*	-	-	-	T	-
Snowy egret	*Egretta thula*	-		4	T	12
Upland sandpiper	*Bartramia longicauda*	-	-	-	E	-
Yellow-breasted chat	*Icteria virens*	-	-	-	E	5

Source: eBird 2021

Note:

a/ T=threatened; E = endangered.

5.3.2 Impacts Analysis for Construction, Operations, and Decommissioning

The potential impacts resulting from the construction, operations, and decommissioning of the Project, as described below, are based on the maximum design scenario from the PDE (**Section 3 Project Description**). For avian species, the maximum design scenario is the full build-out of both the offshore and onshore components, as described in **Table 5.3-4.** This maximum design scenario incorporates a total of up to 157 structures within the Lease Area (made up of up to 155 wind turbines and two offshore substation facilities) with two submarine export cable routes (one to Queens, New York for BW1 and one to either Queens, New York or Waterford, Connecticut for BW2), and the associated onshore substation facilities

TABLE 5.3-4. SUMMARY OF MAXIMUM DESIGN SCENARIO PARAMETERS FOR AVIAN SPECIES

Parameter	Maximum Design Scenario	Rationale
Construction		
Offshore structures	Based on full build-out of the Project (BW1 and BW2) (155 wind turbines and two offshore substation facilities).	Representative of the maximum number of structures.
Duration offshore installation	Based on full build-out of the Project (BW1 and BW2), which corresponds to the maximum number of structures (155 wind turbines and two offshore substation facilities), two submarine export cables, interarray cables, and maximum period of cumulative duration for installation.	Representative of the maximum period required to install the offshore components, which has the potential to have Project-related vessels and associated lighting in the Project Area.

Submarine export cable landfalls onshore	Based on full build-out of the Project (BW1 and BW2):
	• BW1 to Queens, New York (HDD work area in a 246 ft x 246 ft [75 m x 75 m] area).
	• BW2:
	  ○ To Queens, New York (HDD work area in a 246 ft x 246 ft [75 m x 75 m] area) or
	  ○ To Waterford, Connecticut (HDD work in a 328 ft x 164 ft [100 m x 50 m] area).
		Representative of the maximum area to be utilized to facilitate the export cable landfalls.

Onshore substation facilities and components	Based on full build-out of the Project (BW1 and BW2):
	• BW1: Queens, New York (up to a 16 ac [6.5 ha] area).
	• BW2:
	  ○ Queens, New York (up to a 16 ac [6.5 ha] area) or
	  ○ Waterford, Connecticut (up to a 16 ac [6.8 ha] area).
	Construction and installation of the export cable landfalls, onshore export and interconnection cables, and onshore substation facilities.
		Representative of the maximum area to be utilized to facilitate the construction of the onshore substation facilities.

Parameter	Maximum Design Scenario	Rationale
Duration onshore construction	Based on full build-out of the Project (BW1 and BW2): • BW1 to Queens, New York • BW2 to Queens, New York or Waterford, Connecticut. Construction and installation of export cable landfalls, onshore export and interconnection cables, and onshore substation facilities.	Representative of the maximum period required to install the onshore components, which include lighting, noise, vibration, and construction equipment
Staging and construction areas, including port facilities, work compounds, and lay-down areas	Based on BW1 and BW2. Maximum number of work compounds and lay-down areas required. Some ground disturbing activities may be anticipated at Queens, New York with grading and minor tree clearing at Waterford, Connecticut. Independent activities to upgrade or modify staging, construction areas, and ports prior to Project use will be the responsibility of the facility owner.	Representative of the maximum area required to facilitate the offshore and onshore construction activities.
Operations and Maintenance		
Offshore structures	Based on full build-out of the Project (BW1 and BW2), which corresponds to the maximum number of structures (155 wind turbines and two offshore substation facilities).	Representative of new fixed structure placement and the maximum number of wind turbines installed in an area that previously had none. The maximum turbine dimensions result in the greatest overall total RSZ, which potentially increases risks of collision and displacement. Structures may also potentially be an attractant to some birds.
Project-related vessels	Based on full build-out of (BW1 and BW2), which corresponds to the maximum number of structures (155 wind turbines, two offshore substation facilities), two submarine export cables, interarray cables, and maximum associated vessels and movements for servicing and inspections.	Representative of the maximum predicted Project-related vessels, which has the potential to increase attraction of avian species offshore and result in disturbance.

Parameter	Maximum Design Scenario	Rationale
Onshore substation facilities	Based on full build-out of the Project (BW1 and BW2): • BW1 to Queens, New York (up to a 7-ac [2.8-ha] area). • BW2: ○ Queens, New York (up to a 7 ac [2.8 ha] area) or ○ Waterford, Connecticut (up to a 7 ac [2.8 ha] area).	Representative of the presence of a new structure in an area where there was previously none.
O&M Base	Based on full build-out of the Project (BW1 and BW2): 4.5-ac (1.8-ha) area.	Representative of an existing structure in an area that will have been developed for this use.
Onshore operations and maintenance activities	Based on full build-out of the Project (BW1 and BW2): • BW1 to Queens, New York • BW2 to Queens, New York or Waterford, Connecticut. Longest operational duration, with the maximum amount of Project-related activities expected per year.	Representative of the maximum amount of disturbances from the Project during the operations phase, such as lighting and noise that have the potential for temporary displacement of birds.

5.3.2.1 *Construction*

During construction, the potential impact-producing factors for avian species may include:

- Installation of the offshore components, including foundations, wind turbines, offshore substation facilities, and submarine export and interarray cables;
- Construction of the onshore components, including landfall, onshore export and interconnection cables, onshore substation facility; and
- Staging and construction activities and assembly of Project components at applicable facilities and/or areas.

The following impacts may occur as a consequence of the factors identified above:

- Short-term increased avian attraction to Project-related vessels, equipment, and/or components;
- Short-term disturbance of offshore foraging and prey species;
- Short-term alteration of terrestrial habitat;
- Short-term avian avoidance of onshore construction equipment and work areas;
- Short-term avian attraction to onshore construction equipment and work areas; and
- Short-term disturbance and displacement from marine and terrestrial habitats.

Attraction to Project-related vessels, equipment, and/or components during offshore construction: During temporary construction activities offshore, avian species may be attracted to construction equipment, Project components, and vessels, particularly during nighttime activities requiring lighting. Night-time lighting is associated with an increased risk for collision and entrapment or stranding when birds become disoriented by lighting (Fox and Peterson 2019; Gjerdrum et al. 2021).

Beacon Wind proposes to implement measures to limit lighting not required by the FAA, USCG, or BOEM, during construction to reduce attraction for birds. Such measures may include downward projecting lights, lights triggered by motion sensors, and limiting artificial light to the extent safe and practicable. In addition, Project-related vessels will be instructed to avoid rafting seabirds to minimize disturbance.

Disturbance of offshore foraging habitat and access to prey species: During construction, there is potential for temporary seafloor and in-water disturbance (e.g., sediment) during foundation and cable installation (submarine export and interarray). These types of disturbances may temporarily affect the availability of prey species to foraging seabirds either by disturbing prey species or preventing seabird access to prey species. Since disturbances are anticipated to be temporary and localized and prey species are expected to return, effects are expected to be minimal.

Attraction to onshore construction equipment and work areas: During temporary construction activities onshore, certain species may be attracted to construction equipment and disturbed conditions on site. Common, native species that are frequently found on construction sites include killdeer, Canada goose, American robin, mourning dove, various species of gulls, and barn swallow. Non-native, non-protected species that frequent such areas include rock pigeon, European starling, and house sparrow. The most likely species of special status to use the area on a transient basis is the peregrine falcon (New York State Endangered) which is documented to nest on the Throgs Neck Bridge approximately six mi (9 km) to the northeast of the Queens, New York Onshore Study Area and on the Gold Star Memorial Bridge, approximately 5.5 mi (8.5 km) to the northeast of the Waterford, Connecticut Onshore Study Area. (**Appendix M USFWS IPaC and State Listed Species**).

Disturbance and displacement from terrestrial habitats during onshore construction activities: During temporary onshore construction activities to install onshore export and interconnection cables, and onshore substation facility station, disturbance and displacement of birds could potentially occur. Certain species may avoid onshore construction equipment and work areas. Noise, vibration, lighting, and increased human activity or presence can displace or disturb birds that are present. The onshore construction activities for BW1 and BW2 at Queens, New York will be conducted within an extensively developed area of heavy industry lacking suitable habitat for most bird species other than urban tolerant and/or non-native species. Potential risk to birds from disturbance and displacement is, therefore, considered minimal since onshore construction activities require no modifications of suitable habitat (e.g., tree clearing) and are temporarily conducted in an area of low bird presence and intensive land use. Tree clearing and habitat alteration is not anticipated to be required in Queens, New York, due to the highly developed nature of the onshore area and lack of natural vegetation.

Potential risk to birds from the onshore infrastructure components associated with BW2 are in the minimal to low category due to the expected low presence of birds and low exposure of non-disturbed habitat to project activities within the Waterford, Connecticut Onshore Study Area, an industrial area located adjacent to an estuarine environment. Forested areas and shrub/sapling thickets that could represent suitable habitat for various bird species may be cleared. Vegetation clearing is expected for construction of the BW2 proposed Waterford onshore substation facility and landfall.

Measures proposed to potentially reduce negative impacts on avian species and their habitats include:

- Onshore components will be sited in previously disturbed areas, existing roadways, or otherwise unsuitable avian habitat and/or rights-of-way to the extent practicable;

- The Project will utilize an existing O&M Base and will not require construction of a new O&M Base in the State of New York, therefore avoiding additional potential impacts to birds as a result of new construction;
- Avoidance of tree clearing for BW1 and BW2 onshore Project components in Queens, New York due to the highly developed nature of the onshore area and lack of natural vegetation;
- If required upon federal and state agency consultation, avoidance of key habitats and tree clearing for BW2 onshore Project components in Waterford, Connecticut, where appropriate and required during sensitive times of year (e.g., breeding season), to minimize disturbance of tree nesting birds. This is not anticipated to be required for BW1 or the BW2 onshore Project components in Queens, New York, due to the highly developed nature of the onshore area and lack of natural vegetation;
- In Waterford, Connecticut, impacts to the nearshore and beach habitats will be minimized to the extent practicable. Installation techniques for the submarine export cable landfall will be done via trenchless (e.g., HDD, jack and bore, or micro-tunnel) methods.
- Lighting not required during construction will be limited, as appropriate, to peak exposure and subject to other receptors and user requirements, to reduce attraction of avian species; and
- Project-related vessels will be instructed to avoid rafting seabirds to minimize disturbance.

5.3.2.2 Operations and Maintenance

During operations, the potential impact-producing factors to avian species may include:

- The presence of new permanent structures offshore (e.g., wind turbines and offshore substation facilities);
- Operations and maintenance activities associated with the offshore components of the Project;
- The presence of new permanent structures onshore (e.g., onshore substation facility, overhead transmission lines); and
- Operations and maintenance activities associated with the onshore export and interconnection cables and onshore substation facility.

The following impacts may occur as a consequence of factors identified above:

- Long-term increased risk of attraction to and collision with wind turbines;
- Long-term increased risk of attraction to and collision with offshore substation facilities;
- Long-term displacement from wind farm area; and
- Attraction to or displacement from offshore operations and maintenance vessels and equipment.

Attraction to and collision with wind turbines. During the operations phase of the Project, wind turbines will be fixed structures on the seascape with potential for collision when birds enter the RSZ of the wind turbine blades. Additional factors associated with collision risk are birds' attraction to wind turbine lighting and behavioral factors such as flight height. Injury or mortality to birds can result from collision while light entrapment may lead to death through exhaustion (USFWS 2018). Levels of risk of collision with wind turbines varies with species and use of the Offshore Study Area. Spatial and temporal components affect the level of risk to birds. Birds are exposed spatially on the horizontal plane when exposed within habitat and on the vertical plane when flying at altitudes (flight heights) placing them within a hazard zone (RSZ). Bird exposure, on a temporal basis, is based on avian presence and use of the Offshore Study Area for breeding, staging, migrating, or wintering. Risk of collision and/or attraction in the Offshore Study Area results from the combination of exposure to the wind development and vulnerability to collision or displacement (Goodale and Stenhouse 2016) as related to species behavioral tendencies. As indicated by Allison et al. (2019), recent offshore surveys and subsequent modeling in the eastern U.S. have indicated that seabird abundance and species diversity generally decrease with increasing distances from shore, though the distributions of individual species can vary.

Potential for exposure of birds to the Project in the Lease Area was analyzed in the Avian Impact Assessment (**Appendix P Avian Impact Assessment**) conducted for the Project. Multiple marine species and a few shorebird species were documented within the Lease Area during the 1st year APEM aerial digital surveys (**Appendix O Ornithological and Marine Faunal Aerial Survey – APEM Studies**). The MDAT abundance models predicted low relative densities for all birds, combined, within the Lease Area (**Figure 5.3-4**). In the Avian Impact Assessment (**Appendix P Avian Impact Assessment**) prepared for the Project, MDAT models were quantitatively assessed with the results of the APEM surveys conducted within the Lease Area and buffer zone shown on **Figure 5.3-1**. The results of the quantitative risk assessment suggest that, of the avian species federally listed under the ESA, piping plovers and red knots have a Low estimated collision risk and Minimal estimated displacement risk. Roseate terns were estimated to have Low collision and displacement risk in spring and Medium collision and displacement risk in summer and fall. The Project acknowledges that there will be further consultation regarding appropriate avoidance or minimization measures (i.e., a work window) for cable laying activity around Great Gull Island, New York, to minimize potential impacts to the prey base of roseate terns. Common terns, which are listed as threatened in the State of New York, have the same level of collision and displacement risk as roseate terns. Least terns, which are also listed as threatened in New York, have an estimated Low collision risk in summer and fall and Minimal displacement risk in summer and fall. Other migratory bird species that show High estimated collision risk are herring gull (summer), great black-backed gull (summer), black-legged kittiwake (spring), parasitic jaeger (summer), razorbill (Very High in spring and winter), common murre (winter), long-tailed duck (winter), white-winged scoter (winter), Wilson's storm-petrel (summer), Cory's shearwater (fall and Very High in summer), sooty shearwater (summer), and Northern gannet (fall). Migratory bird species that show High estimated displacement risk are great black-backed gull (summer), razorbill (Very High in spring and winter), common murre (winter), long-tailed duck (winter), white-winged scoter (winter), Cory's shearwater (summer), and Northern gannet (fall).

A transparent, quantitative risk analysis of exposure and vulnerability was conducted, where exposure and vulnerability scores were based on external, independent quantitative assessments (Winship et al. 2018; Robinson Willmott et al. 2013). Risk scores were not adjusted qualitatively following calculation, so as to avoid presenting internal, hidden mechanisms of analysis. External, independent sources (e.g., Spiegel et al. 2017; Loring et al. 2018, 2019; and the APEM digital aerial surveys) aligned with the results from the exposure analysis based on the MDAT abundance models (Winship et al. 2018), confirming the lack of need to adjust scores qualitatively. Even with this conservative approach, the majority of avian species were estimated to have Minimal to Medium risk scores. Observed flight heights in the Northwest Atlantic Seabird Catalog were generally below the RSZ 86 ft (26 m) – 1,083 ft (330 m). Additionally, the RSZ under maximum wind turbine dimensions has increased in height since the Robinson Willmott et al. (2013) vulnerability study, potentially reducing exposure for birds that fly below: e.g., from the Block Island Wind Farm erected in 2016 with RSZ 95 ft (29 m) to 620 ft (189 m), to the largest turbines proposed for Beacon Wind with the potential maximum RSZ 98 ft (30 m) – 1,083 ft (330 m).

Therefore, the High risk scores are suspected to be overestimates, particularly for the species that were estimated to have Very High risk (e.g., razorbill and Cory's shearwater). It is suggested that independent vulnerability assessments (e.g., Robinson Willmott et al. 2013) be updated with recent data on flight heights and the increased sizes of wind turbines. Also, because digital aerial surveys were not conducted throughout the greater region to calculate relative density scores, exposure from the APEM surveys could not be scored. Because the APEM exposure maps aligned with the MDAT abundance models, subjectively adjusting exposure scores was avoided. Implementation of region-wide programmatic, independent digital aerial surveys would be useful for direct comparison to the Lease Area surveys, to calculate exposure in future risk assessment analyses (e.g., pre- and post-construction).

The Lease Area is at a distance offshore that is beyond the breeding areas of terrestrial and coastal species and furthermore does not contain habitat suitable for their use. Some terrestrial and coastal birds may pass through or over the Lease Area during discrete time periods for foraging or in passage during spring and fall migration, but their presence is ephemeral and, therefore, population-level impacts are not expected to terrestrial or coastal species.

Bald eagle and golden eagle (eagles), ESA-listed species (rufa red knot, piping plover, and roseate tern), and ESA-proposed species (black-capped petrel) were included in the Avian Impact Assessment (**Appendix P Avian Impact Assessment**) and analyzed for risk in both the Offshore and Onshore Study Areas. None of these species is expected to be at high risk for potential impacts within the Lease Area as their presence is rare in the offshore environment. Eagles are not typically found away from coastal and inland areas as there is no habitat available for them and their migratory paths are restricted to inland and coastal areas.

Roseate tern was also assessed for potential impacts associated with the submarine export cable corridor as it passes near Waterford Island and Great Gull Island, known as the largest and single most important breeding colony for roseate terns in North America. The roseate tern is a dietary specialist reliant on sand lance (*Ammodytes* sp.) for the majority of its diet (Staudinger et al. 2020). Roseate tern foraging for sand lance within the construction corridor for the submarine export cable may be temporarily reduced during installation of the cable, if the cable is laid during breeding season. However, the implementation of a work window for the portion of cable located near Great Gull Island would avoid or minimize this risk. Additionally, roseate terns historically nested on Waterford Island (11 nests 1977, 1 nest 1984), the reef ledge approximately 1,500 ft (450 m) west of the Waterford shoreline (Nisbet 1989). The proposed submarine cable route is located approximately 900 ft (275 m) south of Waterford Island and 500 ft (155 m) north of Black Rock. Further consultation with CTDEEP/NDDB and USFWS regarding the identification of appropriate monitoring, avoidance, or minimization measures will occur, as needed. Potential impacts to birds are summarized by species group in **Table 5.3-5** and additional information can be found in **Appendix P Avian Impact Assessment.**

Table 5.3-5. Summary of Potential Impacts to Avian Species from Collision and/or Displacement

Taxonomic Group/Species	Summary of Potential Impacts
Federally Listed Species	
Piping plover	The exposure to piping plovers in the Lease Area is limited to migration, they have low collision risk and minimal displacement risk, for these reasons individual level impacts are unlikely.
Rufa red knot	The exposure of rufa red knot in the Lease Area is limited to migration, they have a low collision risk and minimal displacement risk, for these reasons, individual level impacts during operations are unlikely.
Roseate tern	Potential impacts to individual roseate terns from collision or displacement are unlikely because of minimized exposure. They have low collision and displacement risk in spring and medium collision and displacement risk in summer and fall. Flight heights documented generally below the RSZ suggest minimized exposure. Further consultation regarding appropriate avoidance or minimization measures (i.e., work window) for cable laying activity around Great Gull Island, New York and Waterford, Connecticut is proposed to minimize potential impacts to the prey base of roseate terns. Potential impacts to individual roseate terns from operations and maintenance are unlikely along the shoreline and habitats adjacent to Waterford, Connecticut.
Golden eagle	The exposure of golden eagles to the Lease Area is expected to be minimal due to their limited distribution in the Eastern U.S. and their reliance on terrestrial habitats.
Bald eagle	The exposure to bald eagles in the Lease Area is expected to be minimal because the Lease Area is far removed from known bald eagle migration routes, which tend to not include offshore routes.
Taxonomic Groups	
Shorebirds	The exposure to shorebirds other than phalaropes to the Lease Area is expected to be minimal, collisions or displacements are expected to be rare or nonexistent, and unlikely to cause population level impacts.
Raptors	Population level impacts to raptors are unlikely because exposure, primarily related to falcons, is minimal in the Lease Area.
Songbirds	Population level impacts to songbirds are unlikely because these birds have minimal exposure both spatially and temporarily.
Phalaropes	Minimal to medium (spring, summer) collision risk, minimal to low displacement risk. Flight heights documented generally below the RSZ suggest minimized exposure.
Terns	Minimal to medium (summer, fall) collision risk, minimal to medium (summer, fall) displacement risk. Flight heights documented generally below the RSZ suggest minimized exposure.

Taxonomic Group/Species	Summary of Potential Impacts
Gulls	Minimal to medium (fall, winter) and high (spring, summer) collision risk, minimal to medium (spring, summer, fall) and high (summer) displacement risk. Flight heights documented generally below the RSZ suggest minimized exposure.
Jaegers and Skuas	Minimal to high (summer) collision risk, minimal to low displacement risk. Flight heights documented generally below the RSZ suggest minimized exposure.
Alcids	Low to medium (spring, summer, winter) and high (spring, winter) collision risk, low to medium (spring, summer, winter) and high (spring, winter) displacement risk. Flight heights documented generally below the RSZ suggest minimized exposure.
Seaducks	Minimal to medium (spring, summer, fall) and high (winter) collision risk, minimal to medium (spring, summer, fall) and high (winter) displacement risk. Flight heights documented generally below the RSZ suggest minimized exposure.
Loons	Low to medium (spring, summer, winter) collision risk, low to medium (spring, summer, winter) displacement risk. Flight heights documented generally below the RSZ suggest minimized exposure.
Pelicans	Minimal to low collision risk, minimal to low displacement risk.
Grebes	Minimal collision and displacement risk.
Storm-Petrels	Minimal to medium (fall) and high (summer) collision risk, minimal to low displacement risk. Flight heights documented generally below the RSZ suggest minimized exposure.
Shearwaters, Petrels, and Fulmars	Minimal to medium (winter, spring) and high (summer, fall) collision risk, minimal to medium (summer, fall) and high (summer) displacement risk. Flight heights documented generally below the RSZ suggest minimized exposure.
Cormorants	Minimal to medium (spring, summer, fall) collision risk, minimal to low displacement risk. Flight heights documented generally below the RSZ suggest minimized exposure.
Gannets	Medium (spring, summer, winter) to high (fall) collision risk, medium (spring, summer, winter) to high (fall) displacement risk. Flight heights documented generally below the RSZ suggest minimized exposure.

Notes:

Observed flight heights in the Northwest Atlantic Seabird Catalog were generally below the RSZ 86 – 1,083 ft (26 m – 330 m). Additionally, the RSZ has increased in height since the Robinson Willmott et al. (2013) vulnerability study. Therefore, the high risk scores are suspected to be overestimates. It is suggested that independent vulnerability assessments (e.g., Robinson Willmott et al. 2013) be updated with recent data on flight heights and the increased sizes of wind turbines.

Source: Appendix P Avian Impact Assessment

Attraction to and collision with offshore and/or onshore substations: Birds may be attracted to offshore and/or onshore substations during operations and maintenance activities. Perching opportunities and lighting on offshore substations may attract birds, particularly during poor visibility conditions. However, lights are not expected to cause long-term adverse effects because, to the extent practicable, lighting will be minimized, which will reduce the potential for collisions. Beacon Wind proposes to implement measures to limit lighting that is not required by the FAA, USCG, and BOEM during construction to reduce attraction for birds. Such measures may include downward projecting lights, lights triggered by motion sensors, and limiting artificial light to the extent safe and practicable.

Collision with overhead transmission lines onshore: Overhead transmission lines and structures have potential for injury or mortality to birds due to collision and electrocution. However, the likelihood is low for such occurrences due to the low presence of birds using or congregating in the onshore Project area and the short distances of the overhead lines proposed for the Project. Beacon Wind will consult with the applicable agencies (USFWS, NYSDEC, and CT DEEP) regarding the development of a monitoring program to implement best management practices pertaining to the unique presence/use of the onshore and offshore area (e.g., Avian Power Line Interaction Committee standards, 2012).

Long-term Displacement from wind farm area: Some species, such as loons, seaducks, and alcids have been documented in the literature as exhibiting vulnerability to displacement (Robinson Willmott et al. 2013). Information concerning the potential impacts of long-term displacement on bird populations from wind farms in the offshore environment is not extensive and this is a topic requiring continued studies. Some species with avoidance behavior may only be temporarily displaced (scoters) while others may be displaced permanently or over a longer time period. The potential impacts of displacement on individual fitness is not well known but, overall, displacement effects at a population level are not considered to be significant (Fox and Peterson 2019)

Attraction to or displacement from Project-related vessels: During operations and maintenance activities, birds may be attracted to equipment and/or vessel lighting during operations. Maintenance vessels may temporarily attract or displace birds, but are not expected to cause adverse effects (BOEM 2021). Thus, impacts associated with attraction to or displacement from Project-related vessel and equipment is expected to be minimal. However, Beacon Wind intends to install anti-perching devices, where appropriate, on offshore, above-water structures to minimize the introduction of perching structures to the offshore environment. In addition, Project-related vessels will be instructed to avoid rafting seabirds to minimize impacts.

5.3.2.3 *Decommissioning*

Impacts during decommissioning are expected to be similar or less than those experienced during construction, as described in **Section 5.3.2.1**. It is important to note that advances in decommissioning methods/technologies are expected to occur throughout the operations phase of the Project. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and potential impacts will be re-evaluated at that time. For additional information on the decommissioning activities that Beacon Wind anticipates will be needed for the Project, please see **Section 3 Project Description**.

5.3.3 Summary of Avoidance, Minimization, and Mitigation Measures

In order to mitigate the potential impact-producing factors described in **Section 5.3.2**, Beacon Wind is proposing to implement the following avoidance, minimization, and mitigation measures.

5.3.3.1 *Construction*

During construction, Beacon Wind will commit to the following avoidance, minimization, and mitigation measures to mitigate the potential for impacts described in **Section 5.3.2.1**:

- Onshore components for BW1 and BW2 will be sited in previously disturbed areas, existing roadways, or otherwise unsuitable habitat and/or rights-of-way to the extent practicable;
- The Project will utilize an existing O&M Base and will not require construction of a new O&M Base in the State of New York, therefore avoiding additional potential impacts to birds as a result of new construction;
- Consultation regarding the identification of appropriate avoidance or minimization measures, as necessary, during construction of the submarine export cable route in proximity to sensitive bird habitat (e.g., roseate tern foraging area [radius of 10 km] around the nesting colony within the Great Gull Island IBA);
- If required upon federal and state agency consultation, avoidance of key habitats and tree clearing for BW2 onshore Project components in Waterford, Connecticut, where appropriate and required during sensitive times of year (e.g., breeding season), to minimize disturbance of tree nesting birds. This is not anticipated to be required for BW1 or the BW2 onshore Project components in Queens, New York, due to the highly developed nature of the onshore area and lack of natural vegetation and suitable habitat;
- Consultation regarding the identification of appropriate monitoring, avoidance, minimization, management, or protection measures, as necessary, during construction of the onshore Project components in Waterford, Connecticut, to avoid sensitive bird habitat (e.g., piping plover nesting or foraging area) during sensitive times of the year (e.g., piping plover breeding season), and/or to minimize risk to tree nesting birds from tree clearing activities in sensitive bird habitat during sensitive times of the year (e.g., breeding season), unless otherwise determined to be acceptable by the applicable agencies.
- Adherence to time of year restrictions, as necessary, at BW2 in sensitive onshore bird habitats, where feasible and required, unless otherwise determined acceptable by the applicable agencies. This is not anticipated to be required for BW1 due to the highly developed nature of the onshore area and lack of natural vegetation and suitable habitat;
- Lighting not required during onshore construction will be limited, as appropriate, to the minimum required by regulation and for safety, to reduce attraction of avian species;
- Installation of anti-perching devices, where appropriate, on onshore infrastructure and offshore, above-water Project-related vessels and structures to minimize introduction of perching structures to the onshore and offshore environment;
- Lighting not required by the FAA and the USCG during offshore construction will be limited to reduce attraction of birds, where practicable; and
- Project-related vessels will be instructed to avoid rafting seabirds to minimize disturbance.

In addition, during construction, Beacon Wind will consider the following avoidance, minimization, and mitigation measures to mitigate the impacts described in **Section 5.3.2.1**:

- Consideration of the use of the HDD method for installation of the export cable landfall at BW1 and BW2 to avoid surficial disturbances.

5.3.3.2 Operations and Maintenance

During operations, Beacon Wind will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in **Section 5.3.2.2**:

- Consultation with the applicable agencies regarding the development of a monitoring program to answer specific questions, including identifying key species of interest, implementing best management practices (e.g., Avian Power Line Interaction Committee standards), and when possible, to contribute to the understanding of long-term, Project-specific impacts and larger scale efforts to understand cumulative impacts;
- Temporarily disturbed areas will be revegetated with appropriate native species at BW2, as appropriate. This is not anticipated to be required at BW1 due to the highly developed nature of the onshore area and lack of natural vegetation;
- Lighting during operations will be limited to the minimum required by regulation and for safety, therefore minimizing the potential for attraction and possibly collision of birds at night; and
- Project-related vessels will be instructed to avoid rafting seabirds to minimize disturbance.

In addition, during operations, Beacon Wind will consider the following avoidance, minimization, and mitigation measures to mitigate the impacts described in **Section 5.3.2.2**:

- Anti-perching devices will be maintained where appropriate on offshore, above-water Project-related vessels and structures to minimize introduction of perching structures to the offshore environment; and
- Annual bird mortality reporting of any dead or injured birds discovered on Project vessels or structures.

5.3.3.3 Decommissioning

Avoidance, minimization, and mitigation, measures proposed to be implemented during decommissioning are expected to be similar to those implemented during construction and operations, as described in **Section 5.3.3.1** and **Section 5.3.3.2**. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and avoidance, minimization, and mitigation measures for decommissioning activities will be proposed at that time.

5.3.4 References

TABLE 5.3-6. SUMMARY OF DATA SOURCES

Source	Includes	Available at:	Metadata Link
APEM-Normandeau	Avian Observations (Lease Area)	https://remote.normandeau.com/eqn22_overview.php	N/A

Source	Includes	Available at:	Metadata Link
Audubon	IBAs	https://gis.audubon.org/arcgisweb/rest/services/NAS/ImportantBirdAreas_Polygon/MapServer	N/A
BOEM	Lease Area	https://www.boem.gov/BOEM-renewable-Energy-Geodatabase.zip	N/A
BOEM	State Territorial Waters Boundary	https://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/ATL_SLA(3).aspx	http://metadata.boem.gov/geospatial/OCS_SubmergedLandsActBoundary_Atlantic_NAD83.xml
Marine Geospatial Ecology Labs/ Duke University	MDAT/All Birds Group Abundance	http://seamap.env.duke.edu/models/mdat/	http://seamap.env.duke.edu/models/mdat/Avian/MDAT_Avian_Summary_Products_Metadata.pdf
Northeast Ocean Data Portal	Tracking Movements of Diving Birds (Offshore Study Area)	https://services.northeastoceandata.org/arcgis1/rest/services/MarineLifeAndHabitat/MapServer	N/A
New York Breeding Bird Atlas	Avian Observations (Onshore Study Area)	http://www.dec.ny.gov/maps/bbasoutheast.kmz	N/A
CTDEEP	Critical habitat, Endangered, threatened, species of concern	https://portal.ct.gov/DEEP/GIS-and-Maps/Data/GIS-DATA#EndangeredSpecies https://cteco.uconn.edu/viewer/index.html?viewer=blueplan	N/A
Connecticut Breeding Bird Atlas	Avian Observations (Onshore Study Area)	http://www.pwrc.usgs.gov/bba http://ctbirdatlas.org/lists/breeding/Breeding_101D.html	N/A
eBird	Avian Observations (Onshore Study Areas)	GBIF.org	N/A

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5.4 Bat Species

This section describes bat species known or expected to occur in the Project Area. Potential impacts to bat species resulting from construction, operations, and decommissioning of the Project are discussed. Proposed Project-specific measures adopted by Beacon Wind are also described, which are intended to avoid, minimize, and/or mitigate potential impacts to bat species.

Other resources and assessments detailed within this COP that are related to bat species include:

- Terrestrial Vegetation and Wildlife (**Section 5.1**);
- USFWS IPaC and State Listed Species (**Appendix M**);
- Offshore Bat Survey Report (**Appendix Q**); and
- Bat Impact Assessment (**Appendix R**).

Data Relied Upon and Studies Completed

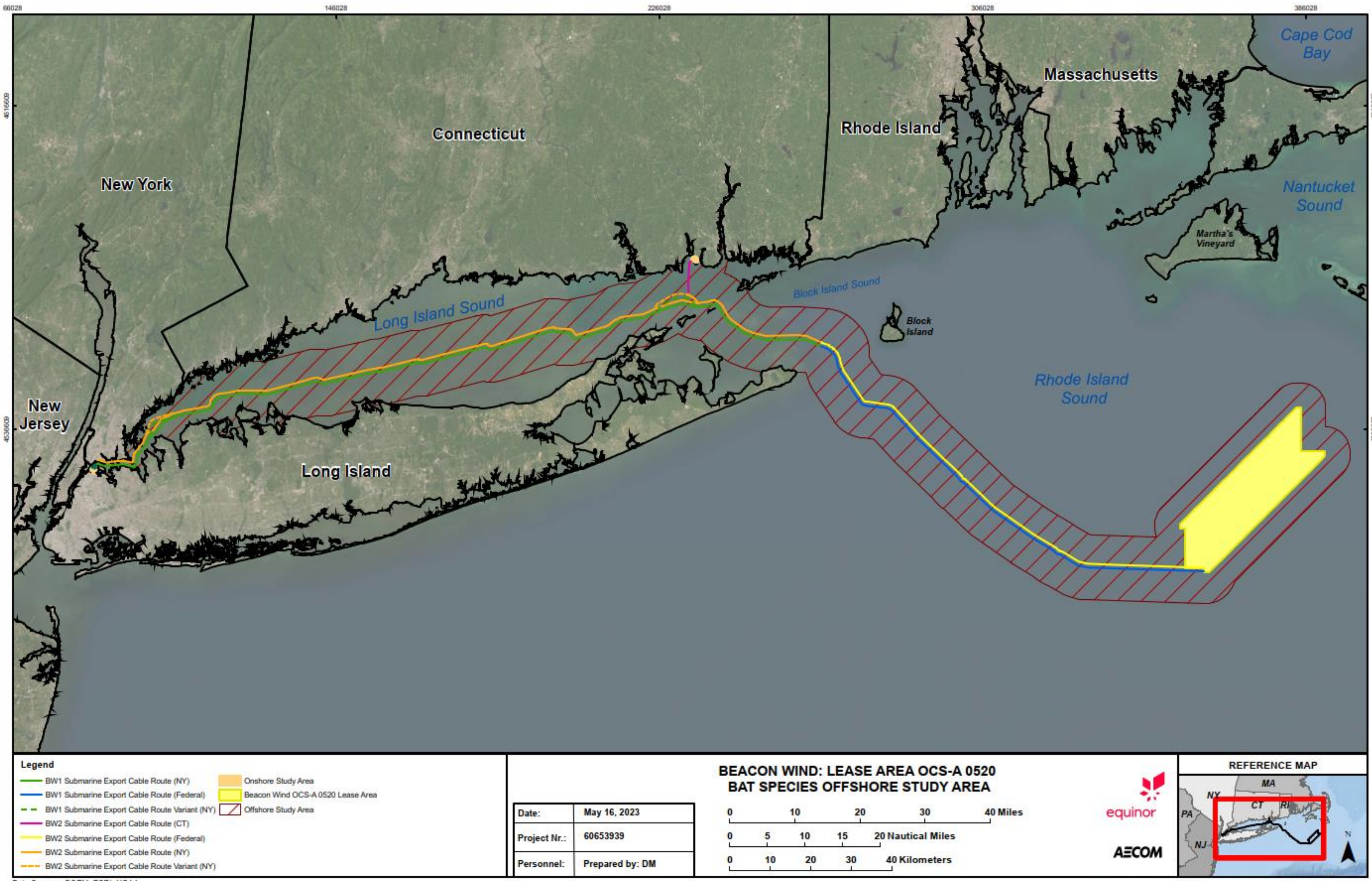
For the purposes of this section, the Study Area consists of two areas: those portions of the Project Area consisting of the offshore components, referred to as the Offshore Study Area and those portions of the Project Area consisting of the onshore components referred to as the Onshore Study Area, which were assessed for potential impacts to bat species (**Appendix R Bat Impact Assessment**). The Offshore Study Area consists of the Lease Area and the offshore components for BW1 and BW2, inclusive of an overlap area (see **Figure 5.4-1)**. The offshore infrastructure addressed for the Offshore Study Area includes the wind turbines, offshore substation facilities, foundations, interarray cables, and the portions of the submarine export cables within the Lease Area. The Onshore Study Area consists of two locations. The first of these locations is the area identified within the Astoria power complex in Queens, New York, where two locations are under consideration (NYPA and AGRE) for the BW1 and BW2 landfall, onshore export and interconnection cables, and onshore substation facilities. The second location is the area identified near the Dominion Millstone Power Station in Waterford, Connecticut which will be considered along with that Queens, New York location not selected for BW1 for the proposed BW2 landfall and onshore infrastructure (see **Figure 5.4-2 and Figure 5.4-3**).

This section relies upon available literature, data sources, and an offshore bat acoustic survey conducted in the Lease Area from August to November of 2020 and March and April 2021. The offshore acoustic survey was performed as a baseline characterization and species inventory study within the Lease Area, in which acoustic bat data was collected from a 250-ft (76-m) geophysical research vessel (*Stril Explorer*). Results of this survey are provided in **Appendix Q Offshore Bat Survey Report.**

5.4.1 Affected Environment

The affected environment is defined as the offshore and onshore areas where bat species are known to be present, traverse, or incidentally occur and have the potential to be directly or indirectly affected by the construction, operations, and decommissioning of the Project. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Beacon Wind expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Beacon Wind will comply with in using the facilities.

FIGURE 5.4-1. BAT SPECIES OFFSHORE STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS

FIGURE 5.4-2. BAT SPECIES ONSHORE STUDY AREA – QUEENS, NEW YORK

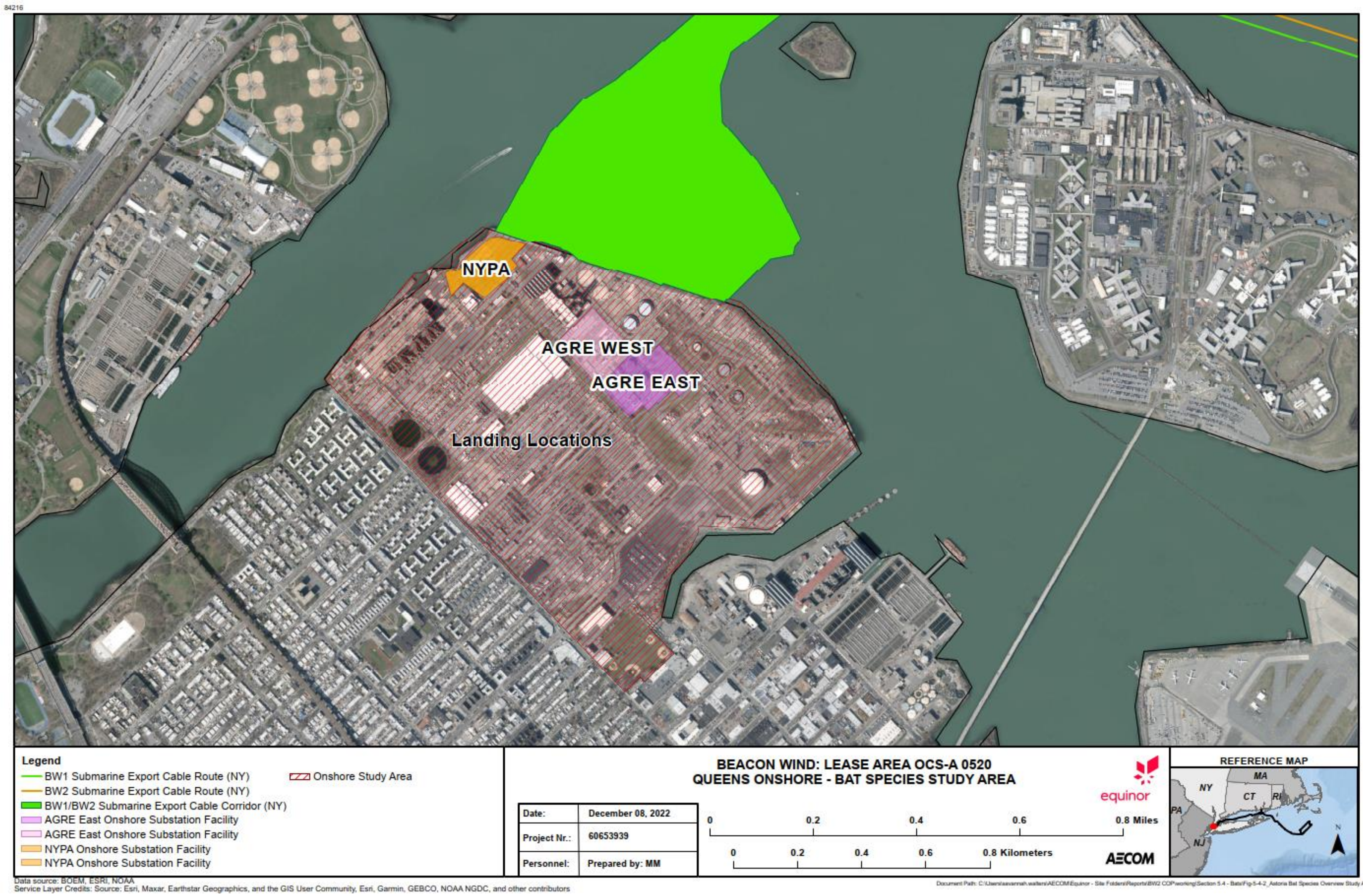
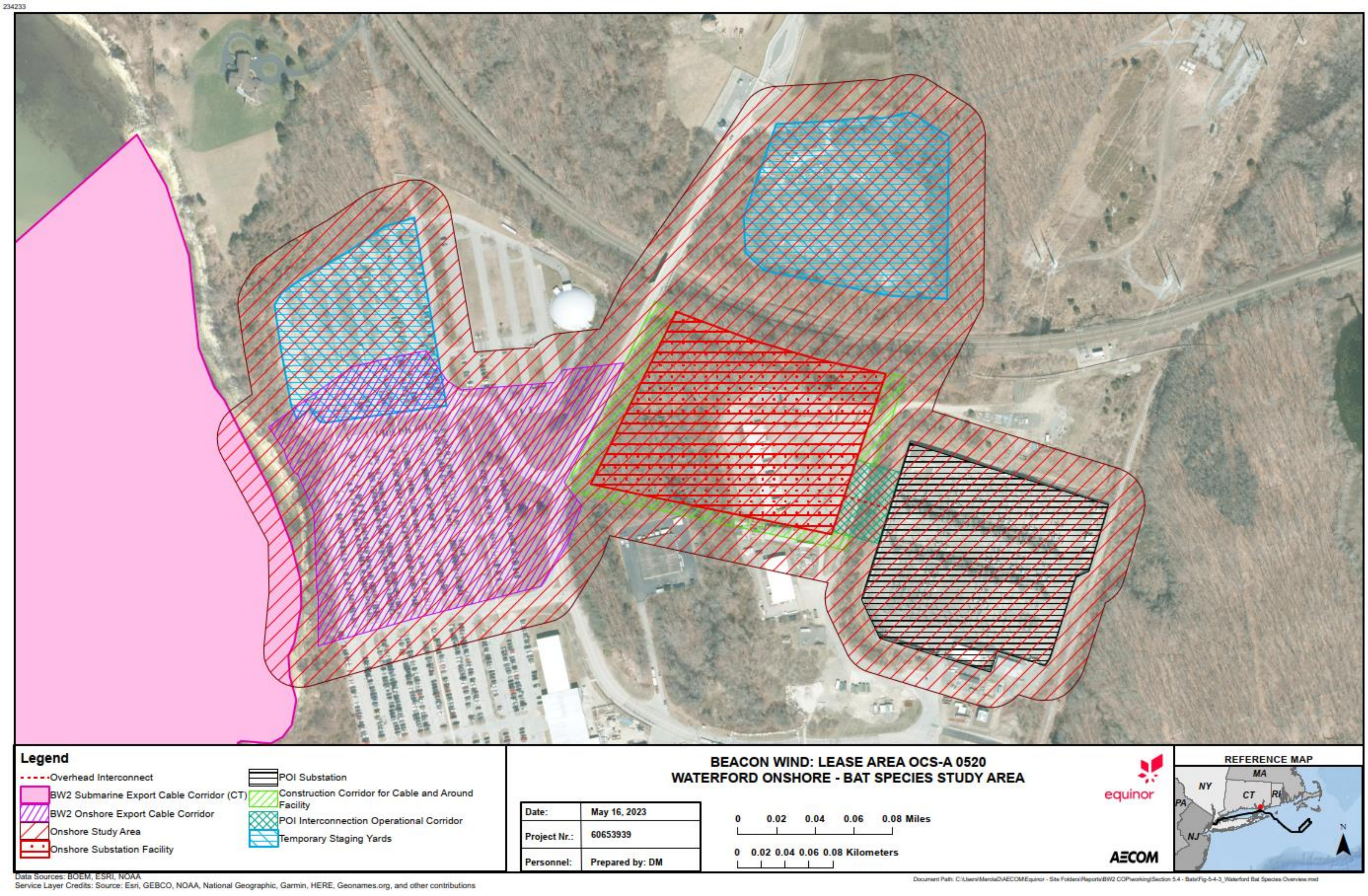


FIGURE 5.4-3. BAT SPECIES ONSHORE STUDY AREA – WATERFORD, CONNECTICUT



5.4.1.1 *Baseline Characterization*

Bat species within the Study Area can be categorized into two major groups based on their wintering strategy: cave-hibernating bats and long-distance migratory tree bats. Long-distance migrators are at higher risk of collision with operating wind turbines during migration, while cave-hibernating bats are at higher risk of displacement by onshore habitat alterations. Both groups of bats are nocturnal insectivores, active during March to November, and occur in forested and open land habitats. Cave-hibernating bats are non-migratory or migrate regionally between summer breeding habitat and winter hibernacula (typically a cave) in the northeastern U.S. and are generally not observed offshore (over 3.5 mi [5.6 km] from shore). Cave hibernating bats known to occur in the northeastern U.S. include big brown bat (*Eptesicus fuscus*), eastern small-footed bat (*Myotis leibii*), Indiana bat (*Myotis sodalis*), little brown bat (*Myotis lucifugus*), northern long-eared bat (*Myotis septentrionalis*), and tri-colored bat (*Perimyotis subflavus*). As northern long-eared bats and Indiana bats are both federally and state (New York) protected, these species are discussed in a separate section below. These two species are cave-hibernating and would not be found offshore in the Lease Area where impacts may be present for long-distance migrators. Long-distance migratory tree bats known to occur in the northeastern U.S. include eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and silver-haired bat (*Lasionycteris noctivagans*). Rather than hibernating in the winter months, these species fly to the southern parts of the U,S. and Mexico (Cryan 2003) and have been observed offshore during fall migration and summer.

Of the nine species of bats present in the northeastern U.S. region, eight species are known to potentially occur in the Study Area, and four were documented in the Lease Area that may be exposed to Project development, construction, operations, and decommissioning (**Table 5.4-1** and **Appendix Q Offshore Bat Survey Report)**.

TABLE 5.4-1. BAT SPECIES THAT MAY OCCUR IN THE OFFSHORE AND ONSHORE STUDY AREA

Common Name	Scientific Name	Winter Strategy	Confirmed Presence in the Lease Area a/
Big brown bat	*Eptesicus fuscus*	Cave-hibernating	Yes
Eastern small-footed bat	*Myotis leibii*	Cave-hibernating	No
Little brown bat	*Myotis lucifugus*	Cave-hibernating	No
Northern long-eared bat	*Myotis septentrionalis*	Cave-hibernating	No
Tri-colored bat	*Perimyotis subflavus*	Cave-hibernating	No
Eastern red bat	*Lasiurus borealis*	Long-distance migratory	Yes
Hoary bat	*Lasiurus cinereus*	Long-distance migratory	Yes
Silver-haired bat	*Lasionycteris noctivagans*	Long-distance migratory	Yes

Note:
a/ Species observed and confirmed within the Lease Area through survey efforts. “No” indicates that while the Project is within the known range of this species, it was not detected during survey activities. (**Appendix Q Offshore Bat Survey Report**).

5.4.1.2 *Cave-Hibernating Bats*

5.4.1.2.1 Onshore

Cave-hibernating (regionally migratory) bat species hibernate in caves, mines, and other structures, and feed primarily on insects in terrestrial and freshwater habitats. Bat active periods extend from April 1 to October 31, and maternity roosting periods extend from June 1 to July 31. During the summer, cave-hibernating bats roost under bark, in tree crevices, and foliage of both dead and live trees, and forage within forest, along forest edges, forest openings, and in riparian areas (Harvey et al. 2011). Within the Onshore Study Area, big brown bats are the most likely cave hibernating bat to be present due to their large population and ability to co-exist in buildings and disturbed areas (NYSDEC 2021a). In areas of suitable summer roosting habitat (i.e., forest) located in proximity to hibernacula, other species may occur. A summary of the likelihood for cave-hibernating bat species to occur along each onshore export cable route and onshore substation parcel is described below.

The onshore export and interconnection cable route and onshore substation facility locations under consideration in Queens, New York are already highly developed with no contiguous forested habitat. Some species of bats, such as big brown bats, will hibernate in buildings and man-made structures; however, without surrounding foraging habitat such as forests, this is unlikely to occur. Therefore, due to the high level of development and lack of trees, the onshore export and interconnection cable route and onshore substation facility areas are unlikely to support cave-hibernating or tree-roosting bat species during any period of their lifecycle and are not discussed further. Additionally, no endangered, threatened, or special concern bat species have been documented by the New York Natural Heritage Program database within the Queens, New York Onshore Study Area. The Waterford, Connecticut Onshore Study Area consists of both developed and forested lands, and construction of the onshore substation facility would potentially require up to five acres (2 hectares) of tree clearing. An IPaC review of the Waterford, Connecticut site indicated that the location is within the range of the northern long-eared bat (**Appendix M USFWS IPaC and State Listed Species**).

5.4.1.2.2 Offshore

Cave-hibernating bats generally exhibit lower activity offshore than long-distance migratory tree bats (Sjollema et al. 2014), with their migratory movements occurring primarily in the fall (Sjollema et al. 2014). Acoustic studies indicate that the greatest percentage of migration activity for cave-hibernating bats takes place between July and October (Peterson et al. 2014). In addition, acoustical monitoring at Block Island, Rhode Island identified *Myotis* species during the Summer and Fall of 2009 and Spring of 2010, indicating cave-hibernating bats were active in the nearshore and onshore areas; however, calls were not identified to species (Svedlow et al. 2012). Based on these data and existing information in the literature, *Myotis* are not expected to be present in the Lease Area, as the maximum distance they have been detected offshore in the mid-Atlantic is 7.2 mi (11.5 km) (Sjollema et al. 2014). Overall, acoustic studies indicate limited use of the offshore environment by cave-hibernating bats, and any use of the Lease Area by this group is likely limited to fall migration. Of the cave-hibernating bats that have the potential to occur in the Offshore Study Area, only big brown bats were acoustically detected in the Lease Area during the 2021 Offshore Bat Acoustic Survey (**Appendix Q Offshore Bat Survey Report**).

5.4.1.3 *Long-distance Migratory Tree Bats*

5.4.1.3.1 Onshore

Long-distance migratory tree bats are less dependent on contiguous forest for foraging than cave-hibernating bats; however, they depend on forest for foliage roosts. Due to the high level of development and lack of trees within the Astoria power complex, particularly at the onshore export and interconnection cable location, this area is unlikely to support migratory bat species habitat during their lifecycle and are not discussed further. Additionally, no endangered, threatened, or special concern bat species have been documented by the New York Natural Heritage Program database within the Queens, New York and the Onshore Study Area (**Appendix M USFWS IPaC and State Listed Species**). The Waterford, Connecticut Onshore Study Area consists of both developed and undeveloped areas, including some forested habitat which may be suitable habitat for a variety of bat species, including the northern long-eared bat.

5.4.1.3.2 Offshore

Offshore, long-distance migratory bats have been documented in the northeastern U.S., though there is uncertainty regarding the specific movements of these species (Grady and Olson 2006; Cryan and Brown 2007; Johnson et al. 2011; Hatch et al. 2013; Pelletier et al. 2013; Dowling et al. 2017). In Maine, bats have been detected on islands up to 25.8 mi (42 km) from the mainland (Peterson et al. 2014). Long-distance migratory tree bats leave in the winter months and journey to warmer parts of the southern U.S. and Central America to overwinter between December and March. These bats have been documented most often in the offshore environment during fall migration (August–November) (BOEM 2014). Eastern red bats, for example, have been detected migrating from Martha’s Vineyard in the late fall (October–November), with one bat tracked as far south as Maryland before records ceased (Dowling et al. 2017). These results are supported by historical observations of eastern red bats offshore as well as recent acoustic and survey results where migrating bats have been observed temporarily roosting on structures, such as lighthouses and on nearshore islands (Biodiversity Works 2016; Dowling et al. 2017; Hatch et al. 2013; Peterson et al. 2014; Sjollema et al. 2014). Eastern red bats were also detected up to 27.3 mi (44 km) offshore in the mid-Atlantic by high-definition video aerial surveys (Hatch et al. 2013). In a study of bat acoustical detections offshore in the mid-Atlantic, eastern red bats comprised 78 percent of the identified calls, with a maximum distance offshore of 13.6 mi (22 km) offshore and a mean distance of 5.2 mi (8 km) offshore (Sjollema et al. 2014).

The three tree bat species known to occur in the region (eastern red, hoary, and silver-haired bats) have also been detected in low numbers at Block Island, though mainly during migration (May; August–October (Svedlow et al. 2012). The acoustic survey conducted by Beacon Wind in the Lease Area corroborates these findings (**Appendix Q Offshore Bat Survey Report**). In the Lease Area, the most commonly recorded bat passes were eastern red bats and silver-haired bats. Hoary bats were also detected in the Lease Area, though in lower numbers than the other migratory species (**Appendix Q Offshore Bat Survey Report, Figure 5.4-4**, and **Figure 5.4-5**). As described in **Appendix R Bat Impact Assessment**, bat activity in offshore environments seems to be seasonal, following the spring and fall migration patterns of tree-roosting species.

FIGURE 5.4-4. BEACON WIND OFFSHORE BAT SURVEY RESULTS - PERCENT OF DETECTIONS IN LEASE AREA BY SPECIES

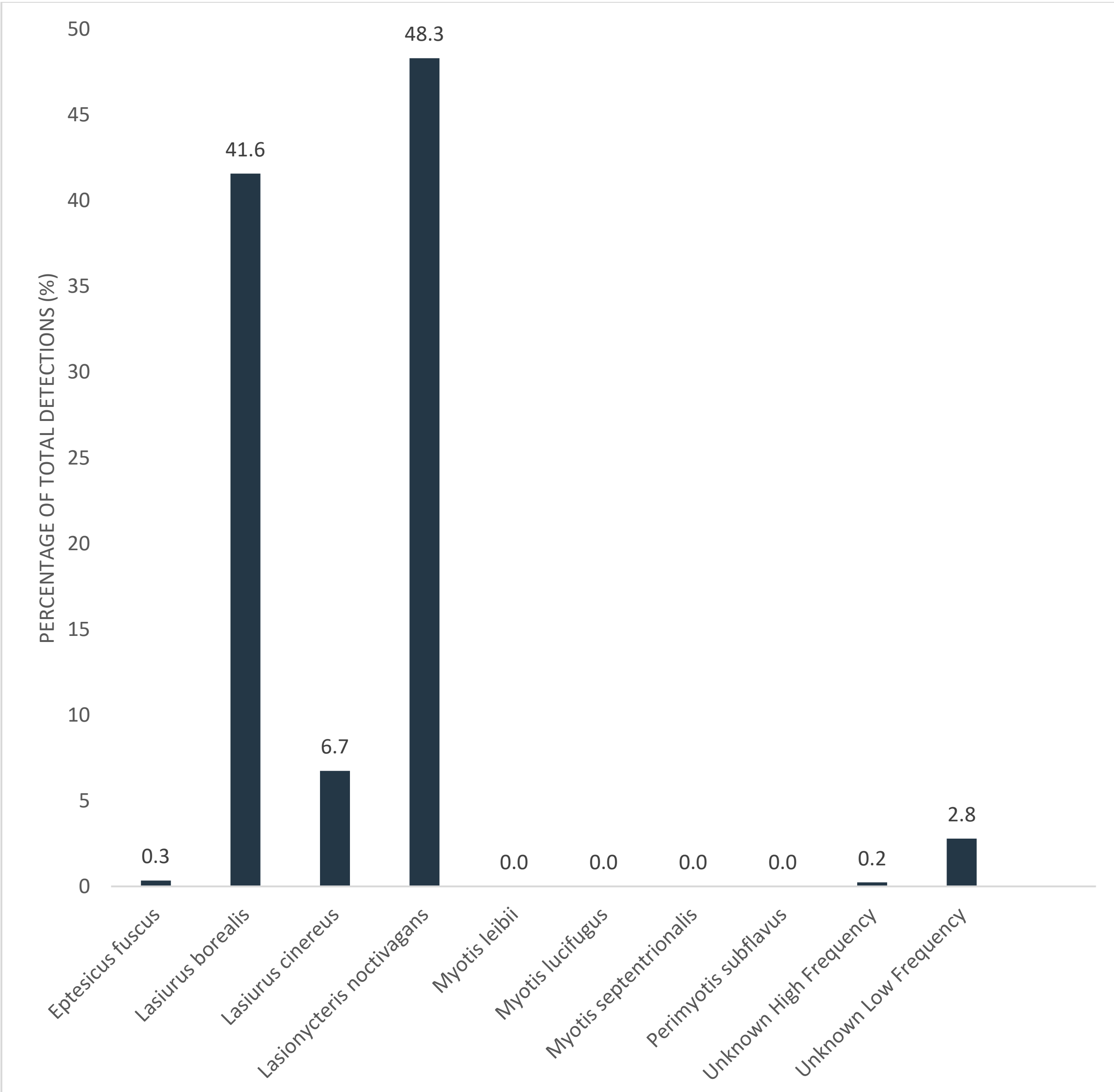
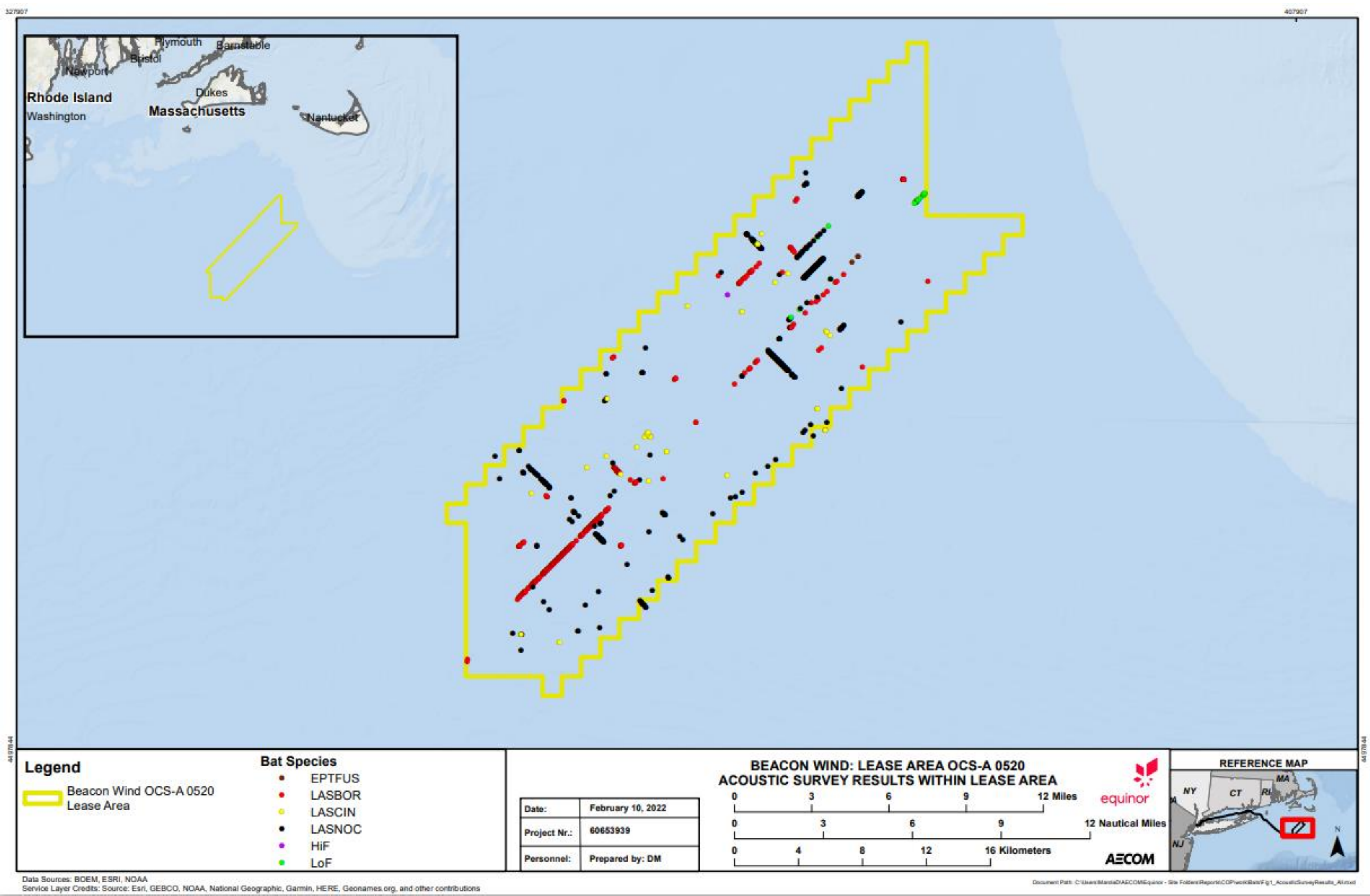


FIGURE 5.4-5. BEACON WIND OFFSHORE BAT SURVEY RESULTS - LOCATIONS OF BAT SPECIES DETECTIONS IN LEASE AREA



Notes: EPTFUS = *Eptesicus fuscus;* LASBOR = *Lasiurus borealis;* LASCIN = *Lasiurus cinereus;* LASNOC = *Lasionycteris noctivagans;* HiF = Hi Frequency Unknown; LoF= Low Frequency Unknown.

5.4.1.4 *Threatened and Endangered Species*

Of the nine bat species known to occur in the states adjoining the Project Area (New York, Connecticut, Rhode Island, and Massachusetts), two are federally listed: northern long-eared bat (endangered), and Indiana bat (endangered). Five of the nine species (including the federally-protected species) have a special protected status in at least one neighboring state (**Appendix R Bat Impact Assessment, Section R.4.2 Federally Listed Bat Species**). Rhode Island has not assigned a state listing designation for any bat species and is excluded from **Table 5.4-2**, which summarizes the federally and state listed bat species within the Study Area.

5.4.1.4.1 Federally-Listed Species

A review of the USFWS IPaC system did not indicate the likely presence of any federally-listed bats within the Lease Area. An IPaC review identified both the Queens, New York and Waterford, Connecticut landfall locations as being within the known range of the northern long-eared bat (**Appendix M USFWS IPaC and State Listed Species**. As of March 31, 2023 under the ESA, the northern long-eared bat islisted as endangered (87 FR 73488-73504). Northern long-eared bats hibernate in caves, mines, and other locations (e.g., possibly talus slopes) in winter, and spend the remainder of the year (March–November) in forested habitats (Brooks and Ford 2005; Menzel et al. 2002). During the non-winter hibernation, this species prefers to roost in clustered stands of large trees with living and/or dead trees that have shelter (loose bark, crevasses, large cavities), and forage under the forest canopy above freshwater, along forest edges, and along roads.

Northern long-eared bats form maternity colonies at their summer roosting areas. These consist of aggregations of females and juveniles and are where females give birth to young in mid-June (USFWS 2016). Roost tree selection varies and the size of tree and canopy cover changes with reproductive stage (USFWS 2016). Adult females and juveniles able to fly remain in maternity colonies until mid-August, at which time the colonies begin to break up and individuals begin migrating to their hibernation sites (Menzel et al. 2002). Bats will continue to forage around the hibernacula site and mating occurs prior to entering hibernation in a period known as the fall swarm (Broders and Forbes 2004; Brooks and Ford 2005). Throughout the summer months and during breeding, the species have small home ranges of less than 25 ac (10.1 ha) (Silvis et al. 2016). However, migratory movements can be up to 170 mi (274 km) (Griffin 1945).

Due to impacts from white-nose syndrome (WNS), a fungal pathogen that leads to high mortality in hibernating bats, the species has declined by 90–100 percent in most locations where the disease has occurred, and declines are expected to continue as the disease spreads throughout the remainder of the species' range (USFWS 2016; WNSRT 2021). The devastating and ongoing impact of WNS on northern long-eared bats resulted in the species being listed as threatened under the ESA in 2015. The WNS disease was first detected in New York in 2006 (WNSRT 2021) and rapidly spread to surrounding states including Connecticut, Rhode Island, and Massachusetts.

Presence of northern long-eared bats is very unlikely at the Queens, New York onshore substation facility site due to lack of suitable habitat. No known hibernacula or maternity roost trees are located near the site in New York (**Appendix M USFWS IPaC and State Listed Species**). The Waterford, Connecticut Onshore Study Area consists of both developed and undeveloped areas, including some forested habitat which may be suitable habitat for a variety of bat species, including the northern long-eared bat.

Offshore, use of the Lease Area by northern long-eared bats is unlikely, resulting in very limited risk. While there is little information available regarding the offshore movements of this species, a tracking study on Martha's Vineyard did not indicate movements of northern long-eared bats offshore (Dowling et al. 2017). This is corroborated by the lack of acoustic detection during the Beacon Wind survey documented in **Appendix Q Offshore Bat Survey Report**.

5.4.1.4.2 State Listed Species

The four states that neighbor the Offshore and Onshore Study Areas (New York, Connecticut, Rhode Island, and Massachusetts) each maintain lists of threatened, endangered, and special concern species found within their state. A list of state-listed bat species with their designation categories is provided in **Table 5.4-2**. Rhode Island Natural History Survey (RINHS) does not list any bat species as endangered, threatened, or special concern (RINHS 2006); therefore, Rhode Island is excluded from **Table 5.4-2**.

The NYSDEC is currently proposing changes to its list of endangered and threatened species, which would include status changes of tri-colored bats to a state threatened species and little brown bats to Species of Special Concern (NYSDEC 2021b). These species, along with Indiana bats and northern long-eared bats, are currently consider High Priority Species of Greatest Conservation Need (HPS) under the 2015 New York State Wildlife Action Plan.

Presence of state-listed bat species is very unlikely at the Queens, New York onshore substation facility sites due to lack of suitable habitat. No known hibernacula or maternity roost trees are located near the site in New York (**Appendix M USFWS IPaC and State Listed Species**). The Waterford, Connecticut onshore substation facility site is located within the range of the northern long-eared bat (**Appendix M USFWS IPaC and State Listed Species**) and New London County is home to seven of Connecticut's state-listed bat species: silver-haired bat, eastern red bat, hoary bat, eastern small-footed bat, little brown bat, northern long-eared bat, and tri-colored bat (CTDEEP, 2021).

Offshore, use of the Lease Area by state-listed bats is likely limited to long-distance migrants, which are listed as Special Concern in Connecticut (**Table 5.4-2** and **Appendix R Bat Impact Assessment**). This is corroborated by the results of the Beacon Wind survey documented in **Appendix Q Offshore Bat Survey Report,** which confirmed the presence of big brown bats, eastern red bats, hoary bats, and silver-haired bats within the Lease Area (**Figure 5.4-4** and **Table 5.4-1**).

TABLE 5.4-2. FEDERAL AND STATE LISTING DESIGNATIONS FOR BAT SPECIES OF THE NORTHEASTERN UNITED STATES

Life-History Strategy	Common Name	Scientific Name	New York Status	Massachusetts Status	Connecticut Status	Federal Status
Cave-hibernating	Big brown bat	*Eptesicus fuscus*	-	-	-	-
	Eastern small-footed bat	*Myotis leibii*	SC	E	E	-
	Little brown bat	*Myotis lucifugus*	HPS	E	E	D
	Northern long-eared bat	*Myotis septentrionalis*	T	E	E	E
	Indiana bat	*Myotis sodalis*	E	E	E	E
	Tri-colored bat	*Perimyotis subflavus*	HPS	E	E	P a/
Long Distance Migrants	Eastern red bat	*Lasiurus borealis*	-	-	SC	-
	Hoary bat	*Lasiurus cinereus*	-	-	SC	-
	Silver-haired bat	*Lasionycteris noctivagans*	-	-	SC	-

Note:
E=Endangered; T=Threatened; SC=Special Concern; HPS=High Priority Species of Greatest Conservation Need; P=Petitioned for Listing; D=Discretionary Review for Listing Determination
a/ Proposed for listing as Endangered
Sources: CTDEEP 2015a; MassWildlife 2020; NYSDEC 2015a and 2015b; USFWS 2021, USFWS 2023

5.4.2 Impacts Analysis for Construction, Operations, and Decommissioning

The potential impacts resulting from the construction, operations, and decommissioning of the Project are based on the maximum design scenario from the PDE (see **Section 3 Project Description**). For bat species, the maximum design scenario is the full build-out of both the offshore and onshore components, as described in **Table 5.4-3**. The maximum design scenario for assessments associated with full build-out incorporates a total of up to 157 structures within the Lease Area (including up to 155 wind turbines and two offshore substation facilities) with two submarine export cable routes (one to Queens, New York for BW1 and one to either Queens, New York or Waterford, Connecticut for BW2), and the associated onshore substation facilities. This design concept also incorporates the full build-out of onshore structures, including the onshore substation facilities and onshore export and interconnection cable routes.

A bat species impact assessment is provided within **Appendix R Bat Impact Assessment.**

TABLE 5.4-3. SUMMARY OF MAXIMUM DESIGN SCENARIO PARAMETERS FOR BAT SPECIES

Parameter	Maximum Design Scenario	Rationale
Construction		
Offshore structures	Based on full build-out of the Project (BW1 and BW2) (155 wind turbines and two offshore substation facilities).	Representative of the maximum number of structures.
Duration offshore construction	Based on full build-out of the Project (BW1 and BW2) which corresponds to the maximum number of structures (155 wind turbines and two offshore substation facilities), two submarine export cable routes and interarray cables, and maximum period of cumulative duration for installation.	Representative of the maximum period required to install the offshore components, which has the potential to have Project-related vessels and associated lighting in the Project Area.

Onshore substation facilities and components	Based on full build-out of the Project (BW1 and BW2):
	• BW1 Queens, New York (up to a 16 ac [6.5 ha] area).
	• BW2:
	  ○ Queens, New York (up to a 16 ac [6.5 ha] area) or
	  ○ Waterford, Connecticut (up to a 16 ac [6.5 ha] area).
	
	Construction and installation of export cable landfalls, onshore export and interconnection cables, and onshore substation facilities.
		Representative of the maximum area to be utilized to facilitate the construction of the onshore substation facilities and components for BW1 and BW2.

Duration onshore construction	Based on full build-out of the Project (BW1 and BW2): • BW1 to Queens, New York • BW2 to Queens, New York or Waterford, Connecticut.	Representative of the maximum period required to install the onshore components, which has the potential to have Project-related equipment and

Parameter	Maximum Design Scenario	Rationale
	Construction and installation of export cable landfall, onshore export and interconnection cables, and onshore substation facility.	associated lighting in the Project Area.
Staging and construction areas, including port facilities, work compounds, and lay-down areas	Based full build-out of the Project. Maximum number of work compounds and lay-down areas required. Some ground disturbing activities may be anticipated at Queens, New York with grading and minor tree clearing at Waterford, Connecticut. Independent activities to upgrade or modify staging, construction areas, and ports prior to Project use will be the responsibility of the facility owner.	Representative of the maximum area required to facilitate the offshore and onshore construction activities.
Operations and Maintenance		
Wind turbines	Based on full build-out of the Project (BW1 and BW2) which includes up to 155 wind turbines.	Representative of the maximum number of wind turbines (155), which would result in the greatest overall total RSZ and potentially increase collision risk.
Offshore substation facilities	Based on full build-out of the Project (BW1 and BW2) which includes up to two offshore substation facilities.	Representative of the maximum number of offshore substation facilities, which has the potential to increase attraction of bats that may be travelling offshore.
Offshore operations and maintenance activities	Based on full build-out of the Project (BW1 and BW2) (155 wind turbines, two offshore substation facilities), two submarine export cable routes, and associated interarray cables) and the maximum amount of Project-related activities expected per year.	Representative of the maximum amount of activities from the Project during operations and maintenance.
Project-related operations and maintenance vessels	Based on the full build-out of the Lease Area (BW1 and BW2).	Representative of the maximum condition for the peak number of operations and maintenance vessels affecting the area.

Onshore substation facilities	Based on full build-out of the Project (BW1 and BW2):
	• BW1 to Queens, New York (up to a 7 ac [2.8 ha] area).
	• BW2:
	  ○ Queens, New York (up to a 7 ac [2.8 ha] area) or
	  ○ Waterford, Connecticut (up to a 7 ac [2.8 ha] area).
		Representative of the presence of a new structure in an area where there was previously none, which would result in the maximum habitat loss and introduction of Project-related lighting.

5.4.2.1 *Construction*

During construction, the potential impact-producing factors to bat species may include:

- Construction of the onshore components, including the submarine export cable landfall, onshore export, and interconnection cables, and onshore substation facilities;
- Staging activities and assembly of Project components at applicable facilities or areas; and
- Construction of the offshore components, including foundations, wind turbines, offshore substation facilities, and submarine export and interarray cables.

The following impacts may occur as a consequence of factors identified above:

- Short-term alteration of terrestrial habitat; and
- Short-term disturbance and displacement.

Terrestrial habitat alteration: During construction, the onshore export and interconnection cable and onshore substation facilities may require tree removal, depending on whether the Waterford, Connecticut location is selected for BW2. At the Queens, New York locations, the onshore cable routes and onshore substation facilities are located in an already disturbed area; habitat alteration is not anticipated to be required due to the highly developed nature of the onshore area and lack of natural vegetation at the Queens, New York locations. Activities at staging and construction facilities will be consistent with the established and permitted uses of these facilities, and Beacon Wind will comply with applicable permitting standards to limit environmental impacts from Project-related activities. Beacon Wind will utilize the same O&M Base as Empire Wind. Therefore, the selection of this facility will avoid impacts associated with the construction of a new O&M Base .

At the Waterford, Connecticut location, some tree clearing would be necessary for the construction of the onshore substation facility itself, the trenched installation of the submarine export cable from the HDD landfall to the onshore substation facility, and the overhead interconnect cable from the onshore substation facility to the POI substation. Up to approximately five acres (2 ha) of forested habitat would be cleared, much of which would be permanently converted to an industrial land use.

Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate these potential impacts to bat species:

- Onshore components have been sited in previously disturbed areas, existing roadways, or otherwise unsuitable bat summer habitat, to the extent practicable;
- Avoid tree clearing at the onshore Project components, unless otherwise determined acceptable by the USFWS and NYSDEC/CT DEEP from March through November; and
- The Project will utilize an existing O&M Base and will not require construction of a new O&M Base in the State of New York, therefore avoiding additional potential impacts to bats as a result of new construction.

Disturbance and displacement: Offshore, indirect effects of wind turbine construction on bat species is poorly studied or understood. Wind turbines and other structures present, including equipment and Project components, during construction may provide stopover resting/roosting sites, and the structures or lighting may either attract bats already flying offshore or impede movement through the area (Pelletier et al. 2013). If construction attracts or impedes bat movements during migration, migratory routes may be altered, or flight distances increased. This may lead to increased energetic demands and may lead to decreased survival during migration (Pelletier et al. 2013).

Onshore, bat species may be temporarily displaced from roosting or foraging habitat due to noise, vibrations, and general human activity, even if permanent habitat alteration is not experienced. Bats are most at risk of disturbance during hibernation, which is not anticipated to occur with this Project given that no hibernacula are located near Project-related activities. Bats are also likely to return to the general area once construction is complete if intact habitat remains. Species have different levels of tolerance of human disturbance; for example, big brown bats often co-exist with humans in urban areas. Given the limited bat habitat of marginal quality present onshore, any disturbance or displacement of bats is from construction is expected to be nominal, except possibly in localized areas for a short-term period. Activities at staging and construction facilities will be consistent with the established and permitted uses of these facilities, and Beacon Wind will comply with applicable permitting standards to limit environmental impacts from Project-related activities.

Beacon Wind proposes to implement the following measure to avoid, minimize, and mitigate impacts:

- Lighting not required during onshore construction will be limited to the minimum required by regulation and for safety, to reduce attraction (or attraction of insect prey); and
- Lighting not required during offshore construction by the FAA, BOEM, and the USCG during construction will be limited to the minimum required by regulation and for safety, to reduce attraction of insect prey for bats.

5.4.2.2 Operations and Maintenance

During operations, the potential impact-producing factors to bat species may include:

- Presence of new permanent structures offshore (i.e., wind turbines and offshore substation facilities);
- Presence of new permanent structures onshore (i.e., onshore substation facility);
- Operations and maintenance activities associated with the onshore export and interconnection cables and onshore substation facility; and
- Operations and maintenance activities associated with the offshore components of the Project.

With the following potential consequential impact-producing factors:

- Attraction to offshore operations and maintenance vessels;
- Long-term increased risk of attraction to and collision with wind turbines; and
- Long-term conversion of terrestrial habitat.

Attraction to and collision with wind turbines: During operations, bats have the potential to collide with the operating wind turbines, resulting in mortality. Stationary objects are not generally considered a collision risk for bats because they are able to detect objects with echolocation; however, data regarding bat interactions with and fatalities from offshore wind turbines in North America is currently not available and there is difficulty searching for carcasses in the ocean (BOEM 2014; Horn et al. 2008; Pelletier et al. 2013; Thaxter et al. 2017). In offshore European studies, bats were found to roost and rest directly on turbines and forage in close proximity as insects accumulated around the turbines (Ahlén et al. 2007; Ahlén et al. 2009; Rydell et al. 2010). While limiting the number of lights, using lower intensity lights, using light colors other than white, or using strobing instead of steady lights, and using downward facing or motion sensor lights, where appropriate, may help reduce bat species attraction to light, onshore wind surveys have found no difference in bat foraging rates between lit and unlit turbines or differences between strobing and steady lights (Horn et al. 2008; Orr et al. 2016). Furthermore, bats were found to be attracted to red light during migration along the European coastline and not white light, even though red light is less likely to attract insects (Voigt et al. 2018).

Although bat mortality has not been well documented at offshore wind farms, collision mortalities have been detected at terrestrial wind farms, particularly during the fall migration period (Kunz et al. 2007; Arnett et al. 2008; Strickland et al. 2011; American Wind Wildlife Institute [AWWI] 2018). The level of mortality observed with onshore turbines is not necessarily transferable to offshore turbines due to the different use of habitats, different behaviors, different species composition, and differing levels of bat abundance and activity offshore.

As discussed above in **Section 5.4.1.1**, eastern red, silver-haired, hoary, and big brown bats were detected in the Lease Area during the Beacon Wind offshore acoustic bat survey and, therefore, the Project may pose risks of attraction to and collision with wind turbines for these species (**Appendix R Bat Impact Assessment**). In this study, migratory tree bats were the most commonly documented species group, representing almost 97 percent of the calls recorded (**Figure 5.4-4**). Migratory tree bats and big brown bats were recorded more commonly within the Lease Area in the fall season, with 55 percent of bat calls recorded during the month of August. These data suggested virtually no risk to bats in the winter months, and low risk to these species in spring and early summer, with some potential risk apparent during peak migration periods. Overall, bat detection rates recorded in the Lease Area were positively correlated with warmer temperatures and lower wind speeds (**Appendix R Bat Impact Assessment**). Although hoary, eastern red, and silver-haired bat represents a large percentage of bat fatalities at land-based wind projects in the northeastern U.S. (AWWI 2018), this data may not apply to the less-studied offshore wind energy environments. Cave-hibernating *Myotis* species were not detected within the Lease Area and they are not expected to utilize the offshore environment where wind turbines are proposed, due to the distance from shore. Thus, operation of the offshore portion of the Project presents very low risk to these species.

Beacon Wind proposes to implement the following measure to avoid, minimize, and mitigate impacts:

- Lighting during operations will be limited to the minimum required by regulation and for safety, therefore minimizing the potential for attraction (or attraction of insect prey) and possibly collision of bats with wind turbines.

Attraction to Project-related Operations and Maintenance vessels: During operations and maintenance activities, bats may be attracted to equipment and/or vessel lighting. Overall, stationary objects are not generally considered a collision risk for bats (BOEM 2012) because of bats' use of echolocation (Johnson and Arnett 2004; Horn et al. 2008). Thus, collision with equipment is expected to be minimal. However, bats are known to use islands, ships, and other offshore structures as stopover points during travel (Pelletier et al. 2013). Vessels may also provide roosting opportunities offshore for rest (Carter 1950; Norton 1930; Nichols 1920). As discussed in **Section 5.4.2.1** for the construction period, such lighting and structures may either attract bats already flying offshore, or impede movement through the area (Pelletier et al. 2013). If these attract or impede bat movements during migration, migratory routes may be altered or flight distances increased, leading increased energetic demands (Pelletier et al. 2013).

Beacon Wind proposes to implement the following measure to avoid, minimize, and mitigate impacts:

- Lighting during operations will be limited to the minimum required by regulation and for safety, therefore minimizing the potential for attraction (or attraction of insect prey).

Conversion of terrestrial habitat. Conversion of naturally vegetated lands, such as woody wetlands and deciduous forest that would be converted to accommodate permanent Project structures, such as an onshore substation facility. The impacts of habitat alteration are discussed in detail in **Section 5.4.2.1** above and are expected to be negligible for Queens, New York, due to the developed and industrial nature of this area and lack of vegetated habitat. At the Waterford, Connecticut location, some loss of bat habitat would likely occur as a result of construction of the onshore facilities; however, the amount of lost habitat would be relatively small, and not likely to be of high quality due to the highly developed nature of the surrounding area. Therefore, no mitigation measures are proposed at this time.

5.4.2.3 *Decommissioning*

Impacts during decommissioning are expected to be similar to or less than those experienced during construction, as described in **Section 5.4.2.1** and **Section 5.4.2.2**. It is important to note that advances in decommissioning methods/technologies are expected to occur throughout the operations phase of the Project. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and potential impacts will be re-evaluated at that time. For additional information on the decommissioning activities that Beacon Wind anticipates will be needed for the Project, please see **Section 3 Project Description**

5.4.3 Summary of Avoidance, Minimization, and Mitigation Measures

In order to mitigate the potential impact-producing factors described in **Section 5.4.2**, Beacon Wind is proposing to implement the following avoidance, minimization, and mitigation measures.

5.4.3.1 Construction

During construction, Beacon Wind will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in **Section 5.4.2.1**:

- Onshore components will be sited in previously disturbed areas, existing roadways, or otherwise unsuitable bat habitat to the extent practicable;
- The Project will utilize an existing O&M Base and will not require construction of a new O&M Base in the State of New York, therefore avoiding additional potential impacts to bats as a result of new construction;
- Tree clearing is not anticipated at the Queens, New York location; however, limited tree clearing would likely be necessary at the Waterford, Connecticut location. Should tree clearing be required, then this will be avoided between April 1st and November 1st to the best practical extent, unless otherwise determined acceptable by the USFWS and/or state agencies;
- Lighting not required during onshore construction will be limited to the minimum required by regulation and for safety, to reduce attraction (or attraction of insect prey); and
- Lighting not required during offshore construction by the FAA, BOEM, and the USCG during construction will be limited to the minimum required by regulation and for safety, to reduce attraction of insect prey for bats.

5.4.3.2 *Operations and Maintenance*

During operations, Beacon Wind will commit to the following avoidance, minimization, mitigation, and monitoring measures to mitigate the impacts described in **Section 5.4.2.2**:

- Lighting during operations will be limited to the minimum required by regulation and for safety, therefore minimizing the potential for attraction (or attraction of insect prey).

5.4.3.3 Decommissioning

Avoidance, minimization, and mitigation measures proposed to be implemented during decommissioning are expected to be similar to those implemented during construction and operations, as described in **Section 5.4.3.1** and **Section 5.4.3.2**. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and avoidance, minimization, and mitigation measures for decommissioning activities will be proposed at that time.

5.4.4 References

Table 5.4-4. Summary of Data Sources

Source	Includes	Available at	Metadata Link
BOEM	Lease Area	https://www.boem.gov/BOEM-Renewable-Energy-Geodatabase.zip	N/A
BOEM	State and Territorial Waters Boundary	https://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/ATL_SLA(3).aspx	http://metadata.boem.gov/geospatial/OCS_SubmergedLandsActBoundary_Atlantic_NAD83.xml
NOAA NCEI Bathymetry	Bathymetry	https://www.ngdc.noaa.gov/mgg/coastl/crm.html	N/A

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5.5 Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat

This section describes the benthic and pelagic habitats and species known or expected to be present, to transit through, or to occur incidentally in the waters within and surrounding the Project Area, which includes the Lease Area and submarine export cable corridors. The Study Area includes the offshore waters and coastlines within and in the vicinity of the Lease Area and the submarine export cable corridors (**Figure 5.5-1** and **Section 3.0 Project Description**). Potential impacts to benthic and pelagic habitats and resources resulting from construction, operation, and decommissioning of the Project are discussed. Proposed Project-specific measures adopted by Beacon Wind are also described; these measures are intended to avoid, minimize, and/or mitigate potential impacts to benthic and pelagic habitats and species.

Other resources and assessments detailed within this COP that are related to benthic and pelagic habitats include:

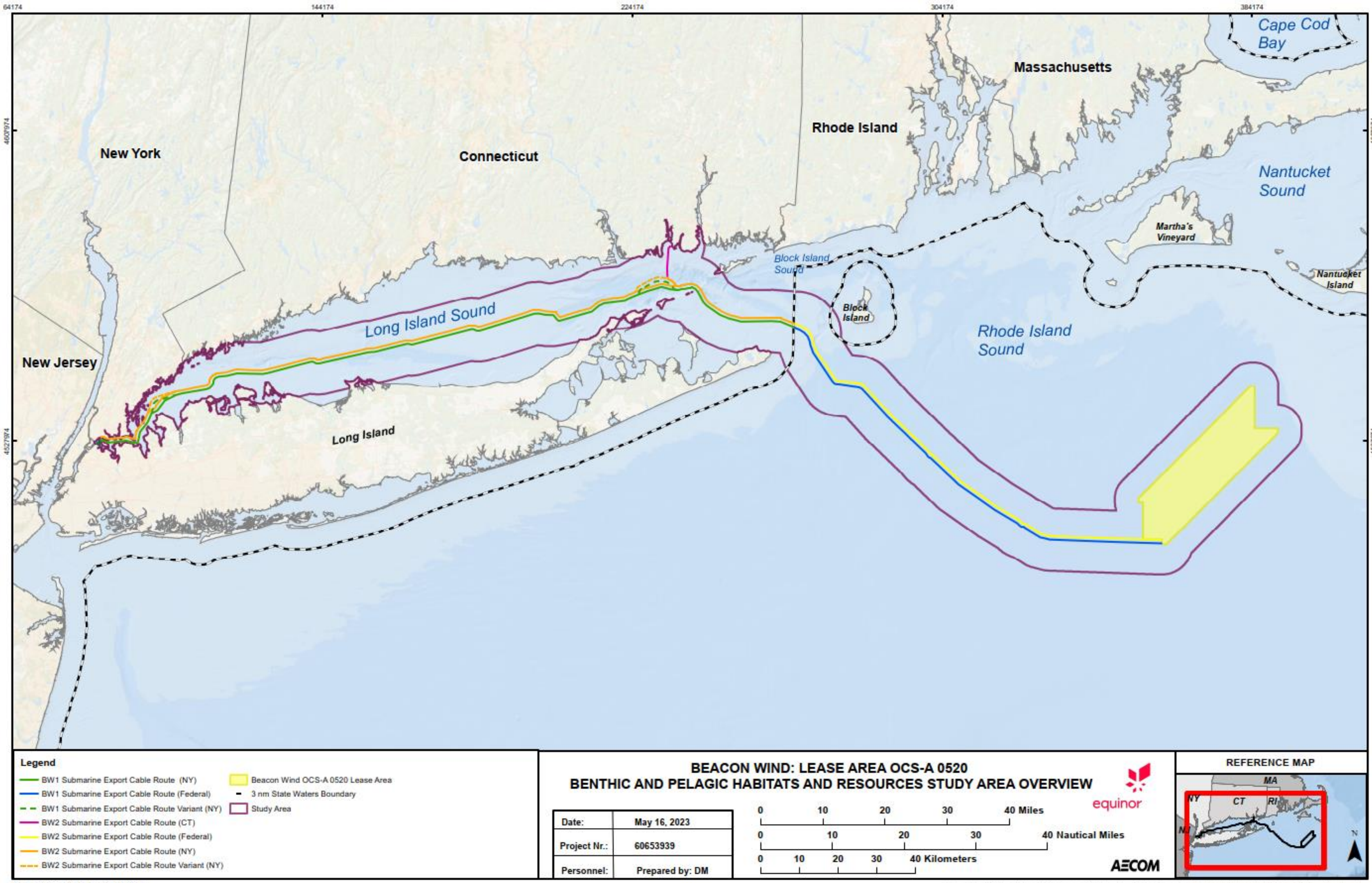
- Water Quality (**Section 4.2**);
- Commercial and Recreational Fishing (**Section 8.8**);
- Coastal Zone Consistency (**Appendix A**);
- Marine Site Investigation Report (**Appendix G**);
- Sediment Transport Analysis (**Appendix I**);
- Underwater Acoustic Assessment (**Appendix L**);
- Benthic Resources Characterization Reports and Mapbooks (**Appendix S**); and
- Essential Fish Habitat Technical Report (EFHTR) Assessment (**Appendix T**).

In the U.S., fisheries are managed within a framework of overlapping international, federal, state, interstate, and tribal authorities. Most individual states and territories have jurisdiction over fisheries in marine waters within 3 nautical miles (nm) (3.5 mi [5.6 km]) of their coasts. Federal jurisdiction includes fisheries in marine waters inside the U.S. Exclusive Economic Zone, which encompasses the area from the State boundary to 200 nm (230 mi [370 km]) from the U.S. coastline. In addition to the regional Fishery Management Councils (FMCs) created under the Magnuson-Stevens Fisheries Conservation and Management Act (MSA), an array of multi-state fishery commissions coordinates conservation and management of the common interstate nearshore fishery resources — marine finfish, shellfish, and anadromous fish — for sustainable commercial and recreational use. Together with NOAA Fisheries, the FMCs regulate commercial and recreational fishing through fishery management plans (FMPs) for one or more species. NOAA Fisheries' Highly Migratory Species Division is responsible for tunas, sharks, swordfish, and billfish in the Atlantic Ocean (NOAA Fisheries 2017a). The FMCs are required to identify EFH in each FMP. EFH is defined as the waters and seafloor necessary for spawning, breeding, or growth to maturity (16 United States Code [U.S.C.] § 1802[10]). "Fish" is defined as "finfish, mollusks, crustaceans, and all other forms of marine animals and plant life other than marine mammals and birds." The role of benthic habitat as a fisheries resource is fundamental to the identification of EFH, as reflected in the emphasis on EFH in the BOEM's benthic survey guidance. The guidance recommends that the National Marine Fisheries Service (NMFS) EFH mapper tool (NOAA Fisheries 2021a) and associated source documents be used for species identification and habitat characterization at particular locations (BOEM 2019a).

Preliminary Resource Characterization

For the purposes of this section, the Study Area includes the offshore waters and coastlines within and in the vicinity of the Lease Area and the BW1 and BW2 submarine export cable corridors (see **Figure 5.5-1**). Data for the Study Area discussed in this **Section 5.5** is from existing literature and field results from the Beacon Wind sampling program.

FIGURE 5.5-1. BENTHIC AND PELAGIC HABITATS AND RESOURCES STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

This section was prepared in accordance with the following guidelines:

- BOEM's site characterization requirements in 30 CFR § 585.626;
- BOEM's Information Guidelines for a Renewable Energy Construction and Operations Plan (COP) version 4 Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 (BOEM 2020b);
- BOEM's Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 (BOEM 2020a); and
- The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) Greater Atlantic Regional Fisheries Office's (GARFO) *Recommendations for Mapping Fish Habitat* (NOAA Fisheries 2021b).

To support the characterization of fish and invertebrate resources, Beacon Wind conducted extensive site-specific surveys, compiled data from publicly available databases (e.g., NOAA Fisheries 2021a [EFH Mapper]; Mid-Atlantic Regional Ocean Council 2021, regional surveys, and resource reports (e.g., NYSERDA 2017; Guida et al. 2017; NEFMC 2017; NOAA Fisheries 2017a; MAFMC 2019, 2017), and incorporated relevant peer-reviewed literature.

This COP submittal includes assessment of the Study Area that includes analysis of existing literature and site specific data obtained by Beacon Wind in the Lease Area and submarine export cable corridors. Beacon Wind contracted MMT and their subcontractors (Continental Shelf Associates, Inc. (CSA), Tombo Environmental, LLC, and NewFields, Inc.) to perform the surveys using the survey vessels *R/V Deep Helder*, *M/V Stril Explorer*, and *R/V Dolphin*. The survey equipment and scope included the following:

- Gridded survey lines at a spacing of approximately 98 feet (ft) by 1,640 ft (30 meters [m] by 500 m);
- Depth sounding (multibeam echosounder) to determine site bathymetry and elevations;
- Seafloor imaging (side-scan sonar survey) for seabed sediment classification purposes, to identify natural and anthropogenic acoustic targets on the seabed, as well as anomalous features;
- Sediment profile images (SPI)/plan view (PV) images; and
- Sediment grab samples and drop-down video transects (see **Table 5.5-1**, below) to support the interpretation of geophysical data to characterize surficial sediment conditions and benthic habitat, including macrofaunal analysis with samples sieved at 0.5-millimeter (mm) mesh size.

Geophysical survey data (multibeam echo sounder and side-scan sonar) were used to support the characterization of seabed conditions within the Lease Area and along the submarine export cable corridors. Sediment grab samples were analyzed for grain size distribution, total organic carbon (TOC), and benthic infauna (identified and classified according to the Coastal and Marine Ecological Classification Standard [CMECS] [FGDC 2012]) and modified CMECS (NOAA Fisheries 2021b). Digital imagery was reviewed to aid in identification of key habitat types, macroinvertebrates, and fish. Details of the survey campaigns are provided in **Appendix G Marine Site Investigation Report** and **Appendix S Benthic Resources Characterization Reports and Mapbooks**.

Beacon Wind's surveys are listed in **Table 5.5-1** with survey results summarized in **Section 5.1.1.1** of this document and full survey reports are included in **Appendix S Benthic Resources Characterization Reports and Mapbooks**.

TABLE 5.5-1. BEACON WIND'S BENTHIC SURVEY IN THE PROJECT AREA

Project Subarea	MBES a/ Percent Coverage	SSS b/ Percent Coverage	Sediment grab c/[4]	Benthic Imagery		
				Video Transect	Benthic grab camera	SPI/PV
Lease Area						
Foundation Locations	100	100	157	157	157	157
Interarray Cable locations	100	100	N/A	N/A	N/A	218
Submarine Export Cable Corridors						
Export Cable Corridors			188	188	188	375

Notes:
a/ MBES = Multibeam echosounder
b/ SSS = Side Scan Sonar
c/ Analysis of SPI/PV, Video, and Benthic Grab Camera data was performed for 157 foundation locations and 188 locations along the Submarine Export Cable Corridors. Benthic infaunal analysis was performed for a subset of 171 locations (44 priority locations in the Lease Area and 128- along the Submarine Export Cable Corridors). The remaining benthic infaunal samples have been archived.
N/A = Not Applicable

Beacon Wind performed high-resolution geophysical (HRG) and benthic surveys supplemented by the following data sources to characterize the distribution and relative abundance of fishes and invertebrates in the Project Area:

- Beam trawls and grab samples collected in 2016 by BOEM for preliminary characterization of the Lease Area (Guida et al. 2017);
- Northeast Fisheries Science Center (NEFSC) seasonal trawls and beam trawls (2003-2016);
- University of Massachusetts Dartmouth - School for Marine Science and Technology (SMAST) Video Survey Samples Collected in Wind Development Area in May 2012 and September 2013 (Stokesbury, 2012, 2014);
- Other reports and publications (e.g., NAS 2018; Walsh and Guida 2017; Hare et al. 2016; Walker et al. 2016 [scallop survey]; and others).
- Analysis of USGS sediment data, grab samples with infauna, and beam trawl surveys for regional habitat mapping of the Massachusetts Wind Energy Area (WEA) (Guida et al. 2017); and
- FMPs (Mid-Atlantic Fishery Management Council [MAFMC] 2017; New England Fishery Management Council [NEFMC] 2017; Atlantic States Marine Fisheries Commission [ASMFC] 2015, 2018a,b,c), and regional analyses of species assemblages (e.g., Walsh et al. 2015; Hare et al. 2016; Selden et al. 2018).

[4] Analyses from sediment grabs included total organic carbon (TOC), grain size, and benthic infaunal community assessment.

Beacon Wind reviewed available fisheries, fish habitat, and non-fisheries datasets, surveys, and reports to identify key species and life stages of fish and invertebrates potentially occurring in the Study Area. The commercial and recreational fishing community provided information to Beacon Wind during numerous engagement events, as detailed in **Section 8.8 Commercial and Recreational Fishing** and **Appendix B Summary of External Engagement Activities.** Data sources include federal and state fisheries agencies (NOAA Fisheries, NEFMC, MAFMC, ASMFC, NYSDEC, and others); expert reviews (Guida et al. 2017 and others); reports from commercial and recreational fishing representatives; and the NOAA Fisheries EFH Mapper tool (NOAA Fisheries 2021a) and source documents to identify fish and invertebrate species likely to occur in the Study Area.

5.5.1 Affected Environment

The affected environment, as described below, is defined as the coastal and offshore acreage in the Lease Area and the submarine export cable corridors where benthic and pelagic habitats and associated fish and invertebrates – including softbottom and hardbottom benthic habitat, pelagic habitat, plankton, benthic infauna and epifauna, managed fish, and macroinvertebrates – are known to be present, traverse, or incidentally occur and have the potential to be directly or indirectly affected by the construction, operation, and decommissioning of the Project. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Beacon Wind expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Beacon Wind will comply with in using the facilities.

The Lease Area covers approximately 128,811 acres (ac) (52,128 hectacres [ha]) and is located approximately 20 statute miles (mi) (17 nautical miles [nm], 32 kilometers [km]) south of Nantucket, Massachusetts and 60 mi (52 nm, 97 km) east of Montauk, New York in water depths ranging from 118 ft to 203 ft (36 m to 62 m). The proposed submarine export cable corridors exit the southern portion of the Lease Area, head generally northwest through Block Island Sound, and then west-southwest through Long Island Sound. Beacon Wind proposes to develop the entire Lease Area with up to two individual wind farms for BW1 and BW2, with a submarine export cable route for BW1 to Queens, New York and a submarine export cable route for BW2 to either Queens, New York or to Waterford, Connecticut. Two locations are under consideration in Queens, New York (NYPA and AGRE [which includes the AGRE East and AGRE West sites]) for the single proposed BW1 landfall and onshore substation facility. The Queens, New York onshore substation facility sites that are not used (NYPA, AGRE East, or AGRE West) for BW1 will remain under consideration, in addition to the Waterford, Connecticut site, for the single proposed BW2 onshore substation facility.

Ecologically, these geographic distinctions for areas within the Project Area from the Lease Area to further ashore, have little meaning because dominant fish species assemblages from the ecoregions are resident in or transient through the Project Area. With sea temperatures increasing, historically southern species are moving north, further blurring the ecoregion boundary (Hare et al. 2016). While field collected data specifically within the Beacon Wind Study Area are given the greatest weight in this section, recent regional reports of conditions in the New England continental shelf are considered representative of the Project Area, as appropriate.

Harvested fishes and macroinvertebrates managed under the MSA or other fisheries programs occur throughout the Project Area. Most of the managed species have designated EFH in the Project Area. Additional information on managed species and designated EFH found within the Project Area are presented in **Appendix T Essential Fish Habitat Technical Report (EFHTR)**.

This subsection consists of two parts. The first part describes baseline conditions, including typical habitats and life stages of species known or expected to occur within the Project Area:

- Benthic habitat;
- Pelagic habitat;
- Benthic-pelagic coupling;
- Demersal species and life stages; and
- Pelagic species and life stages.

The second part details the fish and macroinvertebrates in the Project Area grouped into three categories based on regulatory status, as described in Hare et al. (2016):

- Managed and exploited species;
- Ecologically important unmanaged forage species; and
- Species protected under the ESA.

5.5.1.1 Baseline Conditions

5.5.1.1.1 Benthic Habitat

5.5.1.1.1.1 Desktop Studies

Long Island Sound has been categorized as comprised of softbottom habitat consisting of silts and clays with a mixture of sand in the western and central portions and with harder substrates in the eastern portion of Long Island Sound, along the shorelines of Connecticut and Long Island, and in the East River Narrows (Knebel and Poppe 2000) **(Figure 5.5-2)**.

Sediments in the Lease Area are typical of the U.S. North Atlantic continental shelf, dominated by very fine sand and silt (MAFMC 2019). Mean grain size generally diminishes with distance from shore (MAFMC 2019). Softbottom substrate includes unconsolidated material ranging from gravel (> 2000 micrometers [µm]) to sand (62.5 to 2,000 µm), silt (4 to 62.5 µm), and clay (< 4 µm) (Williams et al. 2006), as well as empty shells and shell fragments of various sizes.

Benthic surveys conducted by SMAST in the Lease Area in 2012 and 2013 corroborate the softbottom, low rugosity, and limited habitat variability in the vicinity of the Massachusetts Wind Energy Area (MA WEA). The MA WEA is characterized as silts and sand with a high occurrence of faunal beds (NYSERDA 2017; Guida et al. 2017; Stokesbury, 2012 and 2014).

Unconsolidated sand, clay, and silt provide a matrix in which a variety of invertebrates reside, including both infaunal (living within the sediment matrix) and epifaunal (living on or in close association with the seafloor) organisms (Ward 2017). In general, assemblages of benthic invertebrate species tend to vary with depth/distance from shore, sediment type, and organic richness.

Pellegrino and Hubbard (1983) conducted a benthic survey of Connecticut waters in Long Island Sound to provide natural resource databases needed to assess the impact of energy-related environmental accidents and to properly plan for the future expansion of energy facilities and activities. The study comprised a natural resource inventory which focused on characterizing and quantifying benthic communities at 413 stations in the Connecticut state waters of Long Island Sound. Benthic samples were collected with a 2.69 ft^2 (0.25 m^2) Van Veen grab and washed on a 0.0098-in (1-mm) sieve. Pellegrino and Hubbard (1983) divided the sampling stations into ten regions to compare community structure among these regions.

General spatial trends in species richness occur in Long Island Sound and are independent of the east - west and/or depth gradient. Generally, large-scale trends reflect differences in factors that may control species richness, such as nitrogen enrichment, grain size, and contamination (Reid 1979). The proximity of the eastern end of Long Island Sound to a greater diversity of species outside Long Island Sound into Block Island Sound and physical conditions, such as salinity, may contribute to higher species richness in the eastern end of Long Island Sound (Pellegrino and Hubbard 1983). Greater habitat heterogeneity in the eastern region increases species richness, in contrast to the western portion of Long Island Sound, which tends to have lower species richness and diversity. The differences within the Sound may be attributable to decreased habitat heterogeneity, higher nutrient loading, lower oxygen levels, and long-term environmental deterioration (Zajac, et al. 2000).

Numerous benthic infauna studies have been performed throughout Long Island Sound, including assessments associated with anthropogenic areas such as the USACE Long Island Sound ocean disposal sites through the Disposal Area Monitoring System (DAMOS) long term monitoring program. DAMOS provides insight into local conditions and softbottom benthic habitat recovery following temporary disturbance. Benthic community shifts, trophic guilds, aggregated sediments and displacements, sediment plumes, grain size distribution, biodiversity, and recolonization rates suggest that infaunal organisms recolonize within months following disturbance.

Munguia et al. (2010) modeled benthic recolonization following anthropogenic disturbance in Long Island Sound. On a local scale, disturbance was interpreted as creating open space, allowing opportunistic species to recolonize. On a regional scale, disturbance may lead to reduced source populations and interference dispersal-limited species.

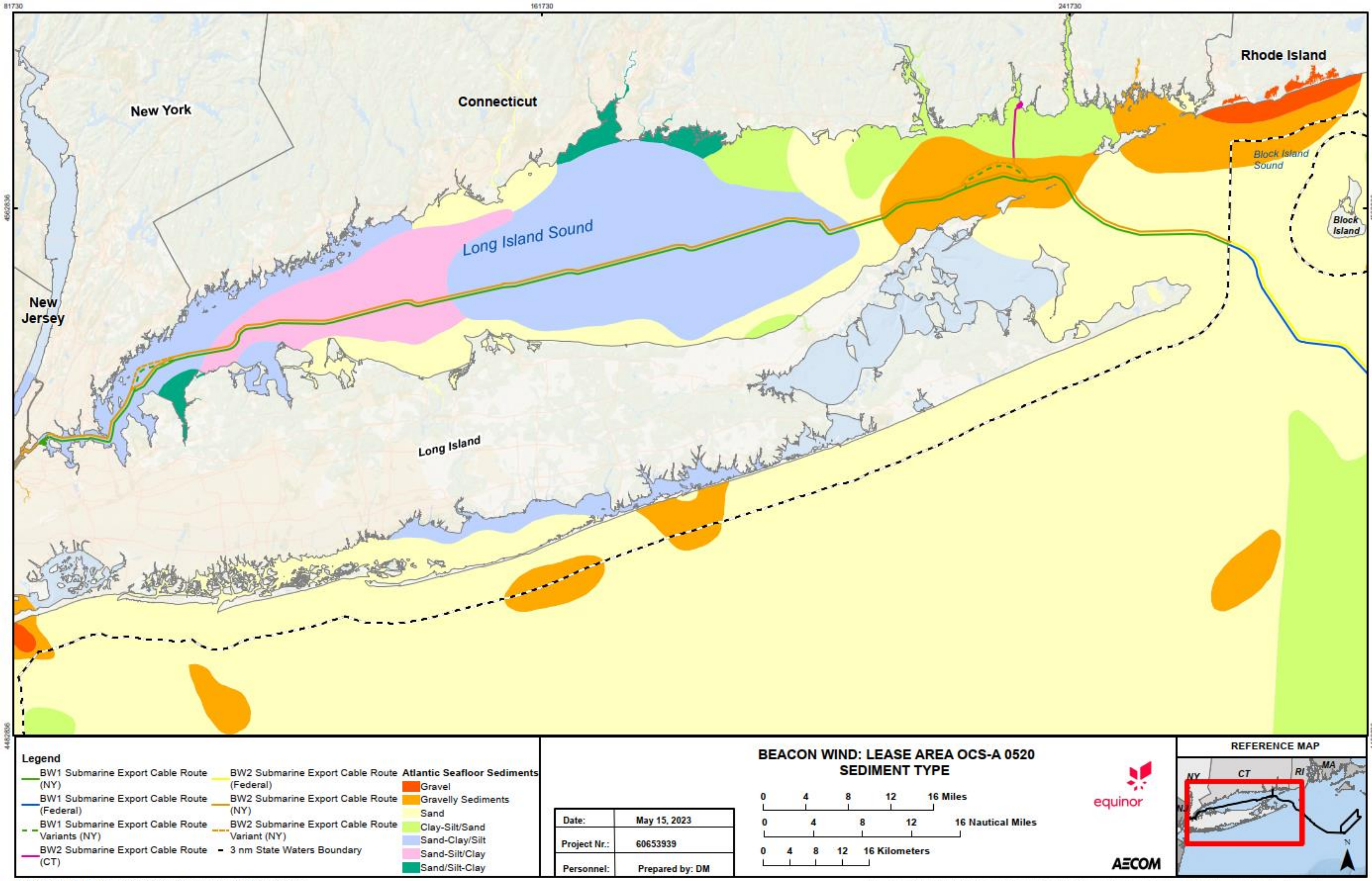
Hardbottom habitat provides exposed, sediment-free surfaces or surfaces with a fine layer of sediment that is colonized by mobile and sessile epifaunal organisms. Hardbottom habitats are characterized by having coarse material (>50 percent gravel, cobbles, boulders in a sand matrix) (NOAA Fisheries 2021b). Glacial-deposited end moraines are typically associated with hardbottom habitats (**Figure 5.5-3**). Hardbottom habitats are defined as heterogeneous and provide complex habitat for benthic communities (NOAA Fisheries 2021b). Hardbottom epifauna in New England and Mid-Atlantic regions may support cold-water corals (e.g., northern star coral [*Astrangia poculata*]), which occurs in subtidal waters. In southern New England, the non-reef-building star coral is abundant on hardbottom substrates, where it encrusts boulders and forms finger-like colonies on vertical substrates. It is usually found in areas with higher plankton-rich currents (Grace 2017; Dimond and Carrington 2007). Substantial aggregations of star coral may enhance habitat value for other benthic organisms (Guida et al. 2017). Star coral stops feeding when the surrounding water temperature drops below 40 °F (4.3 °C) and resumes active feeding when water temperature increases above that threshold (Grace 2017). In general, cold-water corals can be slow-growing though rates of recovery from disturbances vary. In some circumstances, cold-water corals can recover rapidly but recovery depends on the level of affect to the coral mucus membrane (Bent et al. 2021). The Long Island Blue Plan study has identified coral on hardbottom habitat in the eastern portion of Long Island Sound near Plum Island and smaller populations in the central portion of Long Island Sound off Port Jefferson (Stratford Shoal) (CTDEEP 2019).

Existing data for cold-water corals provides an incomplete assessment. The Stratford Shoal data were published in the Long Island Sound Cable Fund Steering Committee Seafloor Mapping report (2015). The Eastern Long Island Sound data were reported within the Long Island Sound Blue Plan with a statement that the information was not fully analyzed. The circle and square symbology as presented in the Long Island Sound Blue Plan Geographic Information System (GIS) dataset stems from a difference in sampling of "blocks" versus "stations" (**Figure 5.5-4, Figure 5.5-5, Figure 5.5-6**).

The EPA and other institutions including CTDEEP, in association with SeaGrant, funded a collaborative initiative lead by the University of Connecticut, Columbia University's Lamont Doherty Earth Observatory, and NOAA's National Center for Coastal Ocean Science for large scale habitat mapping program in Long Island Sound known as the Long Island Sound Mapping and Research Collaborative (LISMaRC). The project published the findings for its pilot study in 2015 with plans to target high-priority areas for post-pilot mapping efforts (**Figure 5.5-7**). The pilot Project area is approximately 178 mi^2 (46,200 ha) in size encompassing Connecticut and New York waters between Bridgeport, Connecticut and Setauket, New York. The high-priority areas extend over large sections of hardground habitat in Long Island Sound and are currently being studied for biodiversity. Subsequently, with additional funding from public sources, the Long Island Sound Blue Plan Habitat and Human Use mapping program has been updated through 2019. Information from this study is available online through the Long Island Sound Ecologically Significant Areas website. The Pilot Program is completed; however, data from additional priority areas other than Stratford Shoal is being analyzed to be made public based upon funding availability.

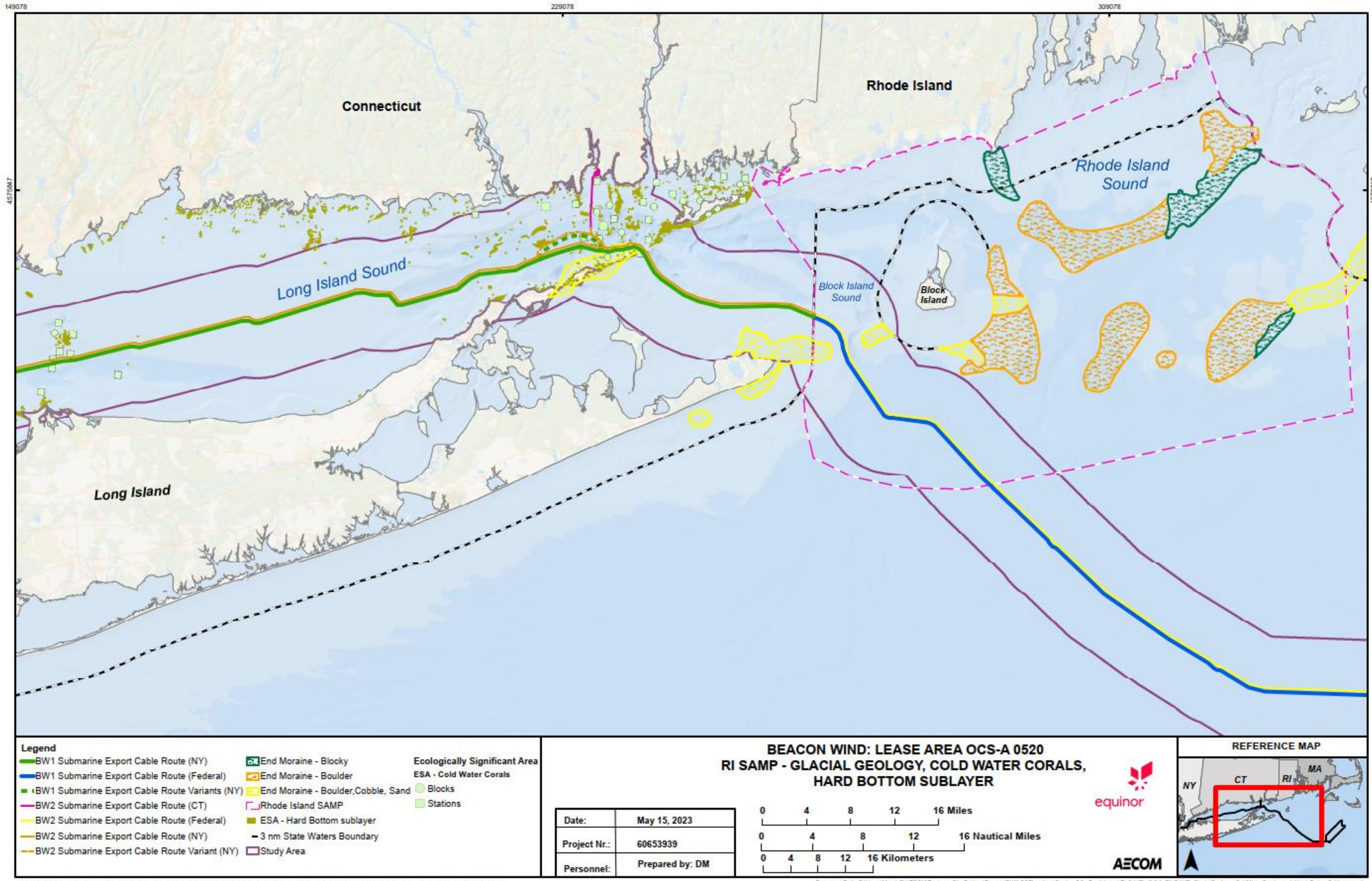
Stratford Shoal is a topographically high ridge and is included within the LISMaRC study. Stratford Shoal runs in a north-south direction across Long Island Sound, separating the western and central basins of Long Island Sound. Currents over the shoal are primarily tidally generated and run in an east-west direction, with accelerated flows occurring over the shoal (Knebel and Poppe, 2000). The Stratford Shoal crest is dominated by boulders that descend to sediment comprised of cobble, coarse sand, and shell debris. While there has not been a systematic biological monitoring program focused on Stratford Shoal, this area has been visited multiple times from 1991 to 2012 using remotely operated vehicles, camera sleds, and divers to acquire imagery of the seafloor for various projects. Dominant taxa in the community included branching sponge (*Haliclona oculate*), northern star coral, blue mussel (*Mytilus edulis*), and bryozoans occurring at high densities. The LISMaRC Pilot Project observed the hardbottom habitat communities of the Stratford Shoal dominated by the same suspension feeding, epifaunal invertebrates at densities consistent with the initial observations. The study suggested a nearly 20-year period of community stability.

FIGURE 5.5-2. LONG ISLAND SOUND SEDIMENT TYPES



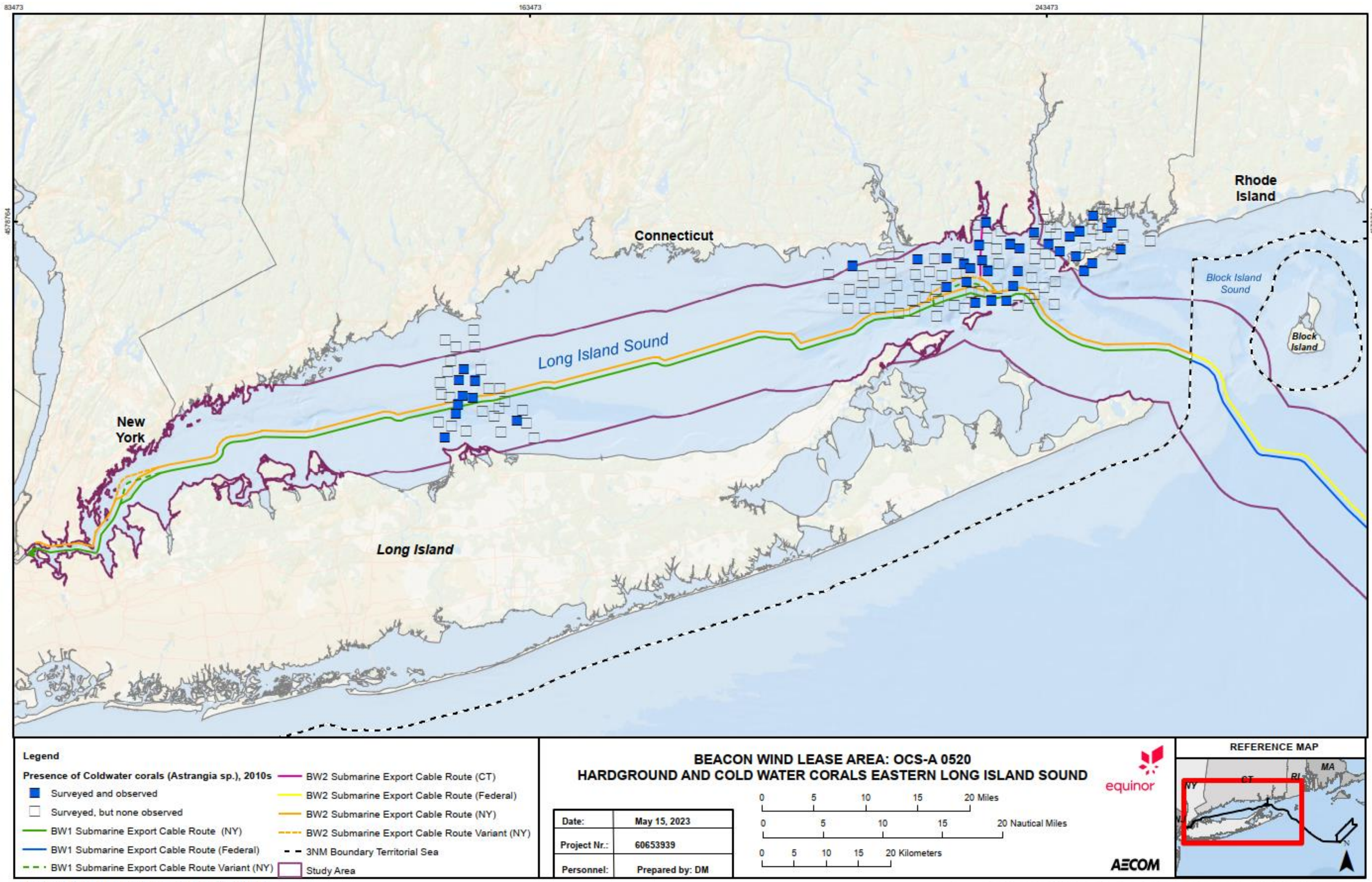
Data Sources: BOEM, ESRI, NOAA NGDC, USGS East-Coast Sediment Analysis
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

FIGURE 5.5-3. RHODE ISLAND SPECIAL AREA MANAGEMENT PLAN, GLACIAL GEOLOGY COLD-WATER CORALS AND HARDBOTTOM



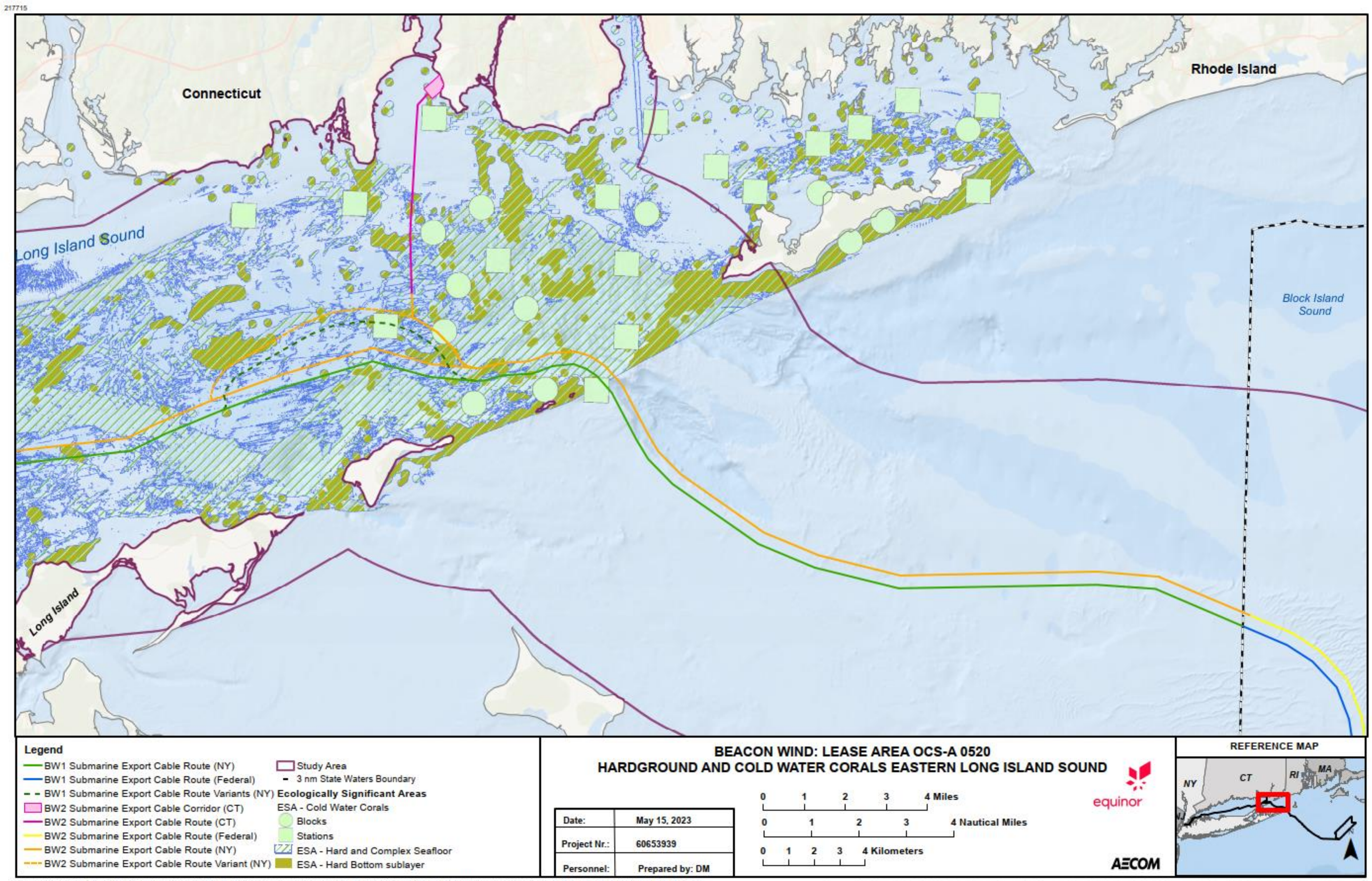
Data Sources: BOEM, ESRI, NOAA, Long Island Sound Blue Plan Significant Areas, Rhode Island Ocean Special Area Management Plan
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

FIGURE 5.5-4. AREA SURVEYED FOR COLD-WATER CORAL IN LONG ISLAND SOUND



Data Sources: BOEM, ESRI, NOAA, Ecologically Significant Areas
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

FIGURE 5.5-5. HARD GROUND AND COLD-WATER CORAL EASTERN LONG ISLAND SOUND



Data Sources: BOEM, ESRI, NOAA, Long Island Sound Blue Plan Significant Areas, Rhode Island Ocean Special Area Management Plan, CTDEEP Long Island Blue Plan Study (2019)
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

FIGURE 5.5-6. HARD AND COMPLEX ECOLOGICALLY SIGNIFICANT AREAS IN LONG ISLAND SOUND

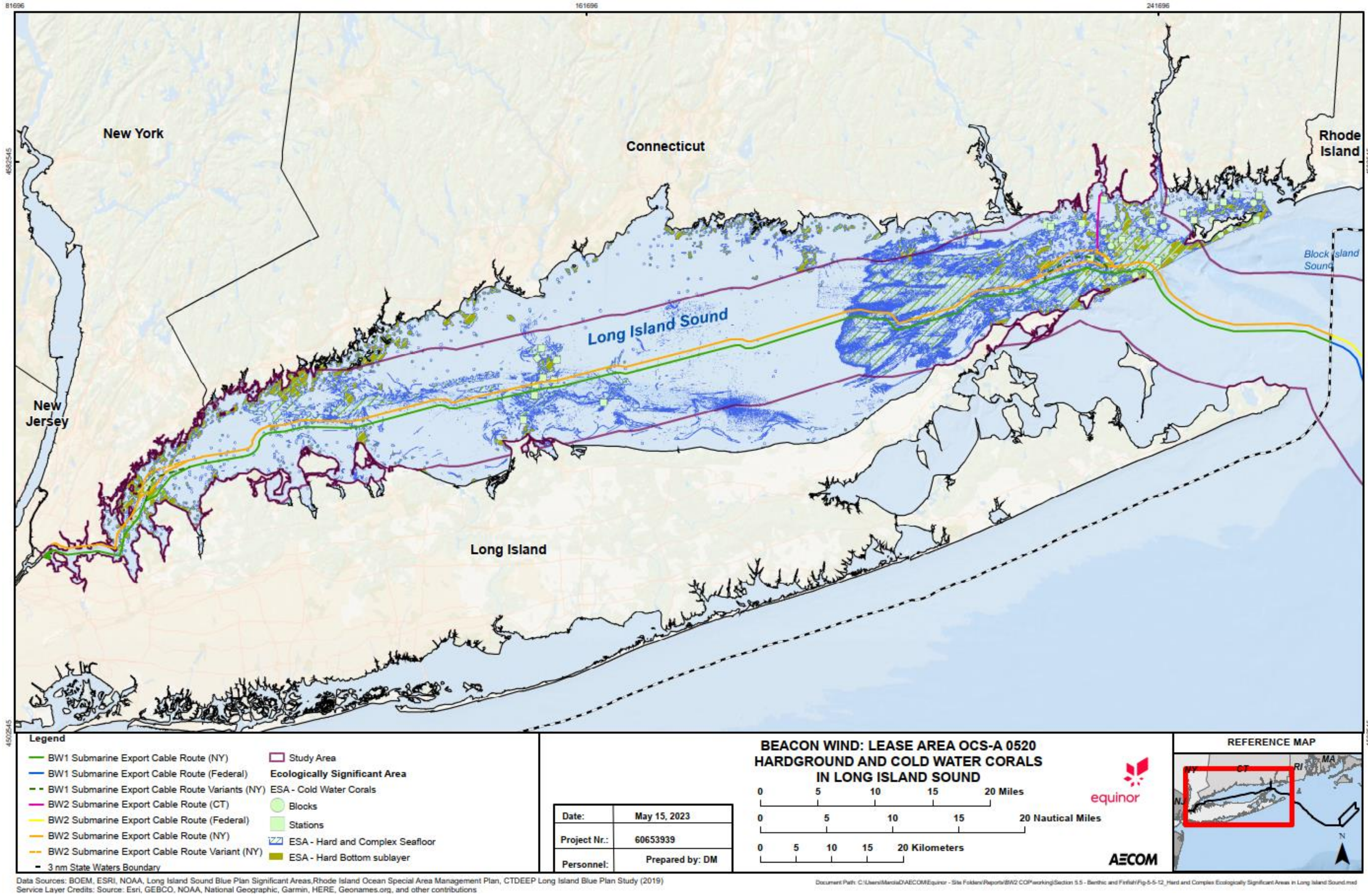
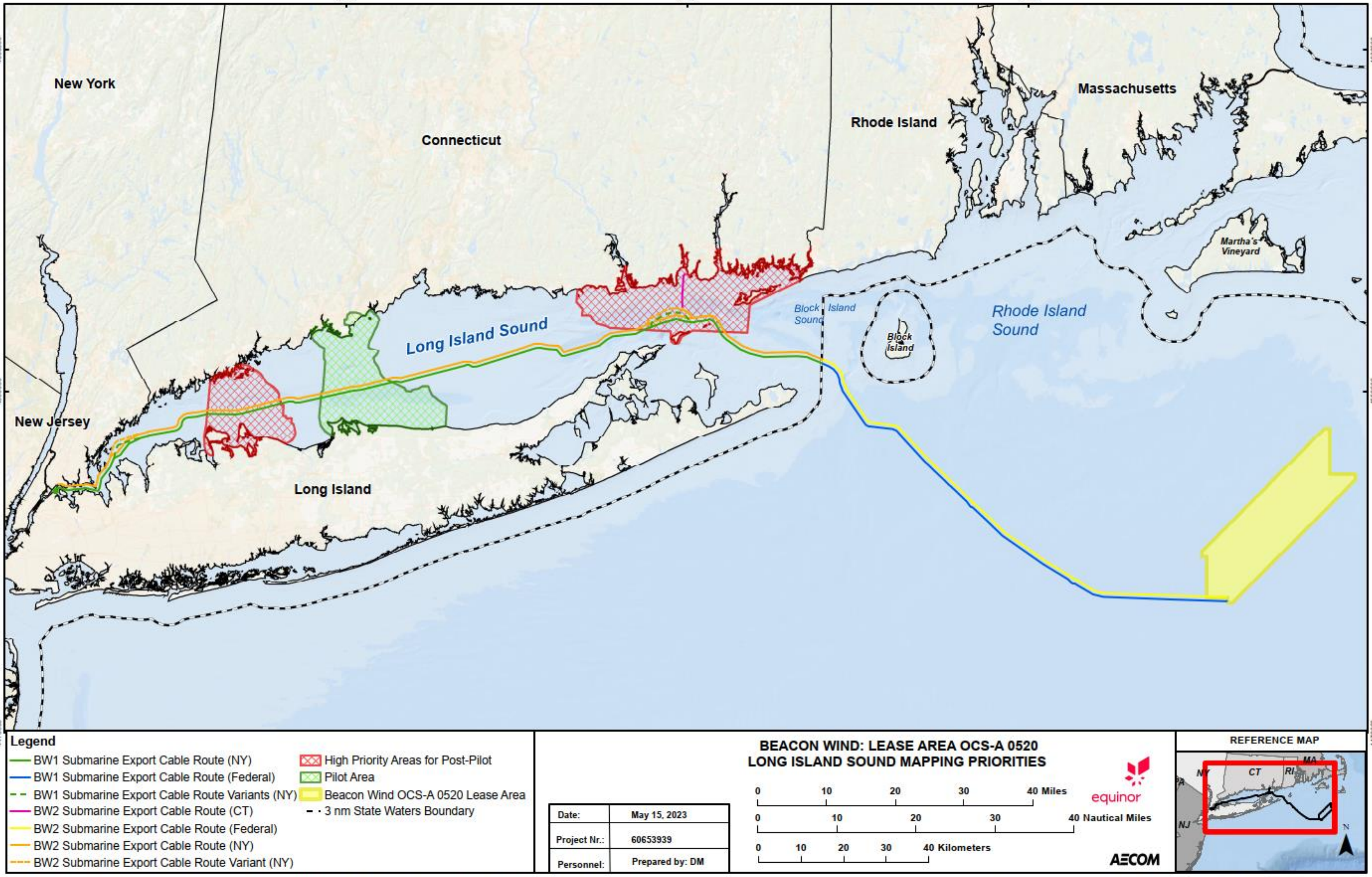


FIGURE 5.5-7. LONG ISLAND SOUND MAPPING AND RESEARCH COLLABORATIVE (LISMARC) MAPPING EFFORT

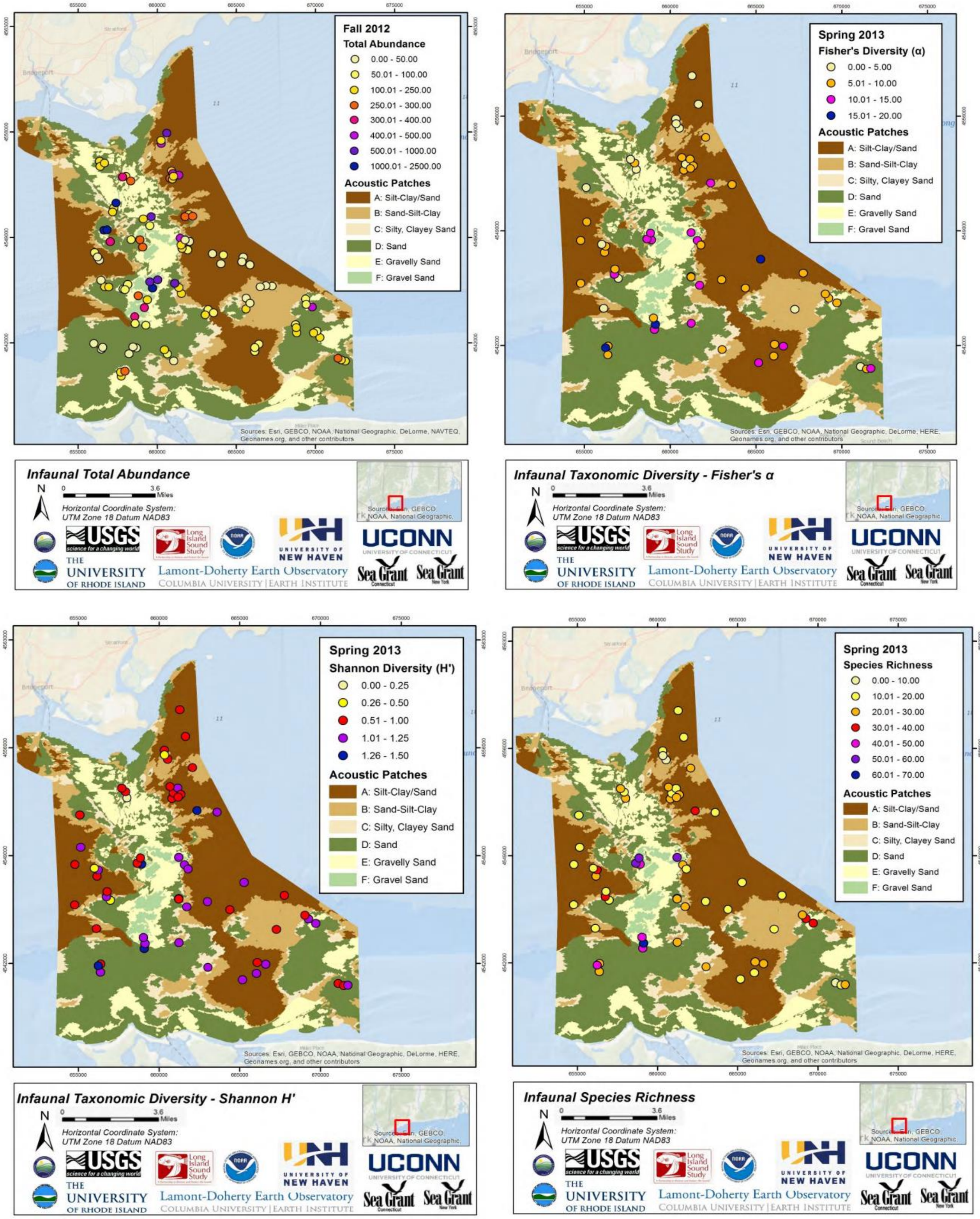


Data Sources: BOEM, ESRI, NOAA, LISMaRC Pilot Project October (2012), Long Island Sound Blue Plan Significant Areas,Rhode Island Ocean Special Area Management Plan
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

Complex seafloor habitat is morphologically rugged and is characterized by high variability in neighboring bathymetry around a central point. NOAA (2021b) defines this type of habitat as being heterogenous, meaning the seafloor habitat has differential aspects of relief. For the CTDEEP Blue Plan (2019), heterogeneity of seafloor habitat was measured by applying a Terrain Ruggedness Index (TRI) and is referred to as Complex Heterogeneous Habitat (CHH). Complex Heterogeneous Habitat (CHH) was measured by calculating TRI through the use of scientific survey tools including video multibeam, side-scan sonar, and backscatter. The TRI metric reflected the difference between the depth at each point on the seafloor and the depth of the points surrounding it. This data is derived digitally from bathymetric results. Higher TRI metrics indicated a more complex or more heterogenous seafloor. In comparison to CMECS, this data describes seafloor habitat based upon sediment grain size measurement and seafloor video results. While both CMECS and TRI provide a metric for assessing seafloor heterogeneity, they are derived using different methodologies to categorize the ruggedness or heterogeneity of seafloor habitat. Species richness and abundance was documented as being higher in sediments that had higher heterogeneity and were comprised of gravel, rock, and shell; and may be related to the three-dimensional structural aspect of this type of habitat with higher TRI values. (Pellegrino and Hubbard 1983, Battista, 2015).

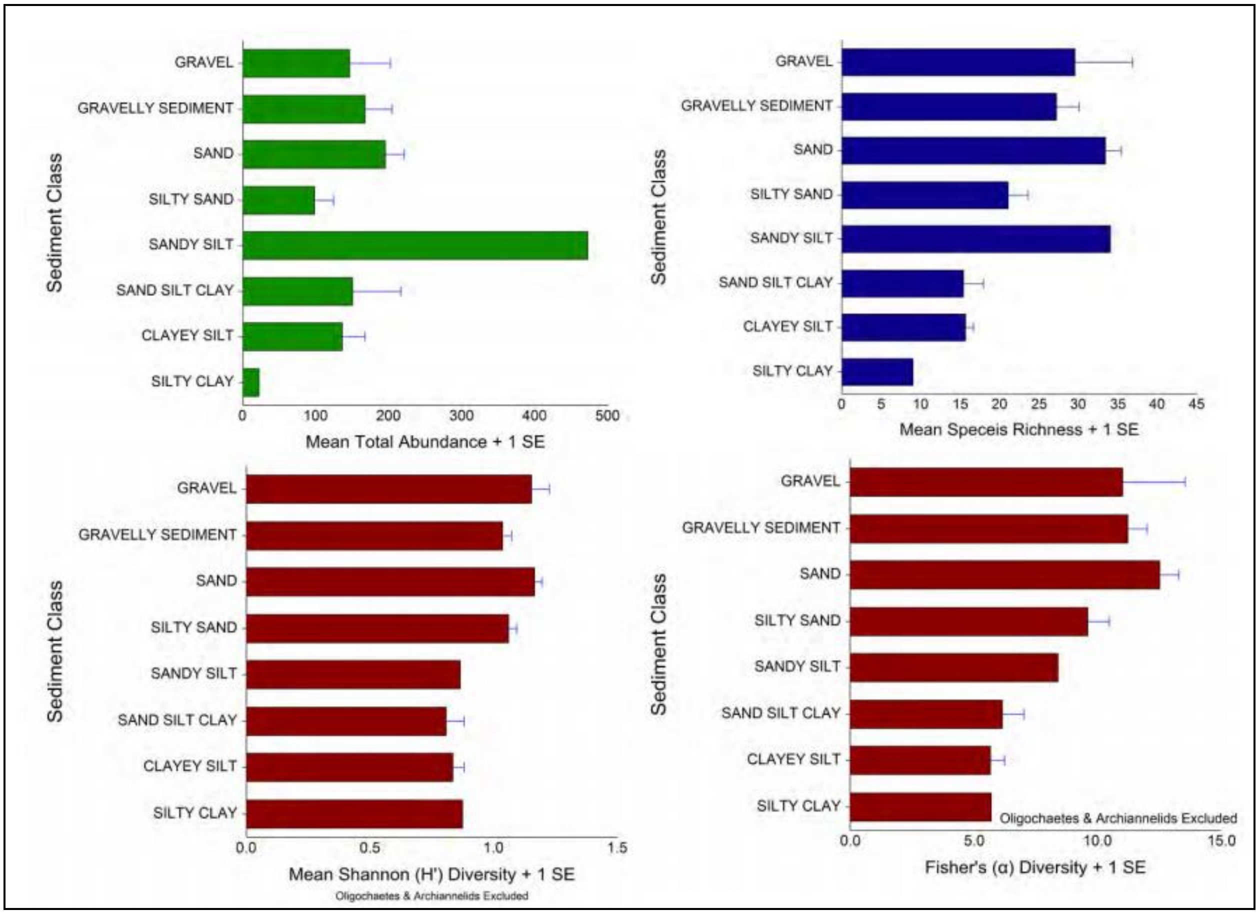
The LISMaRC Pilot Project characterized the infaunal communities across the different sea floor environments found within their study area. More specifically, the study assessed the differences among the six specific large-scale seafloor elements referred to as acoustic patch types. Acoustic patch types are identified through geophysical analyses, including side-scan sonar and backscatter data to build specific ranges of acoustics image properties, to determine the ecological variability within these patch types comprising the seafloor landscape. A total of 101 benthic infauna samples were collected during an October 2012 research cruise across Stratford Shoal. It was determined that the Shoal has areas of softer sediment (silts and clays) as well as rocky outcrops. Diversity of infauna was determined to be highest in gravel or gravelly-sand areas while abundance was highest in the areas with softer sediment (**Figure 5.5-8, Figure 5.5-9)**.

FIGURE 5.5-8. SPATIAL DISTRIBUTION OF INFAUNAL METRICS ACROSS THE STRATFORD SHOAL PILOT STUDY AREA



Source: LISMaRC Pilot Project 2015

Figure 5.5-9. Mean Total Abundance, Species Richness, Shannon Diversity and Fisher's Diversity in Sediment Classes Found in the Acoustic Patches



Source: LISMaRC Pilot Project 2015

5.5.1.1.1.2 Artificial Reefs, Wrecks, and Marine Sanctuaries

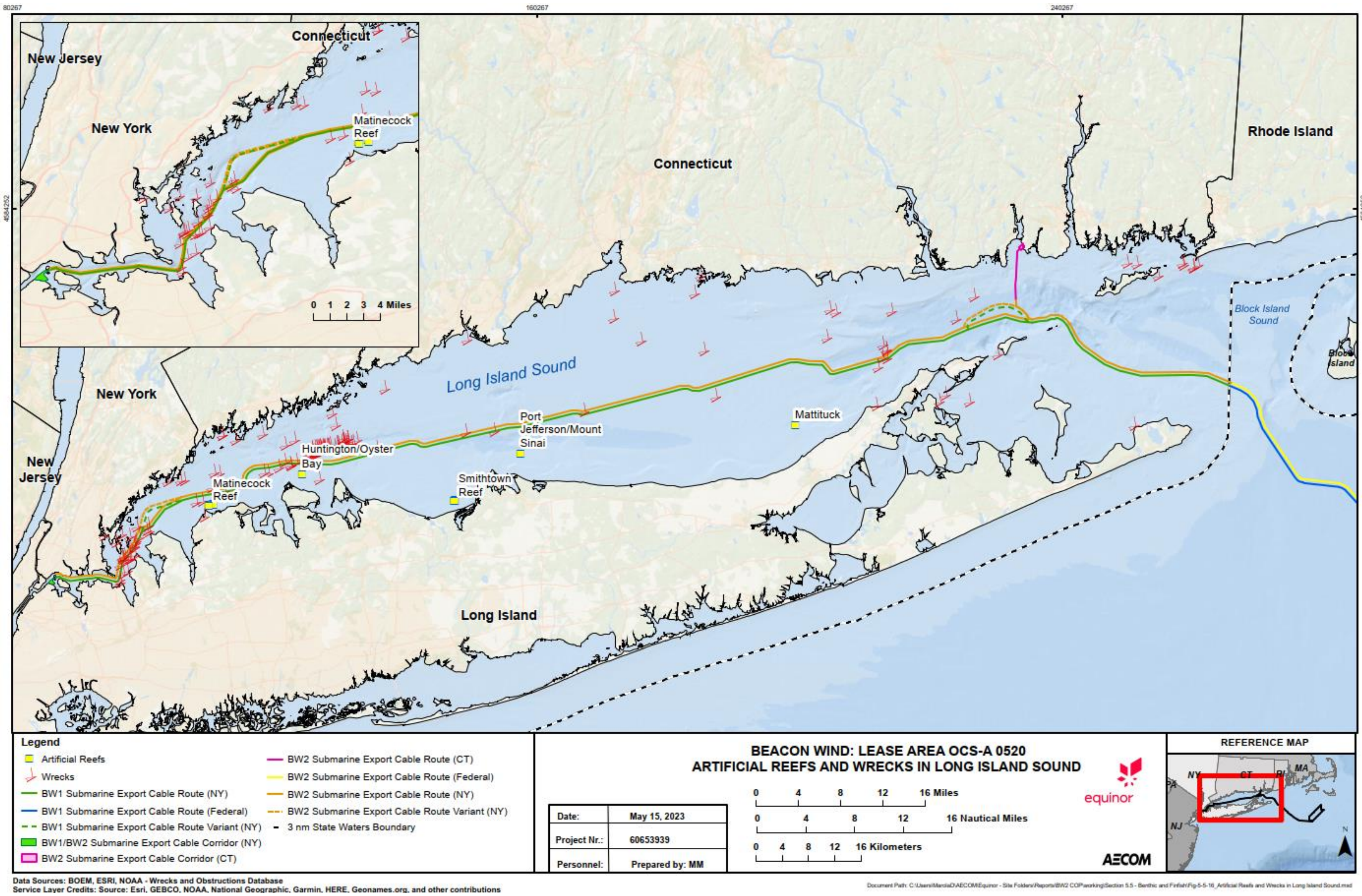
Artificial reefs are anthropogenic features that add three-dimensional complexity to the seafloor. Artificial reef systems can enhance biodiversity, provide habitat, and create recreational opportunities for fishing and diving. There are two artificial reefs in Long Island Sound – Matinecock Reef and Smithtown Reef. Matinecock Reef is approximately 0.5 nautical miles (0.9 km) north of Peacock Point and is comprised of one barge and seven pontoons for a total of 41 acres (16.6 ha) of habitat. Smithtown Reef is approximately 1.6 nm (3 km) northwest of the Stony Brook Harbor entrance and is comprised of two vessels, five barges, steel pipes, and six concrete-filled steel cylinders for a total of 3 acres (1.2 ha) of habitat (NYSDEC 2022)(**Figure 5.5-10**). Both of the artificial reefs in Long Island Sound are under the jurisdiction of NYSDEC. In addition to the two existing artificial reefs in Long Island Sound, three new artificial reef areas have been designated by USACE: Mattituck Reef, Port Jefferson/Mount Sinai Reef, and Huntington/Oyster Bay Reef. The distance from the submarine export cable corridors to each of the artificial reefs is shown in **Table 5.5-2**. NOAA's Office of Coastal Survey's Automated Wreck and Obstruction Information System (AWOIS) catalogs information on submerged wrecks and obstructions found within U.S. coastal waters. The Long Island Sound has 474 shipwrecks and 410 obstructions that have been charted, to date, however there may be uncharted shipwrecks and obstructions that have not yet been discovered. Beacon Wind has performed surveys along the submarine export siting corridor to identify potential undiscovered wrecks and obstructions (**Appendix G Marine Site Investigation Report and Appendix U Marine Archaeological Resource Assessment**). Many of these anthropogenic structures serve to add complexity to the largely homogeneous seafloor habitat within Long Island Sound by providing benthic structure and play a similar ecological role as artificial reefs (**Table 5.5-2**). All known and newly discovered wrecks along the submarine export cable corridors will be mapped and will be avoided to the extent practical when siting the cables.

TABLE 5.5-2. ARTIFICIAL REEF DISTANCES FROM THE SUBMARINE EXPORT CABLE CORRIDORS

Reef Name	Minimum Distance From the BW1 Submarine Export Cable Corridors
Matinecock Reef	0.81 nm (1.51 km)
Smithtown Reef	4.80 nm (8.90 km)
Huntington/Oyster Bay	0.905 nm (1.677 km)
Port Jefferson/Mount Sinai	2.181 nm (4.039 km)
Mattituck	5.084 nm (9.417 km)

There are no marine sanctuaries located within the Study Area. The closest marine sanctuary to the Project is the Stellwagen Bank National Marine Sanctuary which is located north of Cape Cod.

FIGURE 5.5-10. ARTIFICIAL REEFS IN LONG ISLAND SOUND



5.5.1.1.2 Site-Specific Surveys

5.5.1.1.2.1 Lease Area

Beacon Wind conducted benthic surveys including video, grab sampling, and SPI/PV in Summer 2021 at 157 foundation locations in the Lease Area. An additional 218 stations along the interarray cable were sampled using SPI/PV (**Figure 5.5-11** and **Figure 5.5-12**), as shown in **Table 5.5-1**. At each of the 157 foundation locations, and 218 interarray cable stations SPI/PV imagery was reviewed in real time to identify sensitive, rare, or unexpected species (including nonindigenous species) and to note any hardbottom habitat (gravel pavements, cobbles, boulders, exposed bedrock, etc.) requiring additional imagery. Results are summarized below; the full report is in **Appendix S Benthic Resources Characterization Reports and Mapbooks**. Hardbottom habitat was not encountered in the Lease Area.

Results of Beacon Wind's extensive surveys of the Lease Area using multibeam echo sounder, digital imagery, grab samples, and SPI/PV were used to characterize the habitat as predominantly homogeneous consisting of silty sand with high occurrence of faunal beds and mobile crustaceans. The geophysical and geotechnical surveys confirmed that the Lease Area is predominantly flat with low rugosity and slope (**Appendix S Benthic Resources Characterization Reports and Mapbooks; Appendix G Marine Site Investigation Report**). Beacon Wind's geophysical surveys validated that the geophysical characterization of the Lease Area was relatively flat, unconsolidated softbottom dominated by silt and sand, with small areas of sandy mud (**Appendix S Benthic Resources Characterization Reports and Mapbooks; Appendix G Marine Site Investigation Report**). The interpretation of benthic substrate indicated by backscatter was well-correlated with SPI/PV results. Grain size distribution was analyzed in sediment grab samples to ground-truth the SPI/PV results; benthic infauna was also sampled (see **Table 5.5-1**). The full benthic habitat characterization reports of the Lease Area and submarine export cable routes surveys are in **Appendix S Benthic Resources Characterization Reports and Mapbooks** with geophysical data results presented in **Appendix G Marine Site Investigation Report**.

Environmental data acquisition for the site-specific Lease Area Benthic Report included the use of benthic video, sediment sampling, and photography to gather data on existing habitats and species present on the seabed. The survey was performed using a high-definition (HD) drop camera system, a SPI/PV system, a Smith-McIntyre grab sampler for collecting benthic sediment, and an HD benthic video camera mounted on the grab sampler, deployed from the survey motor vessel *Deep Helder*.

The SPI/PV and videographic data displayed a seabed characterized by soft bottom substrate composed primarily of finer grain sizes. No hardbottom substrates, sensitive seafloor communities, or species of concern were identified (with species of concern being informally defined as a species that NOAA Fisheries has determined to be at risk of decline but insufficient information is available to list the species as endangered [Cain 2004]). The collective benthic video and SPI/PV imagery showed a biological assemblage with numerous burrows, bioturbation, polychaete/amphipod tubes, and macrobenthos.

The results from the grain size analysis indicated that the foundation sites mainly consisted of finer grained particles that included very fine sand (0.125 to 0.0625 mm) and silt (0.0625 to 0.0039 mm) based on the Wentworth grain size classification. Average sediment TOC concentrations ranged from 0.064 to 1.200 percent and are considered typical for the survey area.

Upon review of the MBES and SSS data results obtained at the 157 foundation locations, 44 priority foundation location stations were identified to assess the faunal assemblage in the Lease Area. This data was reviewed prior to field sampling to determine patterns of sediment type and areas where homogeneous and heterogenous habitat may be present. These priority stations were selected to provide an extensive array of samples throughout the Lease Area that represented potentially differing sediment and biological habitats. From these priority stations, a total of 20,895 individuals and 156 total infauna taxa from nine phyla were observed: Annelida, Arthropoda, Chordata, Cnidaria, Echinodermata, Mollusca, Nemertea, Platyhelminthes, and Sipuncula. Diversity indices did not vary greatly across samples (see **Appendix S Benthic Resources Characterization Reports and Mapbooks** for detail).

The similarity profile routine (SIMPROF) tests produced 16 groups of stations that were similar with respect to species composition and relative abundance. Approximately 80 percent of the priority stations had similar TOC content and grain size. Some spatial patterns were observed, but the range of variation in environmental factors (including water depth) across the stations was not great enough to cause appreciable change in the infauna assemblage (i.e., the types and densities of organisms found were similar across the Lease Area).

The videographic data displayed a seabed characterized by softbottom substrate composed primarily of finer grain sizes. No potential areas or species of concern were identified. The benthic video showed a relatively productive biological assemblage with numerous burrows, bioturbation, polychaete/ amphipod tubes, and macrobenthos.

Three CMECS Components (Geoform, Biotic, and Substrate) were used to classify benthic habitats in the Lease Area. The Lease Area was classified into two Geoform Level 2 classifications (Geologic-Flat or Biogenic-Burrows/Bioturbation) (**Table 5.5-3 and Figure 5.5-14**). One Biotic subclass (Soft Sediment Fauna) and six biotic groups where applicable (Small Tube Building Fauna, Small Surface-Burrowing, Clam Bed, Sand Dollar, *Leptocheirus* and Starfish Bed) were identified (**Table 5.5-4** and **Figure 5.5-13**). The majority of the Lease Area stations were classified into the Muddy Sand modified NMFS classification (**Table 5.5-5** and **Figure 5.5-15**). Two stations contain greater than 5 percent gravel (WTG-018 [6.8%] and WTG-139 [5.3%]); therefore, they are considered complex habitat in accordance with definitions in NOAA Fisheries (2021b). SPI and PV images along with the video transect footage did not show a transition in habitat associated with the presence of gravel noted at these two locations (**Figure 5.5-16**) (**Appendix S, Benthic Resources Characterization Reports and Mapbooks**).

TABLE 5.5-3. CMECS GEOFORM CHARACTERIZATION FOR LEASE AREA SAMPLING STATIONS

Tectonic Setting	Physiographic Setting	Geoform Level 2	Geoform	Stations a/
Passive Continental Margin	Continental Shelf	Geologic	Flat	WTG-001, WTG-002, WTG-004, WTG-007, WTG-009, WTG-010, WTG-012, WTG-016, WTG-017, WTG-018, WTG-019, WTG-020, WTG-022, WTG-023, WTG-026, WTG-033, WTG-034, WTG-035, WTG-036, WTG-037, WTG-039, WTG-040, WTG-041, WTG-042, WTG-043, WTG-044, WTG-051, WTG-052, WTG-053, WTG-054, WTG-056, WTG-058, WTG-059, WTG-061, WTG-064, WTG-065, WTG-067, WTG-068, WTG-069, WTG-070, WTG-072, WTG-073, WTG-074, WTG-075, WTG-076, WTG-077, WTG-078, WTG-080, WTG-081, WTG-082, WTG-083, WTG-084, WTG-085, WTG-086, WTG-088, WTG-089, WTG-090, WTG-091, WTG-092, WTG-093, WTG-095, WTG-096, WTG-097, WTG-098, WTG-101, WTG-102, WTG-103, WTG-105, WTG-108, WTG-109, WTG-112, WTG-119, WTG-120, WTG-121, WTG-123, WTG-124, WTG-126, WTG-128, WTG-129, WTG-130, WTG-133, WTG-134, WTG-135, WTG-136, WTG-137, WTG-138, WTG-140, WTG-141, WTG-142, WTG-143, WTG-144, WTG-145, WTG-146, WTG-149, WTG-150, WTG-151, WTG-152, WTG-153, WTG-154, WTG-155, WTG-156, WTG-157.
Passive Continental Margin	Continental Shelf	Biogenic	Burrows/ Bioturbation	WTG-003, WTG-005, WTG-006, WTG-008, WTG-011, WTG-013, WTG-014, WTG-015, WTG-021, WTG-024, WTG-025, WTG-027, WTG-028, WTG-029, WTG-030, WTG-031, WTG-032, WTG-038, WTG-045, WTG-046, WTG-047, WTG-048, WTG-049, WTG-050, WTG-055, WTG-057, WTG-060, WTG-062, WTG-063, WTG-066, WTG-071, WTG-079, WTG-087, WTG-094, WTG-099, WTG-100, WTG-104, WTG-106, WTG-110, WTG-111, WTG-113, WTG-114, WTG-115, WTG-116, WTG-117, WTG-118, WTG-122, WTG-125, WTG-127, WTG-131, WTG-132, WTG-139, WTG-147, WTG-148.

Note:
a/ “WTG-000” is a survey naming convention for the 157 foundation locations (two of which will be offshore substation facilities).

TABLE 5.5-4. CMECS BIOTIC CHARACTERIZATION FOR LEASE AREA SAMPLING STATIONS

Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Stations a/
Benthic/ Attached Biota	Faunal Bed	Soft Sediment Fauna	Small Tube Building Fauna	--	WTG-008, WTG-009, WTG-010, WTG-011, WTG-012, WTG-013, WTG-014, WTG-015, WTG-016, WTG-017, WTG-018, WTG-019, WTG-020, WTG-022, WTG-023, WTG-024, WTG-025, WTG-026, WTG-028, WTG-029, WTG-031, WTG-032, WTG-033, WTG-034, WTG-035, WTG-037, WTG-038, WTG-039, WTG-041, WTG-042, WTG-043, WTG-044, WTG-045, WTG-046, WTG-047, WTG-048, WTG-050, WTG-051, WTG-052, WTG-054, WTG-055, WTG-056, WTG-057, WTG-058, WTG-059, WTG-060, WTG-061, WTG-062, WTG-063, WTG-064, WTG-065, WTG-069, WTG-070, WTG-071, WTG-072, WTG-073, WTG-074, WTG-075, WTG-076, WTG-078, WTG-079, WTG-080, WTG-082, WTG-083, WTG-084, WTG-085, WTG-086, WTG-087, WTG-088, WTG-089, WTG-090, WTG-091, WTG-092, WTG-093, WTG-094, WTG-095, WTG-096, WTG-097, WTG-099, WTG-100, WTG-103, WTG-104, WTG-107, WTG-108, WTG-109, WTG-110, WTG-111, WTG-113, WTG-114, WTG-115, WTG-116, WTG-119, WTG-120, WTG-121, WTG-122, WTG-123, WTG-124, WTG-129, WTG-130, WTG-131, WTG-132, WTG-133, WTG-134, WTG-135, WTG-136, WTG-138, WTG-144, WTG-145
				Thin Ampelisca Bed	WTG-021, WTG-053, WTG-066, WTG-081, WTG-098, WTG-128, WTG-137
			Clam Beds	Nucula Bed	WTG-003, WTG-027, WTG-040
			Sand Dollar Bed	--	WTG-001, WTG-002, WTG-004, WTG-005, WTG-006, TG-007
			Starfish Bed	Asterias Bed	WWTG-126, WTG-139, WTG-141, WTG-142, WTG-146, TG-147, WTG-149, WTG-153, WTG-155, WTG-157
				Astropecten Bed	WTG-150, WTG-151, WTG-152, WTG-154, WTG-156
			--	--	WTG-030, WTG-036, WTG-049, WTG-067, WTG-068, WTG-077, WTG-101, WTG-102, WTG-105, WTG-106, WTG-112, WTG-117, WTG-118, WTG-125, WTG-127, WTG-140, WTG-143, WTG-148

Note: a/ “WTG-000” is a survey naming convention for the 157 foundation locations (two of which will be offshore substation facilities).

TABLE 5.5-5. MODIFIED CMECS SUBSTRATE CLASSIFICATIONS FOR THE LEASE AREA SAMPLING STATIONS

Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Stations a/
Modified Coastal and Marine Ecological Classification Standard (NOAA, 2021b)					
Geologic Substrate	Unconsolidated Mineral Substrate	Fine Unconsolidated Substrate	Gravelly	Gravelly Muddy Sand	WTG-018, WTG-139
			Muddy Sand		WTG-001, WTG-002, WTG-003, WTG-004, WTG-006, WTG-009, WTG-009-QC, WTG-011, WTG-012, WTG-015, WTG-017, WTG-020, WTG-021, WTG-023, WTG-025, WTG-026, WTG-027, WTG-028, WTG-029, WTG-030, WTG-031, WTG-032, WTG-033, WTG-034, WTG-035, WTG-036, WTG-037, WTG-038, WTG-039, WTG-040, WTG-040-QC, WTG-041, WTG-042, WTG-043, WTG-044, WTG-045, WTG-046, WTG-047, WTG-048, WTG-049, WTG-050, WTG-050-QC, WTG-051, WTG-052, WTG-053, WTG-054, WTG-055, WTG-056, WTG-057, WTG-058, WTG-059, WTG-060, WTG-060-QC, WTG-061, WTG-062, WTG-063, WTG-064, WTG-065, WTG-066, WTG-067, WTG-069, WTG-070, WTG-070-QC, WTG-071, WTG-072, WTG-073, WTG-074, WTG-075, WTG-076, WTG-078, WTG-079, WTG-080, WTG-080-QC, WTG-081, WTG-082, WTG-083, WTG-084, WTG-085, WTG-086, WTG-087, WTG-088, WTG-089, WTG-090, WTG-090-QC, WTG-091, WTG-092, WTG-093, WTG-094, WTG-095, WTG-096, WTG-097, WTG-098, WTG-099, WTG-100, WTG-100-QC, WTG-101, WTG-102, WTG-103, WTG-104, WTG-106, WTG-107, WTG-108, WTG-109, WTG-110, WTG-110-QC, WTG-111, WTG-112, WTG-113, WTG-114, WTG-115, WTG-116, WTG-117, WTG-118, WTG-119, WTG-120, WTG-120-QC, WTG-121, WTG-122, WTG-123, WTG-124, WTG-125, WTG-127, WTG-128, WTG-129, WTG-130, WTG-130-QC, WTG-131, WTG-132, WTG-133, WTG-134, WTG-135, WTG-136, WTG-137, WTG-138, WTG-140, WTG-140-QC,WTG-141, WTG-142, WTG-143, WTG-144, WTG-145, WTG-146, WTG-147, WTG-148, WTG-149, WTG-150, WTG-150-QC, WTG-152, WTG-154, WTG-155, WTG-156
				Very Coarse/ Coarse Sand	WTG-077

Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Stations a/
			Sand	Medium Sand	WTG-068
				Fine/Very Fine Sand	WTG-005, WTG-007, WTG-008, WTG-010, WTG-010-QC, WTG-013, WTG-014, WTG-016, WTG-019, WTG-020-QC, WTG-022, WTG-024
			Sandy Mud		WTG-105, WTG-126, WTG-151, WTG-153, WTG-157, WTG-157-QC

Note:
a/ "WTG-000" is a survey naming convention for the 157 foundation locations (two of which will be offshore substation facilities).

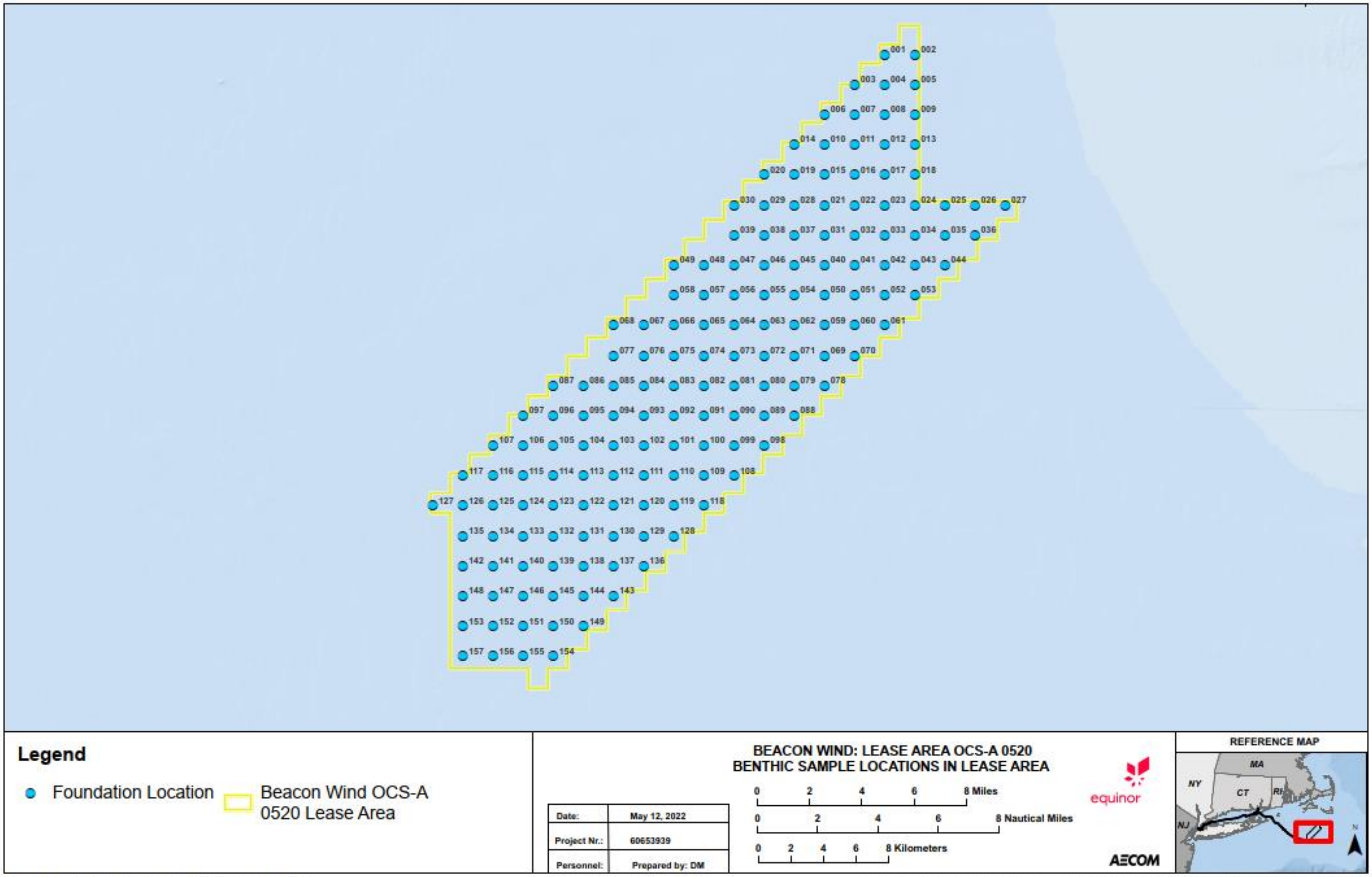
TABLE 5.5-6. SUMMARY OF DATA FOR THE LEASE AREA SAMPLING STATIONS

Lease Area Location	Number of Taxa	Dominant Taxa	Dominant Species	Notes/Successional Stage a/	Grain Size b/
WTG-011, WTG-025, WTG-033, WTG-034, WTG-040, WTG-048, WTG-049, WTG-053, WTG-066, WTG-078, WTG-081, WTG-090, WTG-098, WTG-122, WTG-134, WTG-137, WTG-150	48, 50, 38, 44, 43, 43, 42, 42, 52, 39, 47, 37, 45, 36, 42, 39, 36	Arthropoda (49%) (53%) (65%) (55%) (38%) (54%) (51%) (61%) (49%) (59%) (41%) (57%) (44%) (44%) (46%) (62%) (50%)	*Ampelisca vadorum,*	I over III	Slightly Gravelly Muddy Sand
WTG-128	43	Arthropoda (65%)	*Ericthonius brasiliensis*	I over III	Slightly Gravelly Muddy Sand
WTG-097	43	Annelida (68%)	*Naididae* (LPIL c/)	I over III	Slightly Gravelly Muddy Sand
WTG-008	48	Arthropoda (48%)	*Ampelisca vadorum*	I over III	Slightly Gravelly Sand
WTG-021,	52	Arthropoda (66%)	*Ampelisca vadorum*	I over III	Silty Sand
WTG-020	41	Arthropoda (58%)	*Ampelisca vadorum*	I over III	Fine Sand
WTG-002	20	Echinodermata (73%)	*Clypeaster* (LPIL)	I over III	Silty Sand
WTG-003, WTG-027	38, 38	Mollusca (54%), (78%)	*Nucula proxima*	I over III	Slightly Gravelly Muddy Sand
WTG-047, WTG-054, WTG-074, WTG-076, WTG-083, WTG-084, WTG-085, WTG-087, WTG-101, WTG-107,	32, 30, 22, 51, 53, 47, 51, 48, 40, 30,	Arthropoda (46%) (49%) (38%) (49%) (39%) (45%) (58%) (53%) (53%) (42%)	*Ampelisca vadorum*	I over III	Slightly Gravelly Muddy Sand
WTG-067	41	Annelida (88%)	*Polygordius* (LPIL)	I over III	Slightly Gravelly Muddy Sand
WTG-058, WTG-095, WTG-104, WTG-123	30, 40, 30, 9	Annelida (51%) (56%) (55%), (63%)	*Levinsenia gracilis*	I over III	Slightly Gravelly Muddy Sand
WTG-005	34	Mollusca (60%)	*Nucula proxima,*	I over III	Slightly Gravelly Sand
WTG-157, WTG-077	40, 28	Annelida (87%) (91%)	*Galathowenia oculata*	I over III	Slightly Gravelly Sandy Mud, Slightly Gravelly Sand
WTG-068	24	Annelida (71%)	*Goniada maculata*	I over III	Medium/Coarse Sand

Lease Area Location	Number of Taxa	Dominant Taxa	Dominant Species	Notes/Successional Stage a/	Grain Size b/

Notes:
a/ Based on SPI Results **Appendix S Benthic Resources Characterization Reports and Mapbooks, Attachment D**
b/ Based upon CMECS Substrate Subgroup
c/ LPIL = lowest practicable identification level

FIGURE 5.5-11. FOUNDATION SPI/PV AND BENTHIC GRAB SAMPLE LOCATIONS



Data Sources: BOEM, ESRI, Gardline Habitat Characterization Report (2019), NOAA.
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

FIGURE 5.5-12. INTERARRAY CABLE SPI/PV SAMPLE LOCATIONS

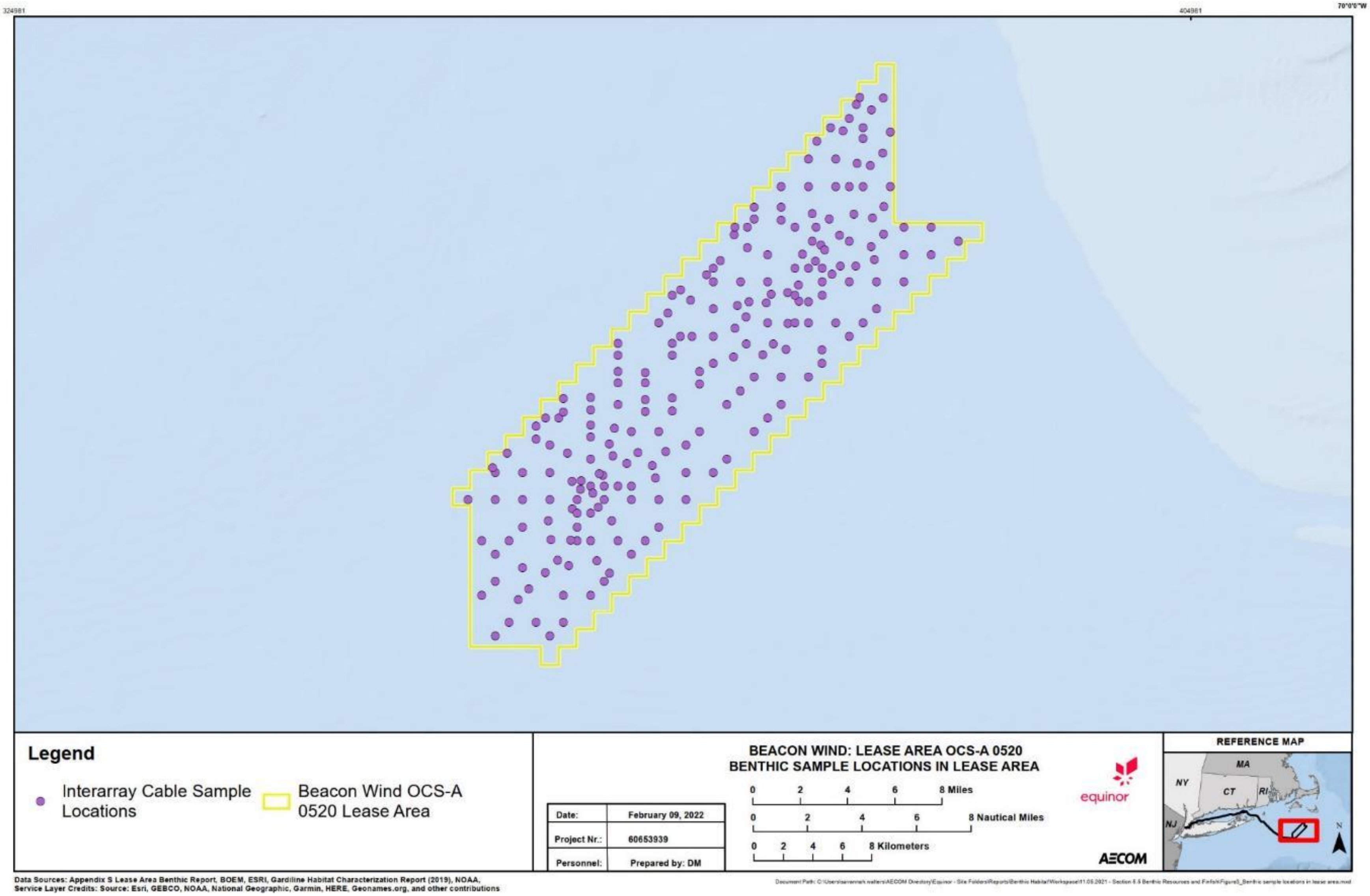
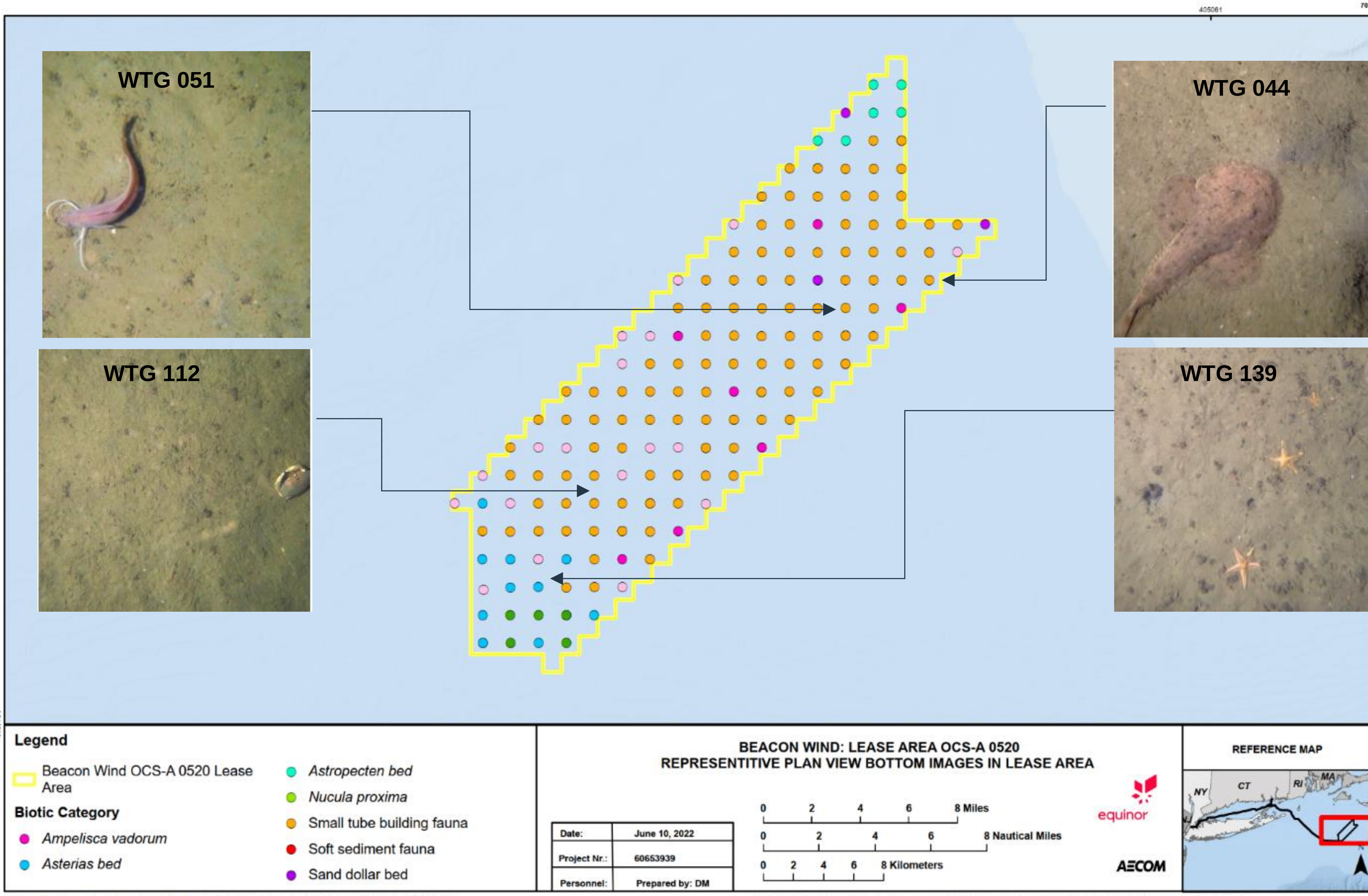
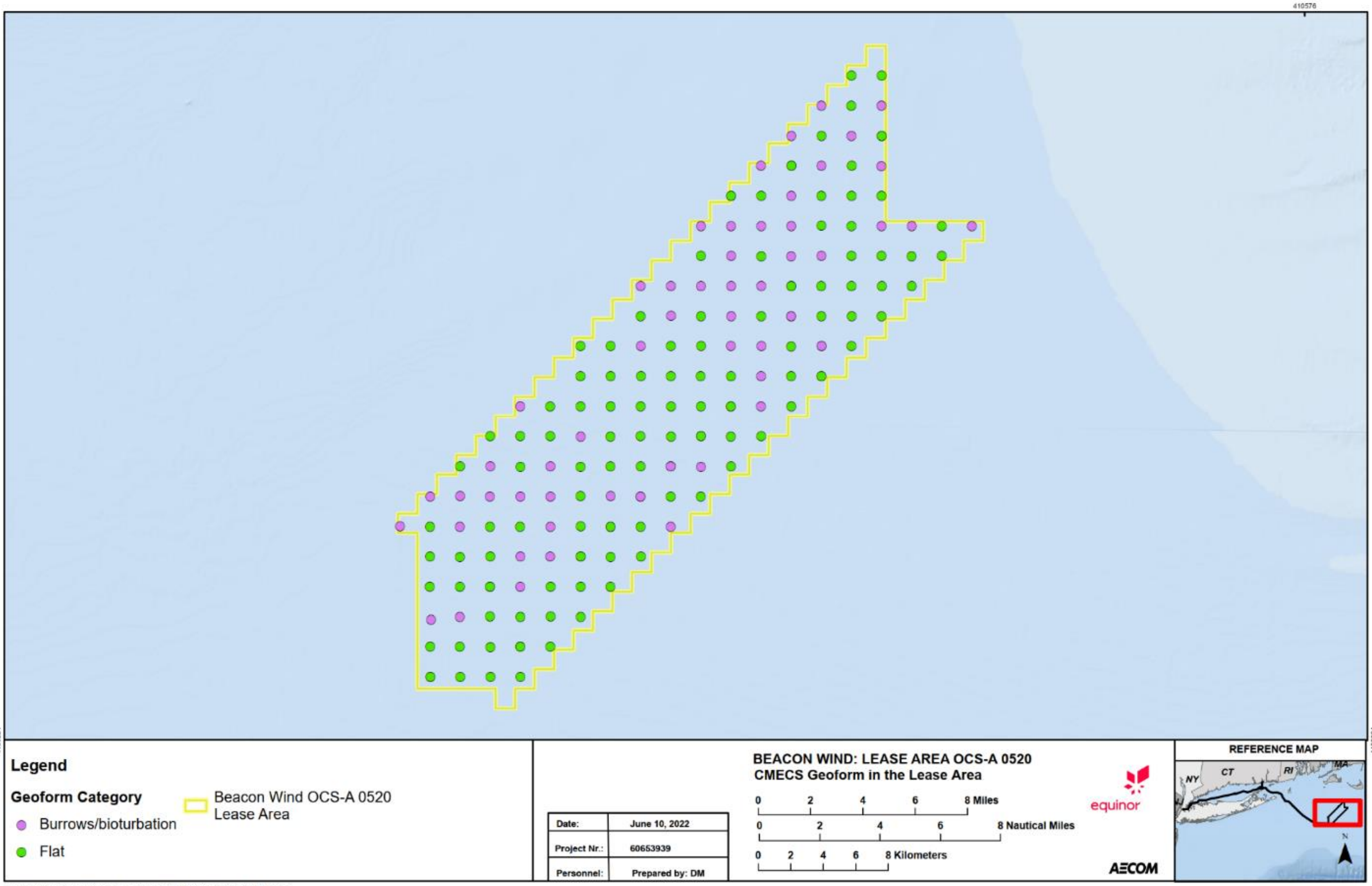


FIGURE 5.5-13. CMECS BIOTIC CATEGORY REPRESENTATIVE PLAN VIEW BOTTOM IMAGES FROM LEASE AREA BENTHIC REPORT



Data Sources: Appendix S Lease Area Benthic Report, BOEM,Gardiline Habitat Characterization Report (2019), NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

FIGURE 5.5-14. CMECS GEOFORM CLASSIFICATION IN THE LEASE AREA



Data Sources: Appendix S Lease Area Benthic Report, BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

FIGURE 5.5-15. OVERVIEW OF NMFS MODIFIED CMECS CLASSIFICATIONS FOR THE SUBSTRATE COMPONENT OF STATIONS IN THE LEASE AREA

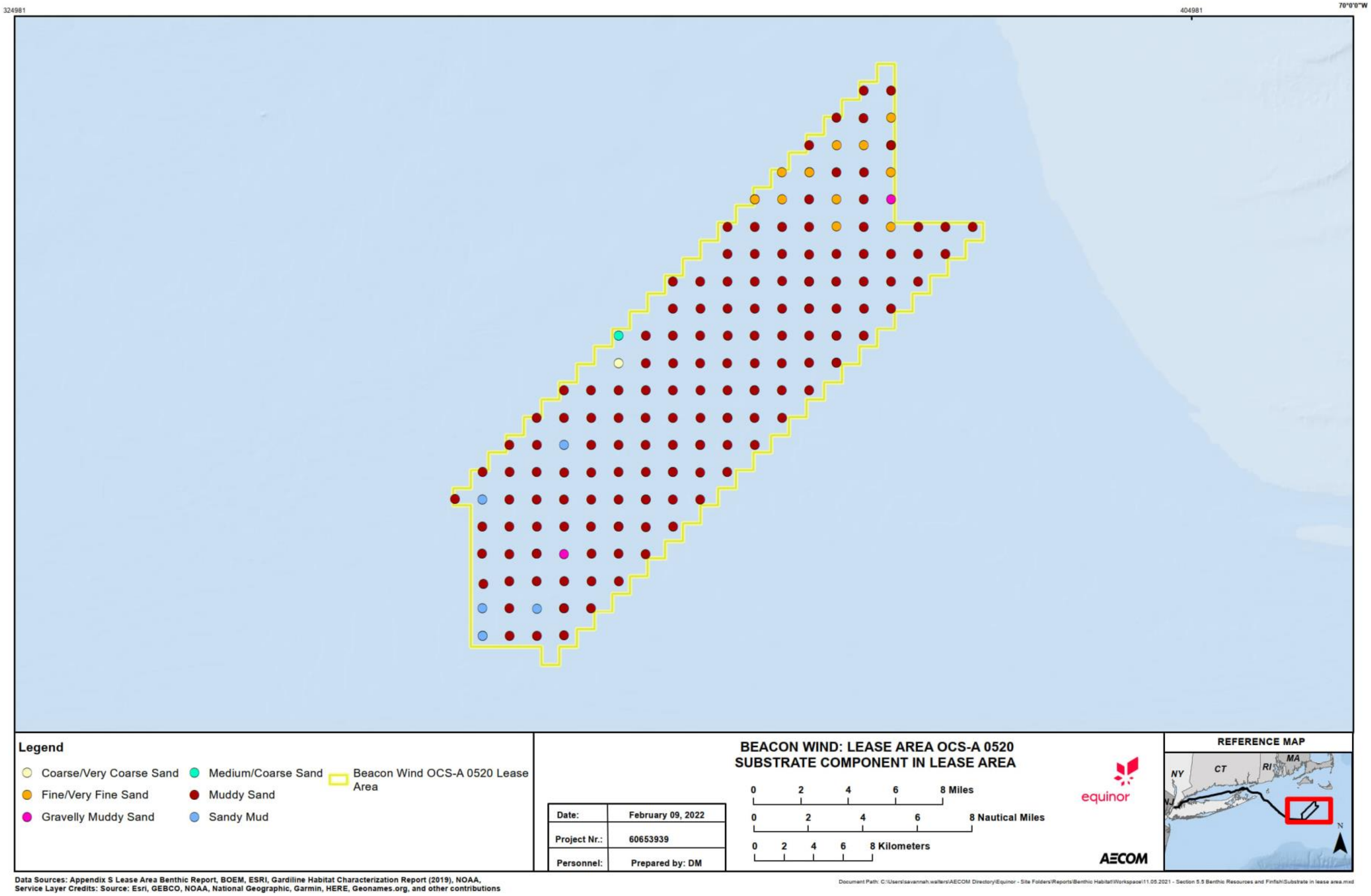
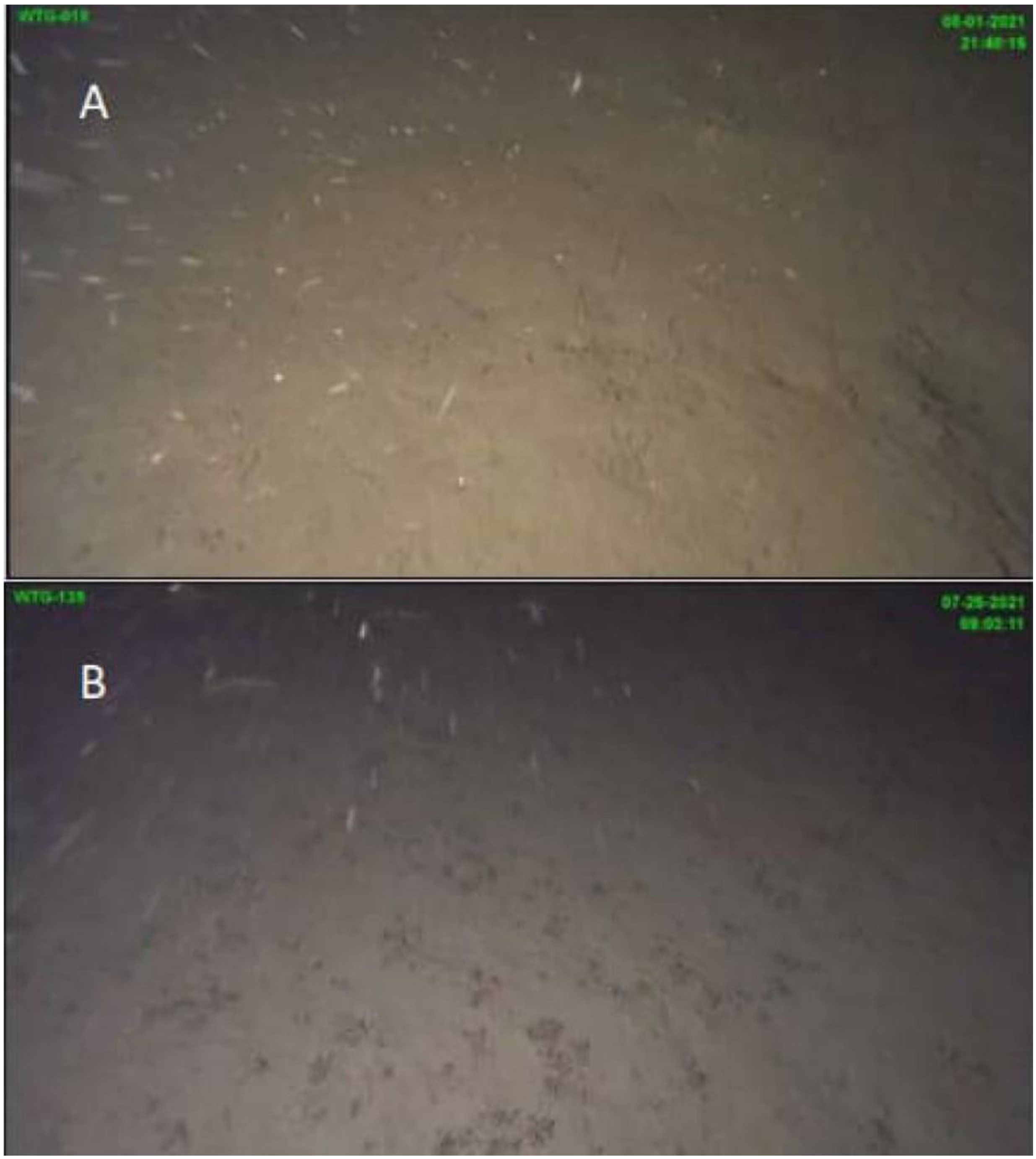


FIGURE 5.5-16. PLAN VIEW IMAGES FROM STATIONS WTG-018 (A) AND WTG-139 (B).



5.5.1.1.2.2 Submarine Export Cable Siting Corridors

Beacon Wind conducted extensive surveys of the submarine export cable corridor using MBES, SPI/PV, digital imagery and grab samples (grain size and infaunal analysis) to characterize the habitat. SPI/PV was collected at a total of 374 benthic stations along the submarine export cable corridor. Benthic video and benthic grabs were taken at 198 of these 374 stations, with 188 stations yielding successful grabs. An additional 93 stations were assessed with benthic video only (for a total of 291 benthic video stations). Stations were selected based on review of the MBES and SSS data results obtained along the submarine export cable corridors during the geophysical survey. These data were reviewed prior to commencement of the benthic field sampling campaign to determine patterns of sediment type and areas where homogeneous and heterogenous habitat may be present. An overview of the benthic resource characterization along the entire submarine export cable route is presented below followed by detailed analysis. The complete benthic survey reports are presented in **Appendix S Benthic Resources Characterization Reports and Mapbooks.**

For reporting purposes, the submarine export cable corridors were divided into eight (8) geographical areas (**Figure 5.5-18** through **Figure 5.5-25**):

- Segment 1 – East River – Astoria power complex (Queens, New York) to Throgs Neck;
- Segment 2 – Long Island Sound – Throgs Neck to Eatons Neck;
- Segment 3 – Long Island Sound – Eatons Neck to Central Long Island Sound;
- Segment 4 – Long Island Sound – Central Long Island Sound to The Race;
- Segment 5 – Long Island Sound – Eastern Long Island Sound to Millstone (Waterford);
- Segment 6 – Block Island Sound – The Race to New York State waters boundary;
- Segment 7 – Block Island Sound – New York State waters boundary to Block Island Sound; and
- Segment 8 – Offshore Submarine Export Cable Corridor – Block Island Sound to Lease Area.

5.5.1.1.3 Overview of the Benthic Resource Characterization for the Submarine Export Cable Corridor

The SPI PV and videographic data collected along the submarine export cable corridor displayed a seabed generally characterized by a soft bottom substrate consisting primarily of finer grain sizes with regions of cobble and boulder sized materials. No consolidated hardbottom substrates, sensitive seafloor communities, or species of concern (with species of concern being guided by the NOAA Fisheries establishment of ESA Threatened and Endangered list and candidate species [NOAA Fisheries 2022a]) were identified. The benthic video collectively showed a biological assemblage with evidence of burrows, bioturbation, polychaete/amphipod tubes and macrobenthos on the finer grain size substrates and attached fauna associated with areas with boulders consisting of diverse colonizers including sponges, hydrozoans, bryozoans, and occasional northern star corals.

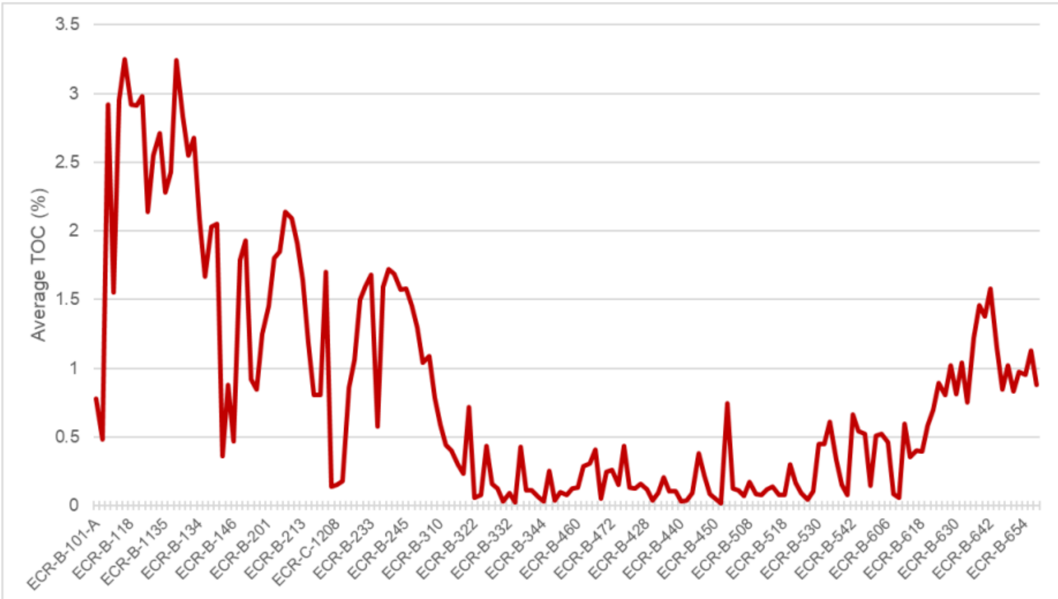
Similar to the results found in the PV characterizations, the drop camera characterizations reported areas of fine substrate with bioturbation from tracks and trails and burrows with smaller macrofaunal type biota (polychaete tubes, etc.); areas with shells or shell fragments/hash with bivalve siphons; areas with gravel/pebbles with megafaunal biota (crabs, starfish, etc.); and areas of cobbles and boulders with epifaunal biota (sponges, anemones, tunicates, bryozoa, etc.) including several notations of northern star coral. Various types of marine vegetation were also noted in Central Long Island Sound in areas where the substrate type allowed for attachment. The marine macrophytes identified were the leathery leafy algae *Chondrus crispus* and *Cocotylus truncatus*, the filamentous algae *Rhizoclonium riparium* and *Ceramium rubrum*, and the sheet algae *Agardhiella subulata* and *Grinella americana*. Most were found as small individual stalks attached to cobble or shell debris, but none were observed covering large surficial benthic areas.

PV observations show the East River stations predominantly had dense populations of live *Crepidula fornicata* and an unknown bivalve species, the *Sertularia* hydroid and tunicates. In Long Island Sound, the most abundant fauna was the sessile gastropod *C. fornicata*, found mostly on sandy bottoms with the highest concentration of live *C. fornicata* forming reefs at two locations at the eastern end of Long Island Sound. Other sessile fauna included the *Sertularia* hydroid, the polychaete *Chaetopterus*, Didenmnidae tunicates, and the mud snail *Ilyanassa obsoleta*. Stations outside of Long Island Sound also had *C. fornicata* and *Sertularia* hydroids, but also often included the burrowing anemone Ceriantharia, *Ampelisca* amphipods and *Amphiura* brittle stars.

The results from the grain size analysis indicated that sampled sites along the offshore submarine export cable corridor mainly consisted of finer grained particles that ranged from Medium Sand to Silt based on the Wentworth grain size classification. Sampled sites with a gravel component were encountered in Block Island Sound and within Long Island Sound. The gravel component of all samples containing gravel consisted of Granule (2.0 - 4.0 mm) and/or Pebble (4.0 - 64.0 mm) with only one exception of Cobble at Station ECR-C-1431 in Segment 7.

Sediment TOC concentrations as depicted in **Figure 5.5-17** from the 188 samples analyzed ranged from 0.02 percent (ECR-B-452) to 3.91 percent (ECR-B-1156) and are considered typical for the survey area. TOC values from sampled sites within the submarine export cable corridor are generally consistent with values reported by MMT (2020) during the EQ20903 Benthic Characterization Survey effort for the MetOcean facility locations (0.47 to 1.23 percent) and previous studies of marine sediments in the area (Boehm, 1984; Venkatesan, 1988; Poppe et al., 2000). Sediment TOC concentrations along the main submarine export cable corridors (excluding alternative corridors) were generally highest in the western portion of Long Island Sound and lowest approaching the eastern end of Long Island Sound to offshore areas.

FIGURE 5.5-17. SEDIMENT TOTAL ORGANIC CARBON (TOC) CONCENTRATIONS ALONG THE SUBMARINE EXPORT CABLE CORRIDORS PLOTTED WEST TO EAST



The soft bottom environment of the submarine export cable corridor which traverses the east-west axis of Long Island Sound before turning southeast onto and across the inner continental shelf was also sampled to quantify infauna assemblages. A total of 128 grab samples taken along the submarine export cable corridor yielded 352 taxa and 27,786 individuals. The data set included eleven phyla arranged in descending order by total abundance: Annelida, Mollusca, Arthropoda, Echinodermata, Nemertea, Cnidaria, Sipuncula, Chordata, Platyhelminthes, Hemichordata, and Phoronida.

Three CMECS Components (Geoform, Substrate, and Biotic) were used to classify benthic habitats in the submarine export cable corridors. For the CMECS Geoform Component, the Tectonic Setting Subcomponent for the entirety of the submarine export cable corridor is classified as a Passive Continental Margin. For the Physiographic Setting, submarine export cable corridor Segments 1 through 6 located within Long Island Sound, were classified as Sound, and Segments 7 and 8, located outside of and east of the Sound, were classified as Continental Shelf. The majority of stations (93 percent) were classified as Level 1 Geologic Geoform of Flat, with the 20 stations in Segment 8 classified as Megaripple. The level 2 Geoform classifications were divided between two of Geologic origin (Boulder Field and Flat), and one of Biological origin (Burrows/Bioturbation). Only 44 stations fell into the Flat category, 47 stations into the Boulder Field classification, and the majority (68 percent) were categorized as Burrows/Bioturbation. The Geoform Level 2 category of Boulder Field was not observed at stations within Segment 8, the most offshore segment. Geoform classifications are summarized in **Table 5.5-7**.

A total of 212 samples from (198 stations) were analyzed for grain size and classified into the NMFS modified Substrate classifications (NOAA Fisheries 2021b). CMECS Substrate classifications are summarized in **Table 5.5-9**. Along the submarine export cable corridors from the Lease Area to landfall sites in New York and Connecticut, a wide range of substrate types were encountered, including biogenic (i.e., shell substrate), coarse unconsolidated, and fine unconsolidated substrates. Based on NMFS modified Substrate classifications, 3.3 percent of samples contained biogenic substrate types (n=7), 38.7 percent contained coarse unconsolidated substrate types (n=82) and 58 percent contained fine unconsolidated substrate types (n=123). Generally, samples and imagery collected from stations offshore and nearer to the Lease Area consisted of predominantly fine unconsolidated substrates, while substrates along the inshore portions of the submarine export cable corridors were heterogeneous and contained a mix of fine and coarse unconsolidated substrates, as well as occasional biogenic substrates.

Included in the characterization of complex habitat are those stations classified as rock substrate and coarse unconsolidated substrate groups (i.e., gravels, gravel mixes, gravelly, and shell) including all subgroups (NOAA Fisheries 2021b). The 38.7 percent of stations sampled during site specific surveys of the submarine export cable corridors that were classified as coarse unconsolidated substrate would be considered to be complex habitat due to the presence of greater than five percent gravels, as would the 3.3 percent of stations that were classified as shell.

For the Biotic classifications, the Biotic Setting and the Biotic Class for the entirety of the submarine export cable corridor were classified as Benthic/Attached Biota and Faunal Bed respectively (**Table 5.5-9)** There were two Biotic Subclasses present at most Segments, Soft Sediment Fauna, which was observed in every Segment and associated with unconsolidated sediments, and Attached Fauna, which was observed where boulders were present and was observed in all but Segment 8 (the most offshore segment closest to the Lease Area). The Biotic Subclass of Soft Sediment Fauna was further classified into three Biotic Groups (Mobile Mollusks on Soft Sediment, Sand Dollar Bed, and Starfish Bed). The Group Mobile Mollusks on Soft Sediment was further classified as the Biotic Community of *Crepidula* spp. (individuals may not all be *C. fornicata*) Bed. The Attached Fauna at all but three stations was further classified as the Biotic Group Diverse Colonizers with Large Macrofauna as the Biotic Community.

In their study of the offshore wind areas Guida et al. (2017) identified species that require relatively rare types of habitats for one or more life stages and species that have limited mobility during one or more life stages. They refer to these species as “species of concern”. Included in this list were sea scallops (*Placopecten magellanicus*), Atlantic surfclams (*Spisula solidissima*), and ocean quahogs (*Arctica islandica*) as well as the immobile, attached egg masses of the longfin squid (*Doryteuthis pealeii*). Also included were Atlantic cod (*Gadus morhua*) juveniles which prefer gravelly or vegetated bottoms and adults that prefer rocky, pebbly or gravelly bottoms (Lough 2004), and black sea bass (*Centropristis striata*), which as juveniles and adults require structured refuge habitats. When observed through video or PV imagery, these species were identified as potentially vulnerableas. The documented occurrence of these species along the submarine export cable corridors is discussed fully in **Section 5.5.1.2.** Per the NMFS updated recommendations for mapping fish habitat (NOAA Fisheries 2021b), long-lived and habitat-forming species that are particularly vulnerable to project impacts (e.g., sponges, anemones, bryozoans, hydrozoans, corals, tunicates, and bivalves) were documented in the benthic report (**Appendix S**), but the only species deemed a potentially vulnerable species (PVS) was the northern star coral. **Figure 5.5-50** illustrates the observations of *A. poculata* observed in digital imagery, which is consistent with published data presented in **Figure 5.5-4, Figure 5.5-5,** and **Figure 5.5-6.** This temperate star coral occurs in shallow subtidal waters from Cape Cod to northern Florida and in the Gulf of Mexico. The NOAA Fisheries 2021b guidance also suggests characterizing soft bottom habitats with emergent fauna (e.g., octocorals, pennatulids, tube dwelling anemones and structure forming amphipods and polychaetes). Instances where these fauna were observed has also been noted and/or mapped.

5.5.1.1.3.1 Segment 1: East River – Astoria power complex (Queens, New York) to Throgs Neck

The SPI/PV and videographic data for Segment 1 displayed a seabed characterized by a range of substrates, from fine sandy silt to coarser sand substrate, with areas of cobble and boulder present covered predominantly in epiphytic growth. There were areas of concentrated shell substrate, some consisting of *Crepidula* spp. (individuals may not all be *C. fornicata*), shell fragments and shell hash. No consolidated hard substrates, sensitive seafloor communities, or species of concern were observed within this segment. The benthic video showed a diverse biological assemblage with macrobenthos including mollusks – slipper shell (*Crepidula* spp. - individuals may not all be *C. fornicata*) and whelks (*Busycotypus* sp. and/or *Busycon* sp.); arthropods - hermit crabs (*Pagurus* spp.) and horseshoe crab (*Polyphemus limulus*); and sessile taxa, including bryozoans, colonial tunicates, hydroids, and various sponges.

Biological assessments from Segment 1 included infauna analysis from 11 stations yielding 3,854 individuals and 107 total taxa (64 identified to species and 43 to LPIL (lowest practicable identification level from eight phyla. Total biomass for the ten stations was 18 g with an average of 1.61 g ± 2.05 SD. Bivalve mollusks contributed 46 percent and polychaetes contributed 45 percent of the total biomass sampled. Diversity indices varied across stations with the highest values generally found at the western stations (East River). The number of species per sample averaged 19 with a range of 7 to 30. Numerically dominant species included eight polychaetes, one arthropod, and one mollusk species; the polychaete *Polycirrus eximius* was overall dominant comprising 19 percent of the total organisms identified to species. SPI analysis results show organisms-sediment index (OSI) successional stages along this segment as predominantly Stage II (45 percent), followed by Stage III (14 percent), Stage 1 (five percent), and Indeterminate (18 percent).

Three CMECS Components (Geoform, Biotic and Substrate) were used to classify benthic habitats. The East River – Astoria to Throgs Neck Segment 1 had a flat overall seafloor topography consisting primarily of unconsolidated substrate and stations were classified as Level 1 Flat Geoform, a general term for a level (or nearly level) surface or area marked by little to no vertical relief and often composed of unconsolidated sediments (FGDC, 2012) at a regional scale of greater than 0.4 mi^2 (1 km^2) in size.

At the smaller scale (less than 0.4 mi^2 [1 km^2] in size), the Geoform Level 2 classification consisted of three categories. The first two categories are of geologic origin, and these included 1) Flat and 2) Boulder Field geoforms. The Flat Geoform is as described above and was seen at 10 of the 19 stations in this segment. The second classification is the Boulder Fields Geoform, observed at six stations in Segment 1, and described as an area dominated by large, boulder-sized (0.8 to 13.4 ft [256 to 4,096 mm]) stones or pieces of rock. The remaining three stations in this segment, located on the west side of the segment and generally close to shore were of biogenic origin and were characterized as Burrow/Bioturbation. The CMECS Geoform component was derived from the benthic drop/towed camera system. An overview of the classified CMECS Geoform Level 2 Stations along Segment 1 is presented in **Figure 5.5-26**. CMECS Substrate component classifications for benthic grab stations sampled along Segment 1 (including the North-South Landfall corridor) are presented in **Figure 5.5-27**.

Modified CMECS classifications were derived from grain size results and digital imagery. Results from the PSD analysis confirmed a range of sediment types, from gravel to sand and silt/clay. Benthic sampling stations within Segment 1 were classified as biogenic (n=2), coarse unconsolidated (n=5) and fine unconsolidated (n=5) substrate types. Coarse unconsolidated substrates and biogenic substrates are considered indicative of complex habitat under definitions found in NOAA Fisheries (2021b). Fine unconsolidated substrates are typically indicative of soft-bottomed habitats (NOAA Fisheries 2021b). There was no discernible spatial pattern concerning the distribution of coarse vs. fine substrates along Segment 1. Sediment TOC concentrations ranged from 0.483 to 3.91 percent (mean: 1.65 percent; SD: 1.12).

CMECS Biotic component was derived from the drop/towed camera benthic video data and is illustrated in **Figure 5.5-28**. All stations in Segment 1 had the CMECS Biotic Class classifications as Faunal Bed. Biotic Subclass consisted of two classifications: Soft Sediment Fauna (13 stations) and Attached Fauna (six stations). The Attached Fauna stations were further classified as Diverse Colonizers (Biotic Group), then Large Macrofauna (Biotic Community).

5.5.1.1.3.2 Segment 2: Long Island Sound – Throgs Neck to Eatons Neck

The CMECS Geoform classification of **Segment 2** (Throgs Neck to Eatons Neck Long Island Sound) included the Physiographic setting of Sound, with a level 1 Flat Geoform. The level 2 classification consisted of a majority of Burrow/Bioturbation (25 of the 35 stations), and the Boulder Field classification was found at ten stations (**Figure 5.5-29**). Eight stations taken through Segment 2 (25 stations) were classified using Modified CMECS definitions as Fine Unconsolidated Substrate (three Muddy Sand, one Sand, and four Sandy Mud); while 19 were found to be Coarse Unconsolidated Substrate (all Gravelly)(**Figure 5.5-30**). Sediment TOC concentrations in this segment ranged from 0.36-3.3 percent (mean: 2.17 percent; SD: 0.16). Mean sediment TOC concentration in this segment was substantially higher than the mean TOC concentration over all sampled sites (0.87 percent).

Biological assessments in Segment 2 included infauna analysis from 16 stations yielding 2,367 individuals and 107 total taxa (64 identified to species and 43 to LPIL from nine phyla. Total biomass for the 16 stations was 130 g with an average of 8.15 g ± 21.1 SD. Bivalve mollusks contributed 86 percent of the total biomass sampled with most of this concentrated at a single station (ECR-B-126) due to two large northern quahogs (*Mercenaria mercenaria*) weighing 85 g. Diversity indices were similar throughout the segment. The number of species per sample averaged 15 with a range of 7 to 27. Numerically dominant species included four polychaete, four arthropod, and two mollusk species; the bivalve *Nucula proxima* was overall dominant comprising 24 percent of the total organisms identified to species. SPI analysis results show OSI successional stages along this segment as predominantly Stage III, present within 90 percent of the SPI images. Several images showed Stage I on III, Stage II was observed at 9 percent, and Stage 1 was only observed at one station. The CMECS Biotic Class at all stations was Faunal Bed, with ten stations categorized as Biotic Subclass Attached Fauna and 25 stations as Soft Sediment Fauna. For seven of the ten stations the Attached Fauna was further broken down into the Diverse Colonizers Biotic Group, and Large Macrofauna Biotic Community (**Figure 5.5-31**).

5.5.1.1.3.3 Segment 3: Long Island Sound – Eatons Neck to Central Long Island Sound

Segment 3 Physiographic Geoform CMECS classification was Sound with the Level 1 Geoform of Flat. The Geoform level 2 was mostly the Biogenic category of Burrows/Bioturbation at 50 of the 55 stations. The remaining five stations were categorized as the Geologic category of Boulder Field (**Figure 5.5-32**). Substrate modified CMECS classification in the Segment was divided equally with 22 stations classified as Coarse Unconsolidated Substrate (all classified as Gravelly) and 22 stations as Fine Unconsolidated Substrate (10 Sandy Mud, two Sand, nine Muddy Sand, and one Mud)(**Figure 5.5-33**). Sediment TOC concentrations in Segment 3 ranged from 0.06-2.1 percent (mean: 1.06 percent; SD: 0.10). Mean sediment TOC concentration in this segment was similar to the mean TOC concentration over all sampled sites (0.87 percent). Sediment TOC concentrations from grab samples collected in this segment were lowest towards the eastern end of Long Island Sound and were generally higher in areas where samples contained relatively higher proportions of silt and clay.

Biological assessments were completed for 23 stations in Segment 3 yielding 4,378 individuals and 119 taxa from eight phyla. The total biomass for all stations was 100 g with a mean of 4.35 g ± 9.93 SD. Gastropods accounted for 59 percent of the total biomass, mostly due to a large number of *Crepidula* spp. (individuals may not all be *C. fornicata*) at station ECR-B-322. Numerically dominant species include six polychaetes, two mollusks, one arthropod, and one nemertean. The most abundant species was the polychaete *Levinsenia gracilis*, which accounted for 26 percent of the total number of individuals. Diversity indices were similar throughout the segment. The number of species per sample averaged 15 with a range of six to 20. SPI analysis results of OSI successional stages along this segment were identified as Stage I on III (47 percent), Stage III (42 percent), Stage II (10 percent), and Stage 1 (1 percent). The CMECS Biotic classifications identified from benthic video in Segment 3 identified all as Faunal Bed (Class) with 50 stations as Soft Sediment Fauna, and five stations as Attached Fauna as the identified Subclass (**Figure 5.5-34**). The Attached Fauna Subclass at all stations was further broken down into the Diverse Colonizers Biotic Group and Large Macrofauna Biotic Community.

5.5.1.1.3.4 Segment 4: Long Island Sound – Central Long Island Sound to the Race

Segment 4 Physiographic Geoform CMECS classification was Sound, with the level 1 Geoform of Flat. The level 2 classifications consisted of three categories, two of Geologic origin (Flat and Boulder Field) and one of Biologic origin (Burrows/Bioturbation). The Flat category was identified at 17 stations, Boulder Field was found at 12 stations, and Burrows/Bioturbation category was identified at 19 stations (**Figure 5.5-35**). Substrate was mostly classified as Coarse Unconsolidated Substrate along the main route as well as an alternate just north of the proposed main route. Modified CMECS classifications for Substrate Group in this Segment include three stations as Gravel Mix, 12 as Gravelly (with one station as Gravel Mix and the replicate as Gravelly), 13 as Muddy Sand, one Sandy Mud, and one with Substrate Subclass as Shell Hash (**Figure 5.5-36**). Sediment TOC concentrations (exclusive of QC replicates) from benthic grab stations within this segment ranged from 0.03-0.45 percent (mean: 0.16 percent; SD: 0.02). The mean sediment TOC concentration in this segment was lower than the average TOC concentration for all sampled submarine export cable route stations (0.87 percent). Sediment TOC concentrations from grab samples collected in this segment were generally higher in areas where samples contained relatively higher proportions of silt and clay.

Infauna analysis was done at 22 stations yielding 3,909 individuals from seven phyla in Segment 4. A total of 82 taxa were identified to species level and another 57 to LPIL. The total biomass for all stations combined was 78.96 g with a mean of 3.59 g ± 4.92 SD. Numerically dominant species include four polychaete, four mollusk, and two arthropod species. The gastropod *Crepidula fornicata* was the overall dominant species accounting for 17 percent of the total abundance for the Segment. SPI analysis results of OSI successional stages along this segment were predominantly indeterminate (37 percent) due to the shallow or no prism penetration. Stage III was observed in 30 percent of the images, Stage I on III at 14 percent, Stage II at 16 percent, and Stage I at only two stations (3 percent). The CMECS Biotic classifications identified from benthic video in Segment 4 identified all stations as

Faunal Bed (Class) with 36 stations as Soft Sediment Fauna, and 12 stations as Attached Fauna as the identified Subclass (**Figure 5.5-37**). The Attached Fauna Subclass was further categorized as Diverse Colonizers (Biotic Group) and Large Macrofauna (Biotic Community) in all cases.

5.5.1.1.3.5 Segment 5: Long Island Sound – Eastern Long Island Sound to Millstone (Waterford)

The landing and alternate corridors to Waterford, Connecticut comprise **Segment 5**. The CMECS Geoform classification included the Physiographic setting of Sound, and all had a level 1 Geoform category of Flat. The level 2 classifications consisted of three categories, two of Geologic origin (Flat and Boulder Field) and one of Biologic origin (Burrows/Bioturbation). The Flat category was identified at six stations, Boulder Field was found at four stations, and Burrows/Bioturbation category was identified at ten stations (**Figure 5.5-38**). Modified CMECS Substrate Groups in Segment 5 include four classified as Fine Unconsolidated Substrate (all Muddy Sand), and three classified as Coarse Unconsolidated Substrate (all Gravelly), with three stations classified as Biogenic (Shell Hash)(**Figure 5.5-39**). Sediment TOC concentrations ranged from 0.06-0.43 percent (mean: 0.22 percent; SD: 0.04). Mean TOC concentration in this segment was considerably lower than the mean average TOC concentration over all sampled sites (0.87 percent).

Infauna analysis was performed at five stations along the main submarine export cable corridors in Segment 5 as well as five along an alternative landfall corridor. The main route samples had a total of 723 individuals from six phyla with a total biomass of 213 g (mean 43 g ± 83 SD). Much of this biomass was held in bivalves at station ECR-C-1437 (178 g). The top ten dominant species included three polychaete, four arthropod, and three mollusks with the overall dominant species as the bivalve *Crassinella lunata* with 8.2 percent of the total. The five stations along the alternative landfall corridor yielded a total of 1,089 individuals from seven phyla with a total biomass of 11.6 g (mean 2.31 g ± 0.74 SD). Similar to the main route stations, the top ten dominant species included three polychaete, four arthropod, and three mollusks with the overall dominant species as the bivalve *Crassinella lunata* with 7.1% of the total. SPI analysis results of OSI successional stages along this segment were identified as predominantly Stage III (41 percent). Stage I on III was observed at 23 percent of the images, Stage II at two stations, Stage 1 at only one station and Indeterminate at three stations due to low prism penetration. The CMECS Biotic classifications identified from benthic video in Segment 5 identified all 19 stations as Faunal Bed (Class) with four stations further broken down into Attached Fauna as the Subclass, Diverse Colonizers as the Group, and Large Macrofauna as the Community (**Figure 5.5-40**). Fourteen stations were further broken down into Soft Sediment Fauna as the Subclass, with one of those further identified to Mobile Mollusks on Soft Sediment as the Group and *Crepidula* spp. (all individuals may not be *C. fornicata*) Bed as the Community.

5.5.1.1.3.6 Segment 6: Block Island Sound – The Race to the New York State Waters Boundary

Similar to Segment 5, the CMECS Geoform classification of **Segment 6** (Block Island Sound) included the Physiographic setting of Sound, and all had a level 1 Geoform category of Flat. The level 2 classifications consisted of three categories, two of Geologic origin (Flat and Boulder Field) and one of Biologic origin (Burrows/Bioturbation). The Flat category was identified at four stations, Boulder Field was found at nine stations, and Burrows/Bioturbation category was identified at ten stations (**Figure 5.5-41**). Substrate modified CMECS classifications in Segment 6 included 10 stations of Fine Unconsolidated Substrate (four as Sand and six Muddy Sand) with only three stations classified as Coarse Unconsolidated Substrate (one Gravel Mix and two Gravelly) (**Figure 5.5-42**). Sediment TOC concentrations (exclusive of QC replicates) ranged from 0.03 to 0.21 percent (mean: 0.10 percent;

SD: 0.01). Mean average TOC concentration in this segment was considerably lower than the mean average TOC concentration over all sampled sites (0.87 percent) and was the lowest of all eight segments.

Biological assessments in Segment 6 included infauna analysis from 12 stations yielding 3,136 individuals and 109 total taxa (70 identified to species and 39 to LPIL) from six phyla. Total biomass for the 12 stations was 184 g with an average of 15.3 g ±43.4 SD. The majority of the biomass was concentrated at a single station (ECR-B-434) with 152 g mainly attributed to gastropods. Gastropod mollusks contributed 89 percent of the total biomass sampled at this segment. The number of species per sample averaged 15 with a range of 3 to 25. Numerically dominant species included five polychaete, two arthropod, and three mollusk species; the gastropod *Crepidula fornicata* was overall dominant comprising 38.0 percent of the total organisms. Diversity did not vary greatly along this segment. The number of species per station averaged 15 and ranged from 3 to 25. SPI analysis results show organisms-sediment index (OSI) successional stages along this segment as Stage III (25 percent), Stage II (4 percent), Stage 1 (2 percent), and Indeterminate (69 percent) due to low prism penetration. The CMECS Biotic classifications identified from benthic video analysis in Segment 6 identified all 23 stations as Faunal Bed (Class) with 14 stations as Soft Sediment Fauna, and nine stations as Attached Fauna as the identified Subclass (**Figure 5.5-43**).

5.5.1.1.3.7 Segment 7: Block Island Sound - New York State Waters Boundary to Block Island Sound

The CMECS Geoform Pysiographic setting classification beginning with **Segment 7** was Continental Shelf. The level 1 Geoform classification remained Flat, similar to the segments in the sound. The level 2 classifications consisted of three categories, two of Geologic origin (Flat and Boulder Field) and one of Biologic origin (Burrows/Bioturbation). The Flat category was identified at seven stations, Boulder Field was found at only one station, and the Burrows/Bioturbation category was identified at 14 stations (**Figure 5.5-44**). Substrate modified CMECS classifications in Segment 7 included eight stations of Fine Unconsolidated Substrate (two as Sand and six Muddy Sand) with seven stations classified as Coarse Unconsolidated Substrate (three Gravel Mix and four Gravelly)(**Figure 5.5-45**). Sediment TOC concentrations (exclusive of QC replicates) ranged from 0.02-0.07 percent (mean: 0.17 percent; SE: 0.05). Mean average TOC concentration in this segment was substantially lower than the mean average TOC concentration over all sampled sites (0.87 percent), but similar to the adjacent segment to the west.

Biological assessments in Segment 7 included infauna analysis from nine stations yielding 4,460 individuals and 139 total taxa (84 identified to species and 55 to LPIL) from eight phyla. Total biomass for the 9 stations was 541 g with an average of 60.2 g ± 174.0 SD. Gastropod mollusks contributed 97 percent of the total biomass sampled due to a large number of *Crepidula* spp. (individuals may not all be *C. fornicata*) found at station ECR-C-142. The number of species per sample averaged 16 with a range of 4 to 35. Numerically dominant species included four polychaete, two arthropod, and four mollusk species; the bivalve *Nucula proxima* was overall dominant comprising 28 percent of the total organisms identified to species. SPI analysis results show OSI successional stages along this segment as Stage I on III (10 percent), Stage III (31 percent), Stage II (17 percent), Stage 1 (4 percent), and Indeterminate (38 percent) due to under penetration or no penetration of the prism. The CMECS Biotic classifications identified from benthic video analysis in Segment 7 identified all 22 stations as Faunal Bed (Class) with 21 stations as Soft Sediment Fauna and only one station as Attached Fauna as the identified Subclasses (**Figure 5.5-46**). The Attached Fauna station was further classified as Diverse Colonizers (Group) and Large Macrofauna (Community). Two of the Soft Sediment Fauna stations were further classified as Sand Dollar Bed (Group), and four more were classified as Mobile Mollusks on Soft Sediment (Group) and *Crepidula* spp. (individuals may not all be *C. fornicata*) Beds (Community).

5.5.1.1.3.8 Segment 8: Offshore Submarine Export Cable Corridor - Block Island Sound to Lease Area

The CMECS Pyhsiographic Geoform classification of all **Segment 8** stations included Continental Shelf, with the Geoform level 2 classifications of all stations as Biogenic Burrows/Bioturbation categories. However, of the 64 stations evaluated 44 stations were classified at the Level 1 Geoform level of Flat while the 20 remaining stations were classified as Megaripple (Small Area) (**Figure 5.5-47**). Substrate modified CMECS classifications in Segment 8 included 50 stations of Fine Unconsolidated Substrate (six as Sand, 35 Muddy Sand, and nine as Sandy Mud) with only one station classified as Coarse Unconsolidated Substrate (Gravelly)(**Figure 5.5-48**). Sediment TOC concentrations ranged from 0.05 to 1.58 percent (mean: 0.60 percent; SD: 0.06). Mean average TOC concentration in this segment was similar to the mean average TOC concentration over all sampled sites (0.87 percent).

Biological assessments in Segment 8 included infauna analysis from 25 stations yielding 10,473 individuals and 183 total taxa (113 identified to species and 70 to LPIL) from ten phyla. Total biomass for the 25 stations was 239 g with an average of 9.5 g ± 14.9 SD. Bivalve mollusks contributed 30.52 percent of the total biomass sampled. The number of species per sample averaged 24.8 with a range of 13 to 41. Numerically dominant species included six polychaete, three arthropod, and one mollusk species; the arthropod *Ampelisca agassizi* was overall dominant comprising 16 percent of the total organisms identified to species. SPI analysis results show OSI successional stages along this segment as Stage I on III (83%), Stage III (10%), Stage II (4%), and Indeterminate (2%). The CMECS biotic classifications identified from benthic video analysis in Segment 8 identified all 63 stations as Faunal Bed (Class) with all stations as Soft Sediment Fauna as the identified subclass (**Figure 5.5-49**). Three stations were further classified as sand dollar bed (biotic group) and 26 were classified as starfish bed (biotic group).

FIGURE 5.5-18. SUBMARINE EXPORT CABLE CORRIDORS STATION LOCATIONS SEGMENT 1 EAST RIVER – ASTORIA POWER COMPLEX (QUEENS, NEW YORK) TO THROGS NECK

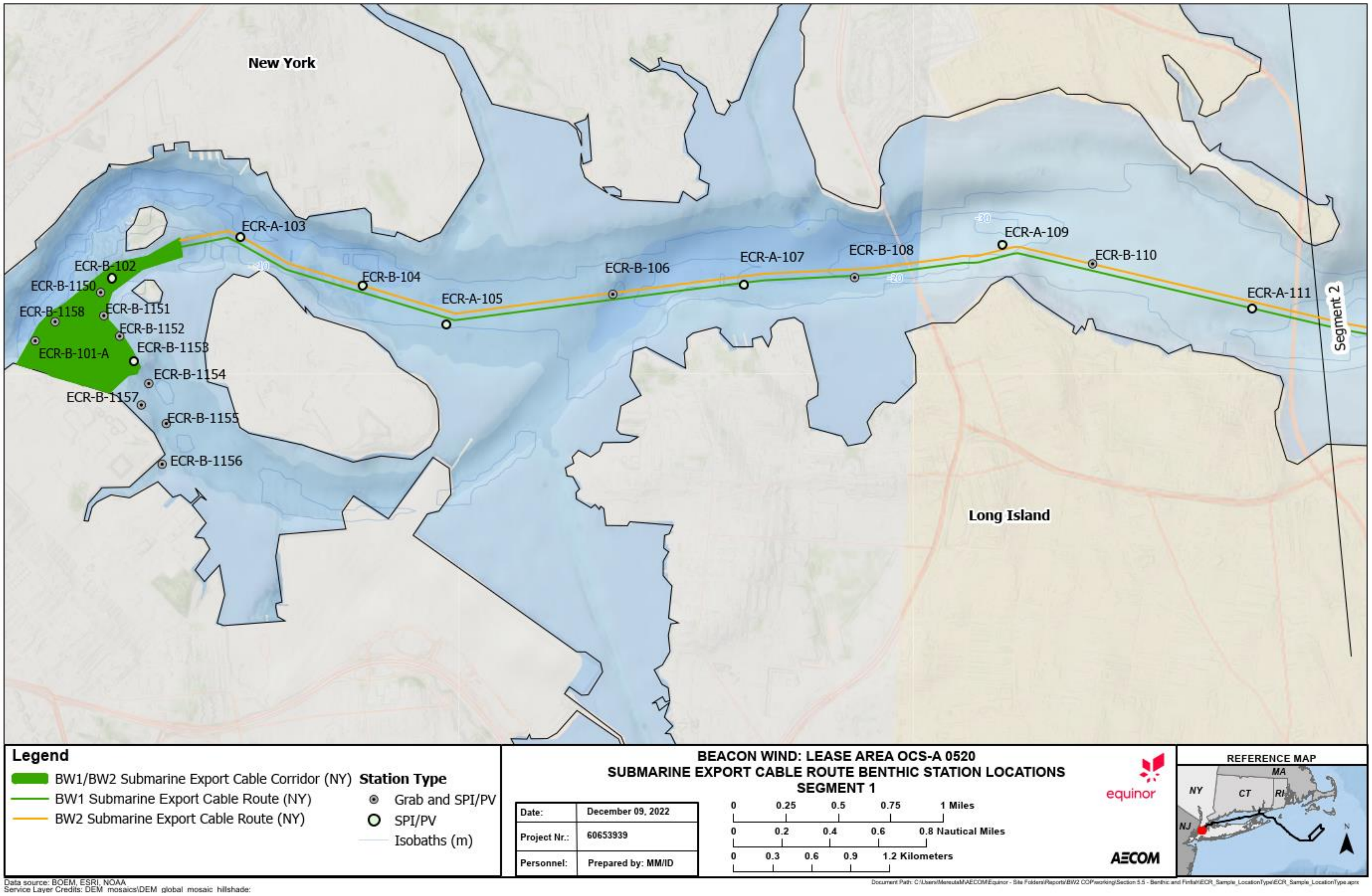


FIGURE 5.5-19. SUBMARINE EXPORT CABLE CORRIDORS STATION LOCATIONS SEGMENT 2 LONG ISLAND SOUND – THROGS NECK TO EATONS NECK

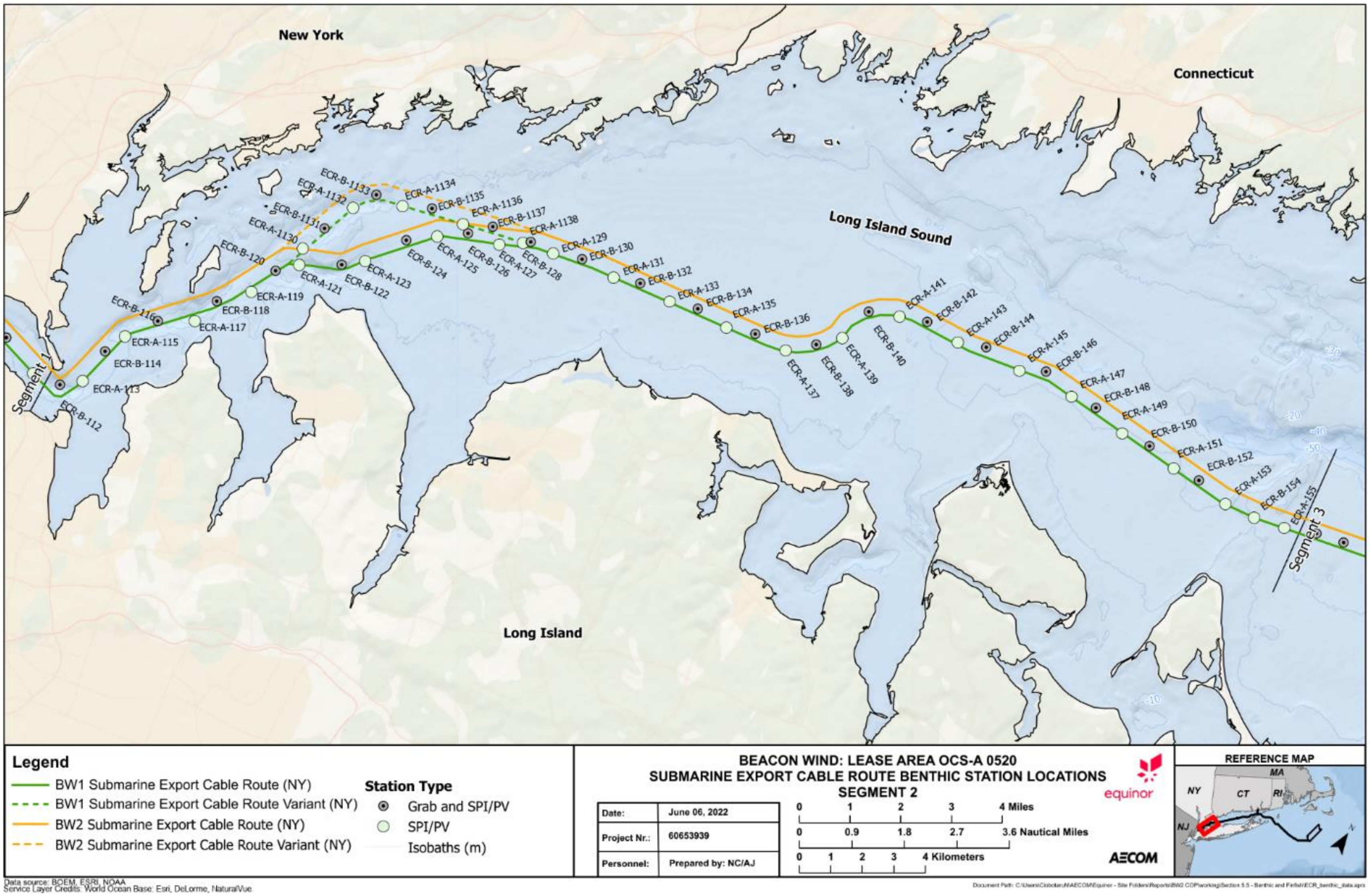


FIGURE 5.5-20. SUBMARINE EXPORT CABLE CORRIDORS STATION LOCATIONS SEGMENT 3 LONG ISLAND SOUND – EATONS NECK TO CENTRAL LONG ISLAND SOUND

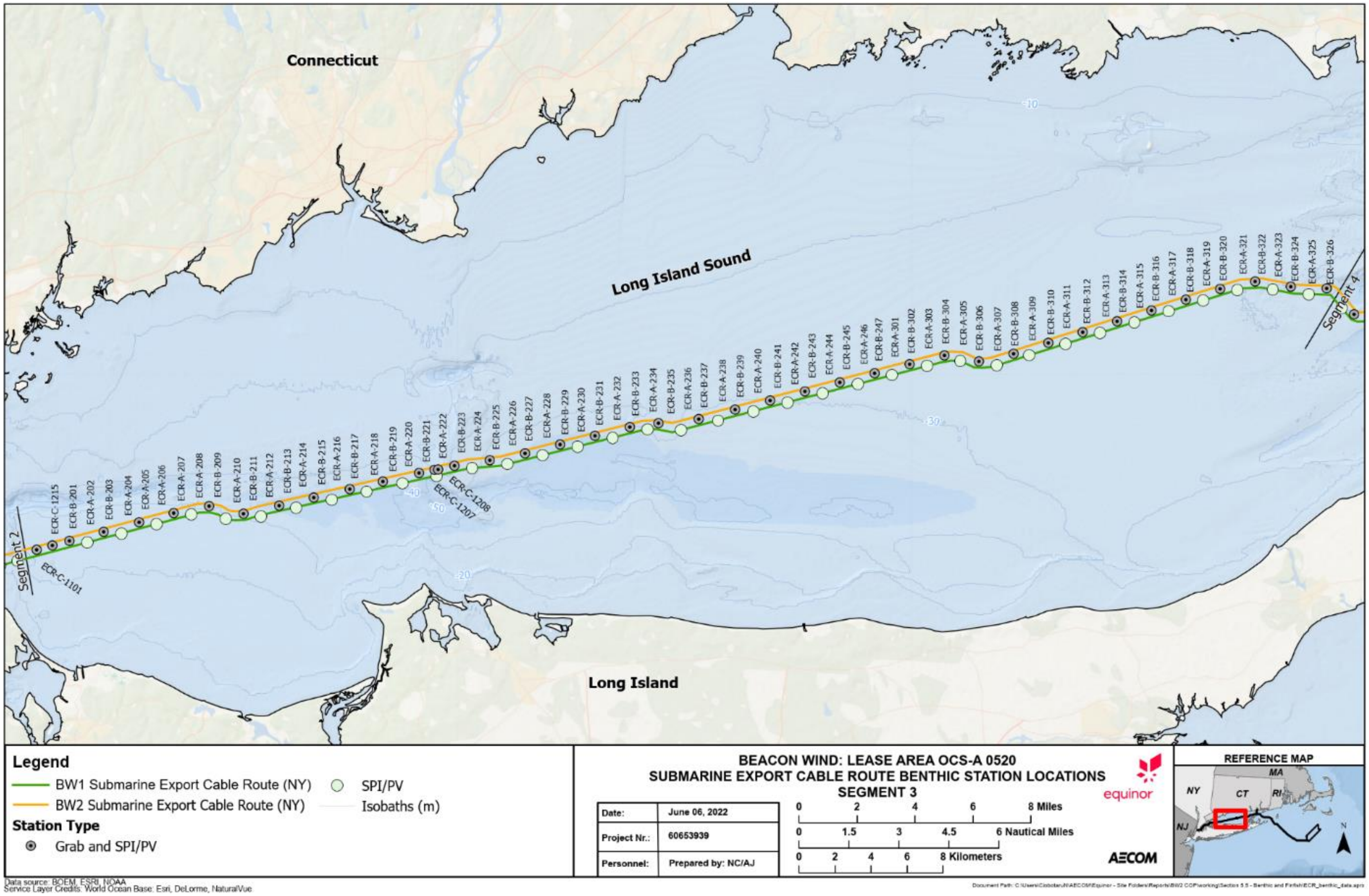
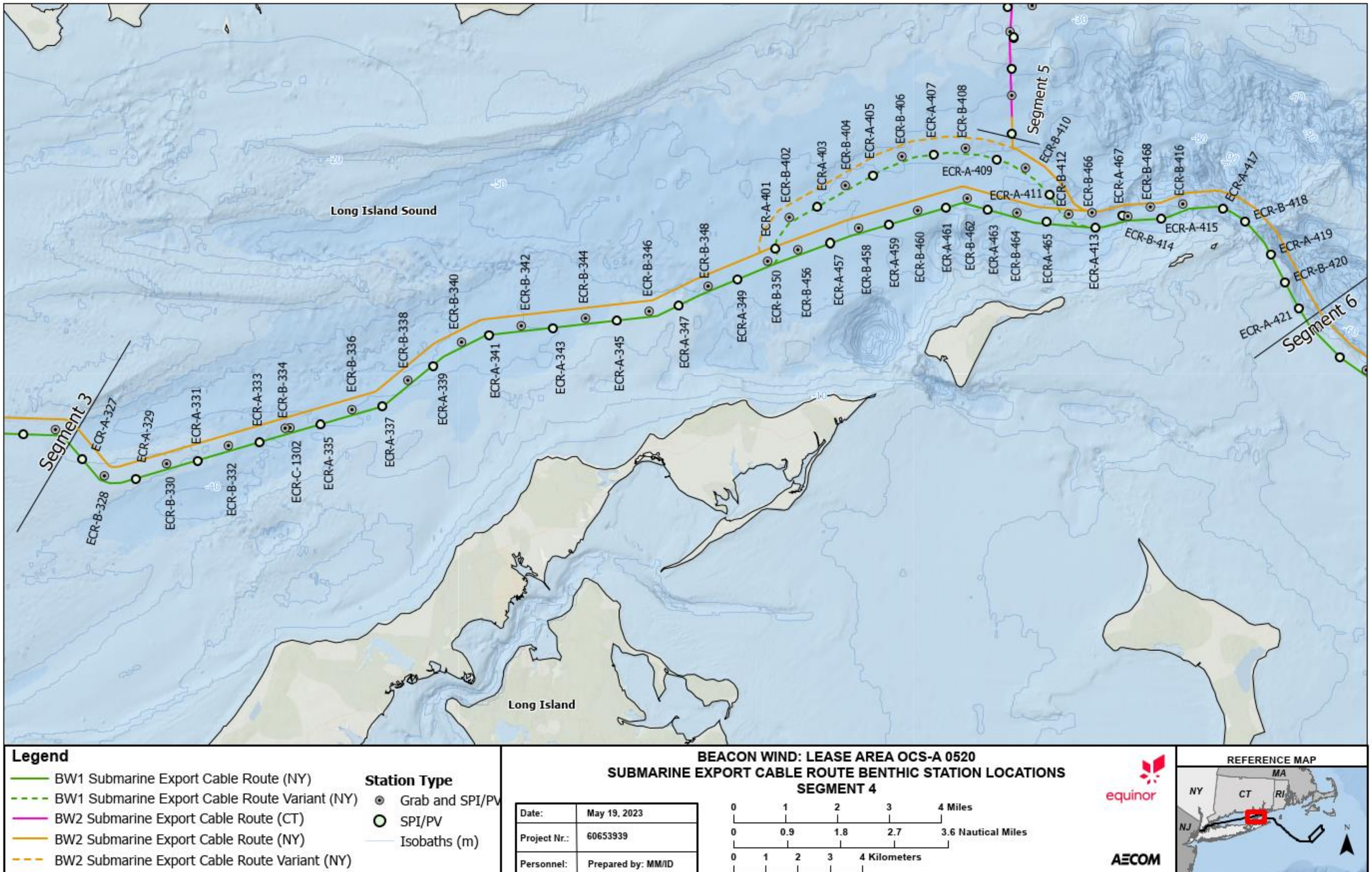


FIGURE 5.5-21. SUBMARINE EXPORT CABLE CORRIDORS STATION LOCATIONS SEGMENT 4 LONG ISLAND SOUND – CENTRAL LONG ISLAND SOUND TO THE RACE



Data source: BOEM, ESRI, NOAA
Service Layer Credits: DEM_mosaics\DEM_global_mosaic_hillshade:

FIGURE 5.5-22. SUBMARINE EXPORT CABLE CORRIDORS STATION LOCATIONS SEGMENT 5 LONG ISLAND SOUND – EASTERN LONG ISLAND SOUND TO MILLSTONE (WATERFORD)

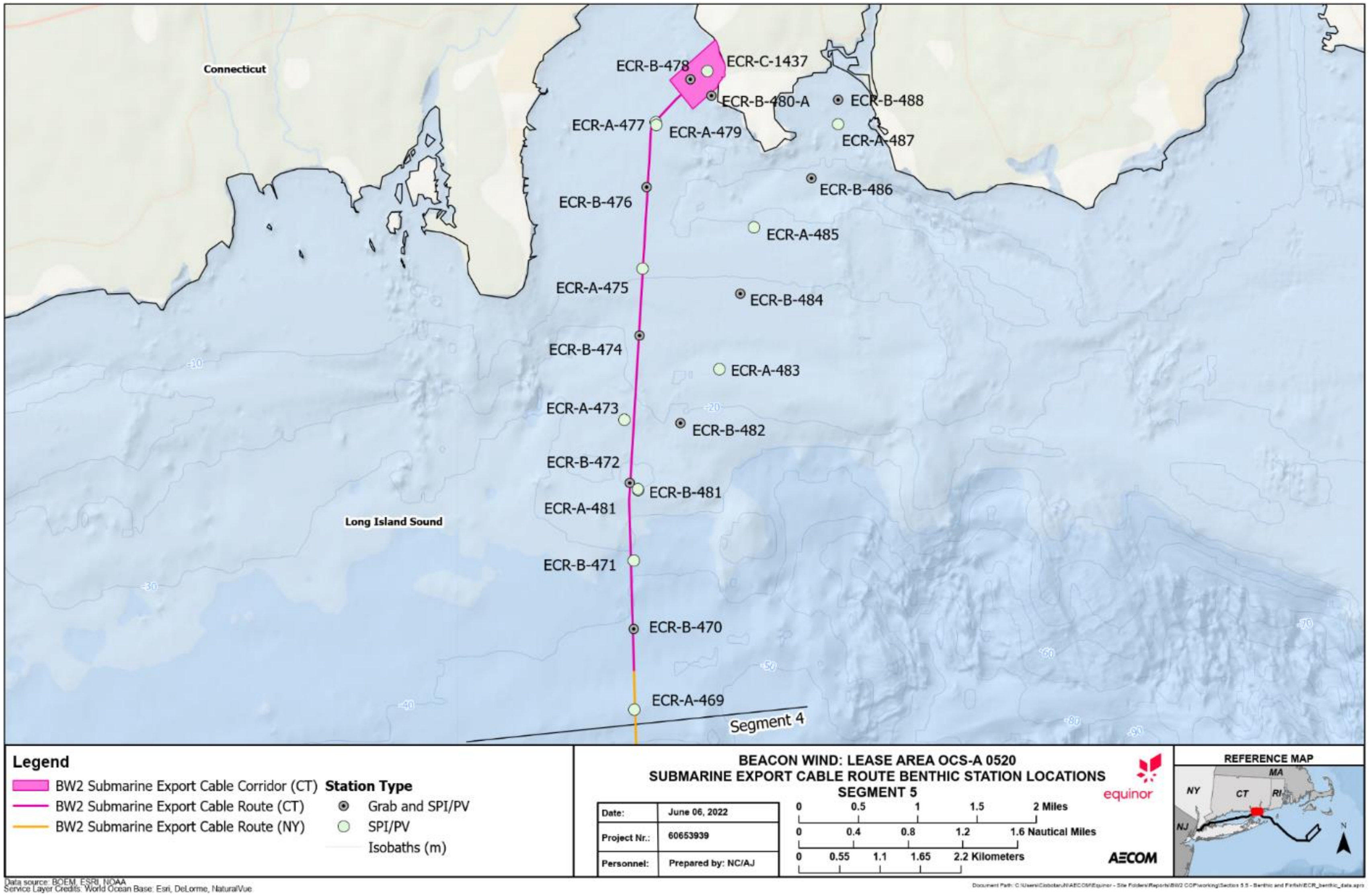


FIGURE 5.5-23. SUBMARINE EXPORT CABLE CORRIDORS STATION LOCATIONS SEGMENT 6 BLOCK ISLAND SOUND – THE RACE TO THE NEW YORK STATE WATERS BOUNDARY

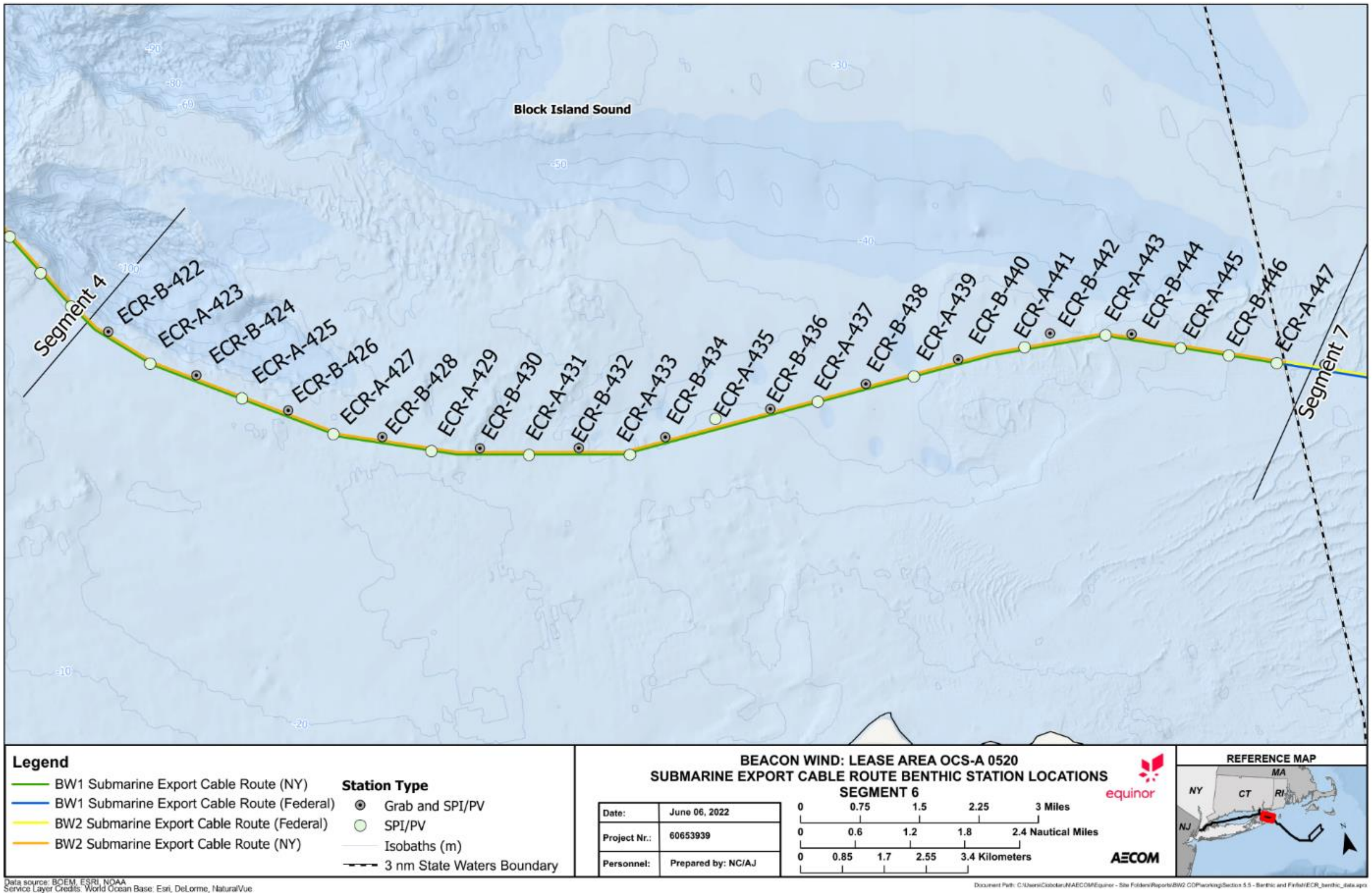


FIGURE 5.5-24. SUBMARINE EXPORT CABLE CORRIDORS STATION LOCATIONS SEGMENT 7 BLOCK ISLAND SOUND - NEW YORK STATE WATERS BOUNDARY TO BLOCK ISLAND SOUND

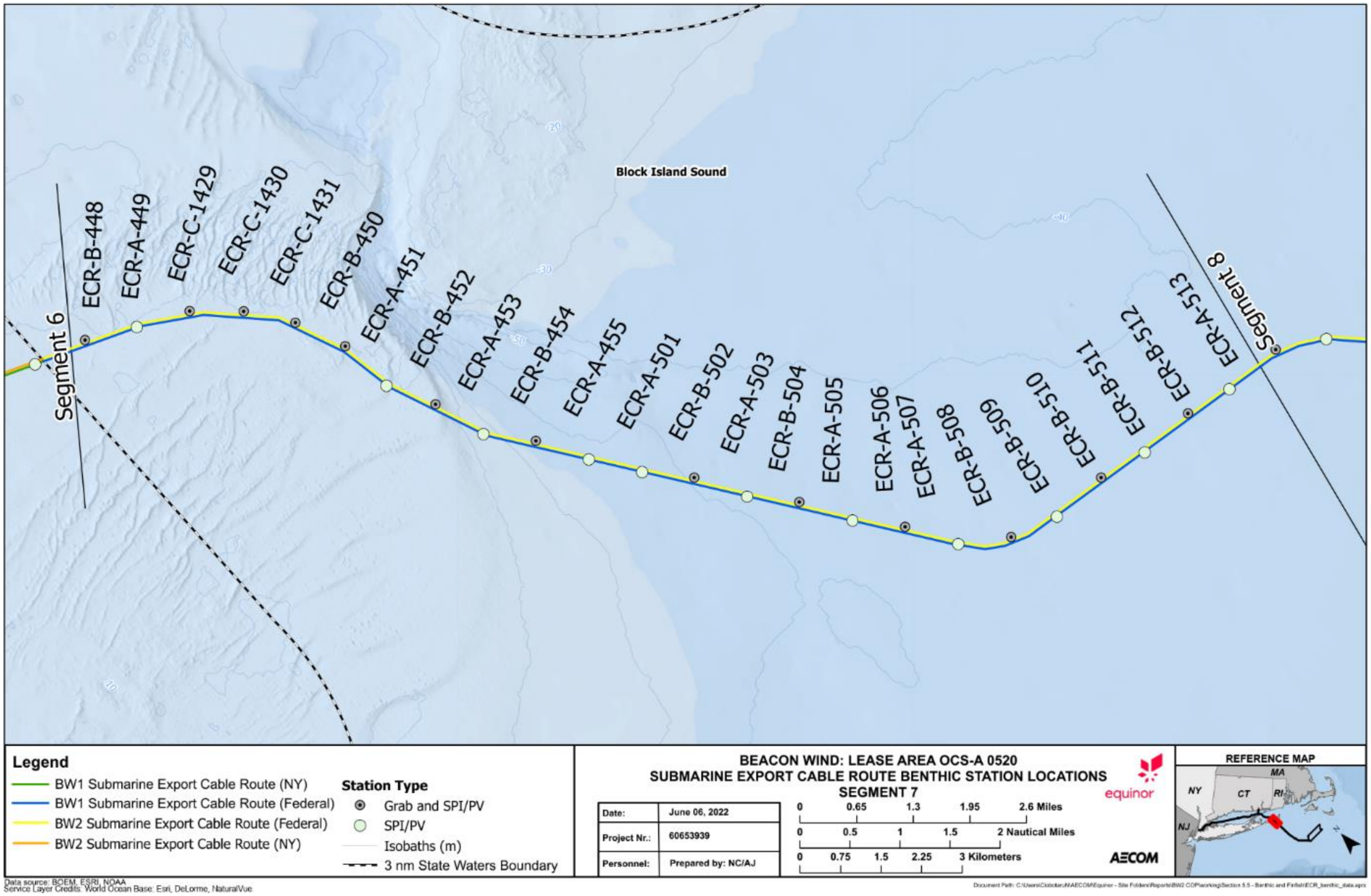


FIGURE 5.5-25. SUBMARINE EXPORT CABLE CORRIDORS STATION LOCATIONS SEGMENT 8 OFFSHORE SUBMARINE EXPORT CABLE CORRIDOR - BLOCK ISLAND SOUND TO LEASE AREA.

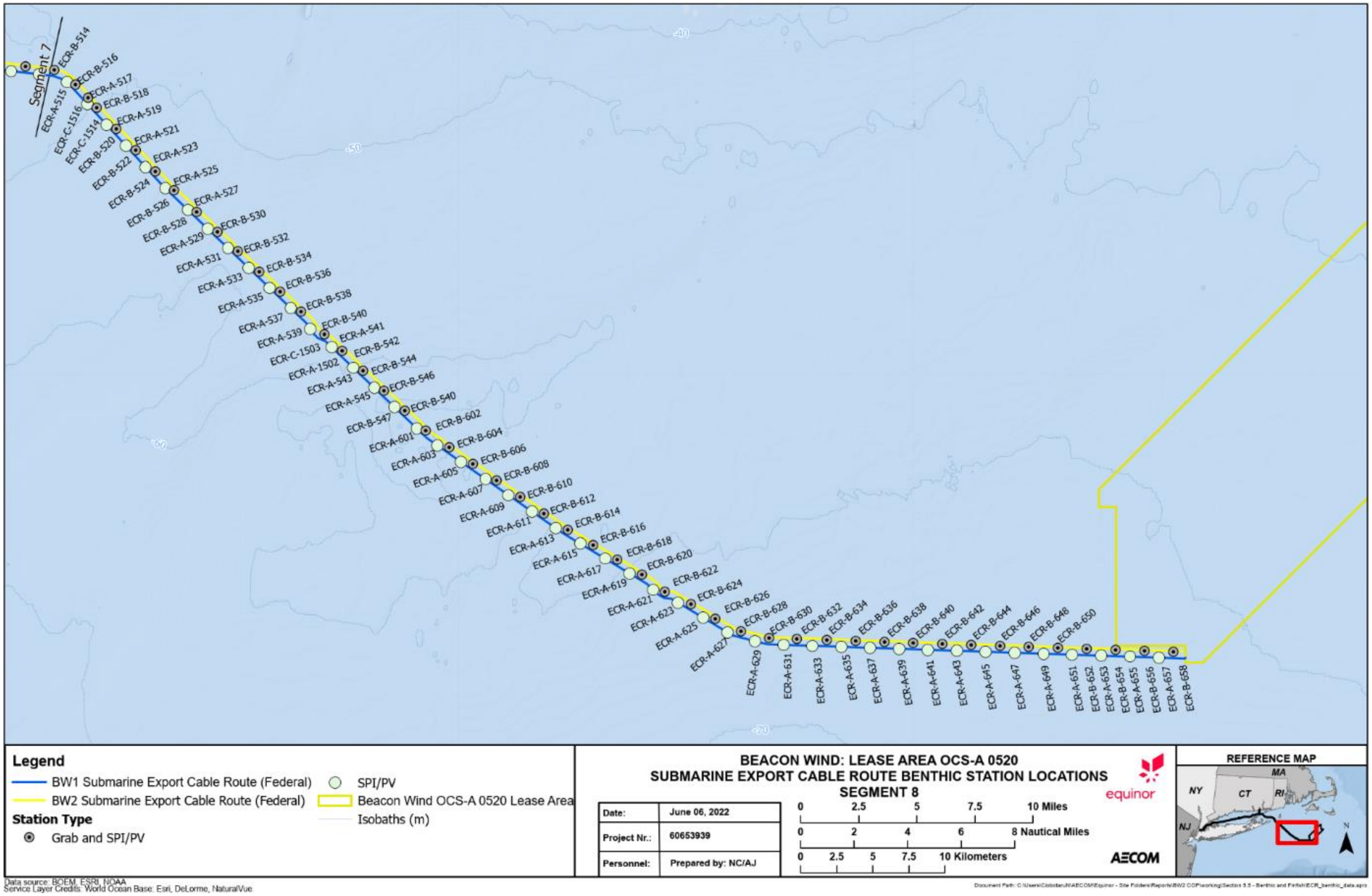


TABLE 5.5-7. CMECS GEOFORM CHARACTERIZATION FOR SUBMARINE EXPORT CABLE CORRIDOR SAMPLING STATIONS, SEGMENTS 1-8

Tectonic Setting	Physiographic Setting	Geoform Level 2	Geoform	Stations a/
Segment 1				
Passive Continental Margin	Sound	Biogenic	Burrows/ Bioturbation	ECR-B-1156, ECR-B-1157, ECR-B-1158
		Geologic	Boulder Field	ECR-B-1151, ECR-B-1153, ECR-C-1107, ECR-C-1108, ECR-C-1110, ECR-C-1113
			Flat	ECR-A-101-A, ECR-B-102, ECR-B-104, ECR-B-106, ECR-B-108, ECR-B-110, ECR-B-1150, ECR-B-1152, ECR-B-1154, ECR-1155
Segment 2				
Passive Continental Margin	Sound	Biogenic	Burrows/ Bioturbation	ECR-B-1131, ECR-B-1135, ECR-B-1137, ECR-B-112, ECR-B-114, ECR-B-116, ECR-B-118, ECR-B-120, ECR-B-124, ECR-B-126, ECR-B-128, ECR-B-130, ECR-B-132, ECR-B-134, ECR-B-136, ECR-B-138, ECR-B-140, ECR-B-142, ECR-B-144, ECR-B-152, ECR-B-154, ECR-C-1102, ECR-C-1104, ECR-C-1105, ECR-C-1111
		Geologic	Boulder Field	ECR-A-121, ECR-A-1133, ECR-B-122, ECR-B-146, ECR-B-148, ECR-B-150, ECR-C-1103, ECR-C-1106, ECR-C-1109, ECR-C-1112
Segment 3				
Passive Continental Margin	Sound	Biogenic	Burrows/ Bioturbation	ECR-A-212, ECR-A-236, ECR-B-201, ECR-B-203, ECR-B-205, ECR-B-207, ECR-B-209, ECR-B-211, ECR-B-213, ECR-B-215, ECR-B-217, ECR-B-219, ECR-B-221, ECR-B-223, ECR-B-225, ECR-B-227, ECR-B-229, ECR-B-231, ECR-B-233, ECR-B-235, ECR-B-237, ECR-B-239, ECR-B-241, ECR-B-243, ECR-B-245, ECR-B-247, ECR-B-302, ECR-B-304, ECR-B-306, ECR-B-308, ECR-B-310, ECR-B-312, ECR-B-314, ECR-B-316, ECR-B-318, ECR-B-320, ECR-B-322, ECR-B-324, ECR-B-326, ECR-C-1101, ECR-C-1201, ECR-C-1202, ECR-C-1203, ECR-C-1204, ECR-C-1205, ECR-C-1206, ECR-C-1210, ECR-C-1211, ECR-C-1212, ECR-C-1215
		Geologic	Boulder Field	ECR-C-1207, ECR-C-1208, ECR-C-1209, ECR-C-1213, ECR-C-1214

Tectonic Setting	Physiographic Setting	Geoform Level 2	Geoform	Stations a/
Segment 4				
Passive Continental Margin	Sound	Biogenic	Burrows/ Bioturbation	ECR-B-328, ECR-B-330, ECR-B-332, ECR-B-334, ECR-B-336, ECR-B-338, ECR-B-340, ECR-B-342, ECR-B-344, ECR-B-346, ECR-B-348, ECR-B-350, ECR-C-1301, ECR-C-1302, ECR-B-414, ECR-B-416, ECR-B-458, ECR-C-1404, ECR-C-1428
		Geologic	Boulder Field	ECR-B-420, ECR-C-1303, ECR-C-1303a, ECR-C-1304, ECR-C-1305, ECR-C-1405, ECR-C-1406, ECR-C-1408, ECR-C-1409, ECR-C-1410, ECR-C-1411, ECR-C-1427
			Flat	ECR-B-402, ECR-B-404, ECR-B-406, ECR-B-408, ECR-B-410, ECR-B-412, ECR-B-418, ECR-B-456, ECR-B-460, ECR-B-462, ECR-B-464, ECR-B-466, ECR-B-468, ECR-C-1401, ECR-C-1402, ECR-C-1403, ECR-C-1407
Segment 5				
Passive Continental Margin	Sound	Biogenic	Burrows/ Bioturbation	ECR-B-474, ECR-B-476, ECR-B-1436
		Geologic	Boulder Field	ECR-B-478, ECR-C-1432, ECR-C-1434
			Flat	ECR-B-470, ECR-B-472, ECR-C-1433, ECR-C-1435, ECR-C-1437
Passive Continental Margin	Sound	Biogenic	Burrows/ Bioturbation	ECR-B-480-A, ECR-B-480-A_Cab, ECR-B-484, ECR-B-486, ECR-B-488, ECR-B-488_Cab, ECR-C-1436
		Geologic	Boulder Field	ECR-C-1438
			Flat	ECR-B-482
Segment 6				
Passive Continental Margin	Sound	Biogenic	Burrows/ Bioturbation	ECR-B-424, ECR-B-426, ECR-B-428, ECR-B-430, ECR-B-432, ECR-B-436, ECR-B-438, ECR-B-440, ECR-C-1412, ECR-C-1418
		Geologic	Boulder Field	ECR-B-442, ECR-B-446, ECR-C-1413, ECR-C-1414, ECR-C-1415, ECR-C-1416|1417, ECR-C-1419, ECR-C-1420, ECR-C-1421
			Flat	ECR-B-422. ECR-B-434, ECR-B-444, ECR-C-1422
Segment 7				
Passive Continental Margin	Sound	Biogenic	Burrows/ Bioturbation	ECR-B-454, ECR-B-502, ECR-B-504, ECR-B-506, ECR-B-508, ECR-B-510, ECR-B-512, ECR-B-514, ECR-C-1425, ECR-C-1426, ECR-C-1518, ECR-C-1519, ECR-C-1520, ECR-C-1521
		Geologic	Boulder Field	ECR-C-1431
			Flat	ECR-B-448, ECR-B-450, ECR-B-452, ECR-C-1423, ECR-C-1424, ECR-C-1429, ECR-C-1430

Tectonic Setting	Physiographic Setting	Geoform Level 2	Geoform	Stations a/
Segment 8				
Passive Continental Margin	Continental Shelf	Biogenic	Burrows/ Bioturbation	ECR-A-1504, ECR-A-1508, ECR-B-516, ECR-B-518 & ECR-C-1514, ECR-B-520, ECR-B-522, ECR-B-524, ECR-B-526, ECR-B-528, ECR-B-530, ECR-B-534, ECR-B-544, ECR-B-546, ECR-B-602, ECR-B-604, ECR-B-612, ECR-B-614, ECR-B-616, ECR-B-620, ECR-B-622, ECR-B-624, ECR-B-626, ECR-B-628, ECR-B-630, ECR-B-632, ECR-B-634, ECR-B-636, ECR-B-638, ECR-B-640, ECR-B-642, ECR-B-644, ECR-B-646, ECR-B-648, ECR-B-650, ECR-B-652, ECR-B-654, ECR-B-656, ECR-B-658, ECR-C-1505, ECR-C-1511, ECR-C-1512, ECR-C-1517, ECR-C-1601, ECR-C-1603
Passive Continental Margin	Continental Shelf	Biogenic	Burrows/ Bioturbation	ECR-A-1501, ERC-A-1502, ECR-A-1513, ECR-A-1515, ECR-A-1604, ECR-B-532, ECR-B-536, ECR-B-538, ECR-B-540 & ERC-C-1503, ECR-B-542 & ECR-B-548, ECR-B-606, ECR-B-608, ECR-B-610, ECR-B-618, ECR-C-1506, ECR-C-1507, ECR-C-1509, ECR-C-1510, ECR-C-1516, ECR-C-1602

Note:

a/ Sampled stations are designated with the format ECR-<letter>-### (e.g., ECR-B-224). “ECR” denoted stations along the submarine export cable route, the letter (A, B or C) denoted the type of sampling, and the three or four number sequence was a unique sample station identifier. In most instances, the “A” stations were designated as SPI and PV imaging sampling only, the “B” stations were all sampling methods, and “C” stations were most often benthic drop/tow camera sampling to evaluate potential complex habitat based on benthic video analysis.

Megaripples of <1 km in size at Segment 8.

TABLE 5.5-8. CMECS BIOTIC CHARACTERIZATION FOR SUBMARINE EXPORT CABLE CORRIDOR SAMPLING STATIONS

Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Stations a/
Segment 1					
Benthic/ Attached Biota	Faunal Bed	Soft Sediment Fauna	--	--	ECR-A-101-A, ECR-B-102, ECR-B-104, ECR-B-106, ECR-B-108, ECR-B-110, ECR-B-1150, ECR-B-1152, ECR-B-1154, ECR-1155, ECR-B-1156, ECR-B-1157, ECR-B-1158
		Attached Fauna	Diverse Colonizers	Large Macrofauna	ECR-B-1151, ECR-B-1153, ECR-C-1107, ECR-C-1108, ECR-C-1110, ECR-C-1113
Segment 2					
Benthic/ Attached Biota	Faunal Bed	Soft Sediment Fauna	--	--	ECR-A-1131, ECR-A-1135, ECR-A-1137, ECR-B-112, ECR-B-114, ECR-B-116, ECR-B-118, ECR-B-120, ECR-B-124, ECR-B-126, ECR-B-128, ECR-B-130, ECR-B-132, ECR-B-134, ECR-B-136, ECR-B-138, ECR-B-140, ECR-B-142, ECR-B-144, ECR-B-146, ECR-B-152, ECR-B-154, ECR-C-1102, ECR-C-1104, ECR-C-1105, ECR-C-1111
		Attached Fauna	Diverse Colonizers	Large Macrofauna	ECR-A-121*, ECR-A-1133, ECR-B-122*, ECR-B-146*, ECR-B-148*, ECR-B-150*, ECR-C-1103*, ECR-C-1106, ECR-C-1109, ECR-C-1112
Segment 3					
Benthic/ Attached Biota	Faunal Bed	Soft Sediment Fauna	--	--	ECR-A-212, ECR-A-236, ECR-B-201, ECR-B-203, ECR-B-205, ECR-B-207, ECR-B-209, ECR-B-211, ECR-B-213, ECR-B-215, ECR-B-217, ECR-B-219, ECR-B-221, ECR-B-223, ECR-B-225, ECR-B-227, ECR-B-229, ECR-B-231, ECR-B-233, ECR-B-235, ECR-B-237, ECR-B-239, ECR-B-241, ECR-B-243, ECR-B-245, ECR-B-247, ECR-B-302, ECR-B-304, ECR-B-306, ECR-B-308, ECR-B-310, ECR-B-312, ECR-B-314, ECR-B-316, ECR-B-318, ECR-B-320, ECR-B-322, ECR-B-324, ECR-B-326, ECR-C-1101, ECR-C-1201, ECR-C-1202, ECR-C-1203, ECR-C-1204, ECR-C-1205, ECR-C-1206, ECR-C-1210, ECR-C-1211, ECR-C-1212, ECR-C-1215
		Attached Fauna	Diverse Colonizers	Large Macrofauna	ECR-C-1207, ECR-C-1208, ECR-C-1209, ECR-C-1213, ECR-C-1214

Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Stations a/
Segment 4					
Benthic/ Attached Biota	Faunal Bed	Soft Sediment Fauna	--	--	ECR-B-328, ECR-B-330, ECR-B-332, ECR-B-334, ECR-B-336, ECR-B-338, ECR-B-340, ECR-B-342, ECR-B-344, ECR-B-346, ECR-B-348, ECR-B-350, ECR-C-1301, ECR-C-1302, ECR-B-414, ECR-B-416, ECR-B-458, ECR-C-1404, ECR-C-1428, ECR-B-402, ECR-B-404, ECR-B-406, ECR-B-408, ECR-B-410, ECR-B-412, ECR-B-418, ECR-B-456, ECR-B-460, ECR-B-464, ECR-B-466, ECR-B-468, ECR-C-1401, ECR-C-1402, ECR-C-1403, ECR-C-1407
		Attached Fauna	Diverse Colonizers	Large Macrofauna	ECR-B-420, ECR-C-1303, ECR-C-1303a, ECR-C-1304, ECR-C-1305, ECR-C-1405, ECR-C-1406, ECR-C-1408, ECR-C-1409, ECR-C-1410, ECR-C-1411, ECR-C-1427
Segment 5					
Benthic/ Attached Biota	Faunal Bed	Soft Sediment Fauna	Mobile Mollusks on Soft Sediments	*Crepidula* spp. Beds	ECR-C-1437
			--	--	ECR-B-470, ECR-B-472, ECR-B-474, ECR-B-476, ECR-C-1433, ECR-C-1435, ECR-C-1436
		Attached Fauna	Diverse Colonizers	Large Macrofauna	ECR-B-478; ECR-C-1432, ECR-C-1434
Segment 5.1					
Benthic/ Attached Biota	Faunal Bed	Soft Sediment Fauna	--	--	ECR-B-482, ECR-B-484, ECR-B-486, ECR-B-488, ECR-B-488_Cab, ECR-C-1439
		Attached Fauna	Diverse Colonizers	Large Macrofauna	ECR-C-1438
Segment 6					
Benthic/ Attached Biota	Faunal Bed	Soft Sediment Fauna	--	--	ECR-B-422, ECR-B-424, ECR-B-426, ECR-B-428, ECR-B-430, ECR-B-432, ECR-B-434, ECR-B-436, ECR-B-438, ECR-B-440, ECR-B-444, ECR-C-1412, ECR-C-1418, ECR-C-1422
		Attached Fauna	Diverse Colonizers	Large Macrofauna	ECR-B-442, ECR-B-446, ECR-C-1413, ECR-C-1414, ECR-C-1415, ECR-C-1416|1417, ECR-C-1419, ECR-C-1420, ECR-C-1421
Segment 7					
Benthic/ Attached Biota	Faunal Bed	Soft Sediment Fauna	--	--	ECR-B-450, ECR-B-452, ECR-B-454, ECR-B-502, ECR-B-504, ECR-B-506, ECR-B-508, ECR-B-510, ECR-C-1425, ECR-C-1426, ECR-C-1430, ECR-C-1518, ECR-C-1519, ECR-C-1520, ECR-C-1521

Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Stations a/
			Mobile Mollusks on Soft Sediments	*Crepidula* spp. Beds	ECR-B-448, ECR-C-1423, ECR-C-1424, ECR-C1429
			Sand Dollar Bed	--	ECR-B-512, ECR-B-514
		Attached Fauna	Diverse Colonizers	Large Macrofauna	ECR-C-1431
Segment 8					
Benthic/ Attached Biota	Faunal Bed	Soft Sediment Fauna	--		ECR-A-1501, ECR-A-1504, ECR-A-1508, ECR-A-1515, ECR-A-1604, ECR-B-516, ECR-B-526, ECR-B-528, ECR-B-530, ECR-B-532, ECR-B-534, ECR-B-536, ECR-B-542 & ECR-A-1502, ECR-B-544, ECR-B-546, ECR-B-612, ECR-B-614, ECR-B-622, ECR-B-624, ECR-B-628, ECR-B-630, ECR-B-632, ECR-B-634, ECR-B-644, ECR-B-646, ECR-B-648, ECR-B-650, ECR-B-652, ECR-C-1506, ECR-C-1509, ECR-C-1510, ECR-C-1516, ECR-C-1517, ECR-C-1602, ECR-C-1603
			Starfish Bed		ECR-A-1513, ECR-B-518 & ECR-C-1514, ECR-B-520, ECR-B-522, ECR-B-524, ECR-B-538, ECR-B-602, ECR-B-604, ECR-B-606, ECR-B-608, ECR-B-610, ECR-B-616, ECR-B-618, ECR-B-620, ECR-B-626, ECR-B-636, ECR-B-638, ECR-B-640, ECR-B-642, ECR-B-654, ECR-B-656, ECR-B-658, ECR-C-1505, ECR-C-1511, ECR-C-1512, ECR-C-1601
			Sand Dollar Bed		ECR-B-540 & ECR-A-1503, ECR-B-548, ECR-C-1507

Note:
a/ Sampled stations are designated with the format ECR-<letter>-### (e.g., ECR-B-224). "ECR" denoted stations along the submarine export cable route, the letter (A, B or C) denoted the type of sampling, and the three or four number sequence was a unique sample station identifier. In most instances, the "A" stations were designated as SPI and PV imaging sampling only, the "B" stations were all sampling methods, and "C" stations were most often benthic drop/tow camera sampling to evaluate potential complex habitat based on benthic video analysis.

TABLE 5.5-9. CMECS SUBSTRATE CLASSIFICATIONS FOR THE SUBMARINE EXPORT CABLE CORRIDOR BENTHIC GRAB SAMPLING STATIONS

Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Gravel Component	Stations
Segment 1					
Unconsolidated Mineral Substrate	Coarse Unconsolidated Substrate	Gravel Mix	Sandy Gravel	Granule/Pebble	ECR-B-1153
			Muddy Sandy Gravel		ECR-B-104, ECR-B-1150
		Gravelly	Gravelly Sand		ECR-B-102
			Gravelly Muddy Sand		ECR-B-101-A, ECR-B-1152, ECR-B-1157
			Gravelly Mud		ECR-B-1156
	Fine Unconsolidated Substrate	Muddy Sand	N/A	N/A	ECR-B-106, ECR-B-110, ECR-B-1154, ECR-B-1158
		Sandy Mud	N/A	N/A	ECR-B-1155
Shell	Shell Rubble/Hash	N/A	N/A	N/A	ECR-B-108
	Shell Hash	N/A	N/A	N/A	ECR-B-1151, ECR-B-1151-QC
Segment 2					
Unconsolidated Mineral Substrate	Coarse Unconsolidated Substrate	Gravelly	Gravelly Muddy Sand	Granule/Pebble	ECR-B-120, ECR-B-122, ECR-B-126, ECR-B-142
			Gravelly Mud		ECR-B-1131, ECR-B-1133, ECR-B-1137, ECR-B-114, ECR-B-116, ECR-B-118, ECR-B-120-QC, ECR-B-124, ECR-B-128, ECR-B-130, ECR-B-132, ECR-B-134, ECR-B-136, ECR-B-138, ECR-B-150
	Fine Unconsolidated Substrate	Sand	Medium Sand	N/A	ECR-B-144
		Muddy Sand	N/A	N/A	ECR-B-112, ECR-B-146, ECR-B-152
		Sandy Mud	N/A	N/A	ECR-B-1135, ECR-B-121, ECR-B-140, ECR-B-140-QC, ECR-B-148
Shell	Shell Hash	N/A	N/A	N/A	ECR-B-154

Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Gravel Component	Stations
Segment 3					
Unconsolidated Mineral Substrate	Coarse Unconsolidated Substrate	Gravelly	Gravelly Sand	Granule/Pebble	ECR-B-324
			Gravelly Muddy Sand		ECR-B-223, ECR-B-225, ECR-B-227, ECR-B-235, ECR-B-326, ECR-B-1207, ECR-B1208
			Gravelly Mud		ECR-B-203, ECR-B-205, ECR-B-207, ECR-B-209, ECR-B-211, ECR-B-213, ECR-B-229, ECR-B-231, ECR-B-233, ECR-B-237, ECR-B-239, ECR-B-239-QC, ECR-B-241, ECR-B-243
	Fine Unconsolidated Substrate	Sand	Medium Sand	N/A	ECR-B-322, ECR-B-322-QC
		Muddy Sand	N/A	N/A	ECR-B-217, ECR-B-219, ECR-B-219-QC, ECR-B-312, ECR-B-314, ECR-B-316, ECR-B-318, ECR-B-320, ECR-C-1101
		Mud	N/A	N/A	ECR-B-247
		Sandy Mud	N/A	N/A	ECR-B-201, ECR-B-215, ECR-B-221, ECR-B-245, ECR-B-302, ECR-B-304, ECR-B-306, ECR-B-308, ECR-B-310, ECR-C-1215
Segment 4					
Unconsolidated Mineral Substrate	Coarse Unconsolidated Substrate	N/A	N/A	Granule/Pebble	ECR-B-418
		Gravelly	Gravelly Sand		ECR-B-456
			Gravelly Muddy Sand		ECR-B-330, ECR-B-346, ECR-B-350, ECR-B-404, ECR-B-406, ECR-B-410, ECR-B-458, ECR-B-460, ECR-B-462, ECR-B-464,ECR-B-466
		Gravel Mix	Muddy Sandy Gravel		ECR-B-412, ECR-B-460-QC
			Muddy Gravel		ECR-B-402
	Fine Unconsolidated Substrate	Sand	Very Coarse/ Coarse Sand	N/A	ECR-B-420
		Muddy Sand	N/A	N/A	ECR-B-328, ECR-B-332, ECR-B-334, ECR-B-336, ECR-B-338, ECR-B-340, ECR-B-340-QC,

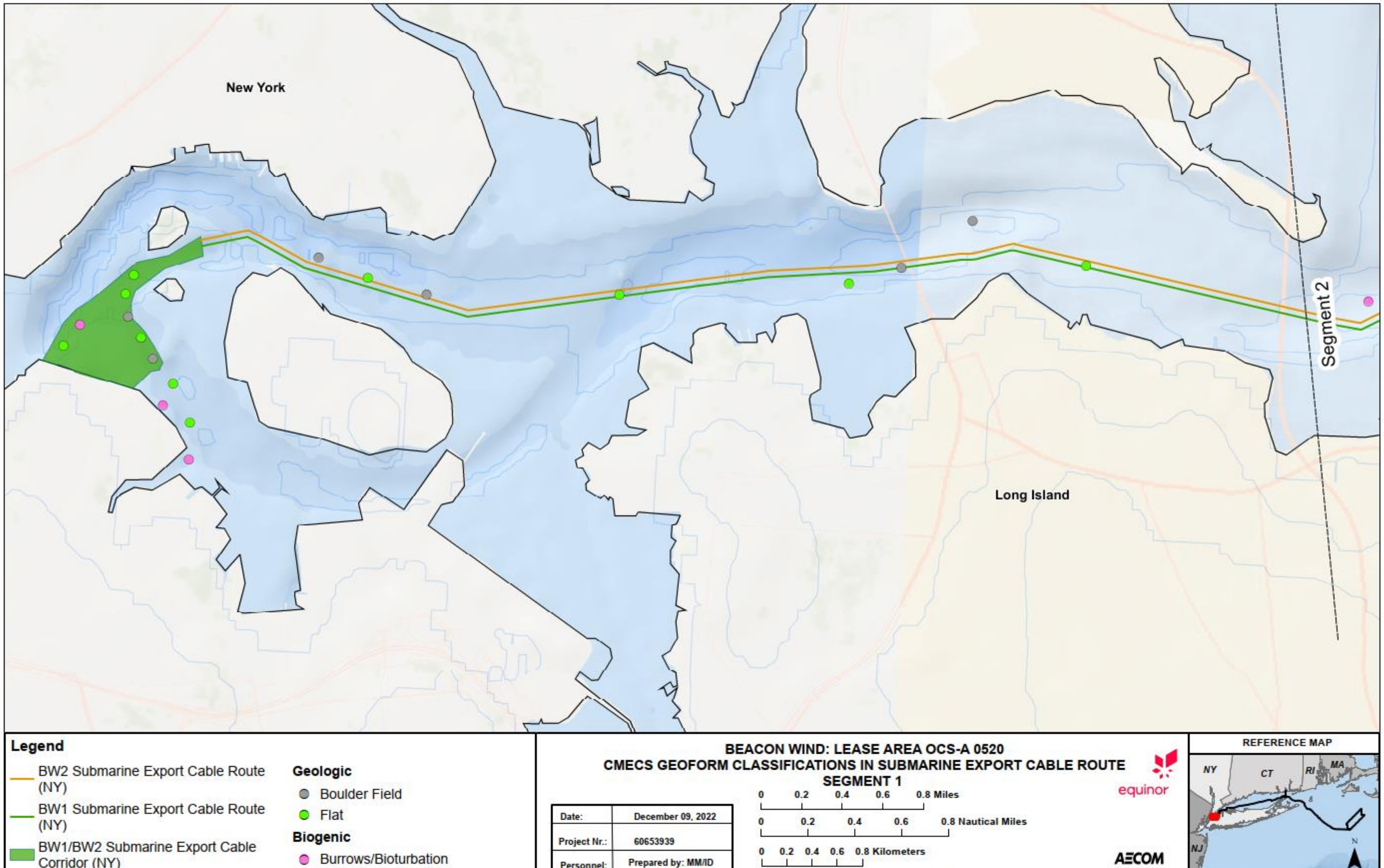
Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Gravel Component	Stations
					ECR-B-342, ECR-B-344, ECR-B-414, ECR-B-416, ECR-B-468, ECR-C-1302
		Sandy Mud	N/A	N/A	ECR-B-348
Shell	Shell Hash	N/A	N/A	N/A	ECR-B-408
Segment 5					
Unconsolidated Mineral Substrate	Coarse Unconsolidated Substrate	Gravelly	Gravelly Muddy Sand	Granule/Pebble	ECR-C-1437
	Fine Unconsolidated Substrate	Muddy Sand	N/A	N/A	ECR-B-474,ECR-B-476
Shell	Shell Hash	N/A	N/A	N/A	ECR-B-470,ECR-B-472
Segment 5.1					
Unconsolidated Mineral Substrate	Coarse Unconsolidated Substrate	Gravelly	Gravelly Muddy Sand	Granule/Pebble	ECR-B-486, ECR-B-488
	Fine Unconsolidated Substrate	Sand	Very Coarse/ Coarse Sand	N/A	ECR-B-478
		Muddy Sand	N/A	N/A	ECR-B-480-A, ECR-B-484
Shell	Shell Hash	N/A	N/A	N/A	ECR-B-482
Segment 6					
Unconsolidated Mineral Substrate	Coarse Unconsolidated Substrate	N/A	N/A	Granule/Pebble	ECR-B-446
		Gravelly	Gravelly Sand		ECR-B-432
			Gravelly Muddy Sand		ECR-B-436
		Gravel Mix	Muddy Sandy Gravel		ECR-B-444
		Sand	Coarse/Very Coarse Sand	N/A	ECR-B-442

Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Gravel Component	Stations
	Fine Unconsolidated Substrate		Medium Sand	N/A	ECR-B-440-QC
			Fine/ Very Fine Sand	N/A	ECR-B-430, ECR-B-438
		Muddy Sand	N/A	N/A	ECR-B-422, ECR-B-424, ECR-B-426, ECR-B-428, ECR-B-434, ECR-B-440
Segment 7					
Unconsolidated Mineral Substrate	Coarse Unconsolidated Substrate	Gravelly	Gravelly Sand	Granule/Pebble	ECR-B-448
			Gravelly Muddy Sand		ECR-B-452, ECR-C-1429
		Gravel Mix	Muddy Sandy Gravel		ECR-B-450
			Sandy Gravel		ECR-C-1430
			N/A	Cobble	ECR-C-1431
	Fine Unconsolidated Substrate	Sand	Medium Sand	N/A	ECR-B-506
			Fine/ Very Fine Sand	N/A	ECR-B-502
		Muddy Sand	N/A	N/A	ECR-B-454, ECR-B-504, ECR-B-508, ECR-B-510, ECR-B-510-QC, ECR-B-512
Segment 8					
Unconsolidated Mineral Substrate	Fine Unconsolidated Substrate	Gravelly	Gravelly Muddy Sand	Granule	ECR-B-514, ECR-B-642
		Sand	Medium Sand	N/A	ECR-B-518, ECR-B-608, ECR-B-610, ECR-C-1514
			Coarse/Very Coarse Sand	N/A	ECR-B-528-QC, ECR-C-1516
			Fine/ Very Fine Sand	N/A	ECR-B-516
		Muddy Sand	N/A	N/A	ECR-B-520, ECR-B-522, ECR-B-524, ECR-B-526, ECR-B-528, ECR-B-530, ECR-B-532, ECR-B-534,

Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Gravel Component	Stations
					ECR-B-536, ECR-B-538, ECR-B-540, ECR-B-542, ECR-B-544, ECR-B-546, ECR-B-548, ECR-B-548-QC, ECR-B-602, ECR-B-604, ECR-B-606, ECR-B-612, ECR-B-614, ECR-B-616, ECR-B-618, ECR-B-620, ECR-B-620-QC, ECR-B-622, ECR-B-624, ECR-B-626, ECR-B-630, ECR-B-634, ECR-B-646, ECR-B-652, ECR-B-654, ECR-B-656, ECR-B-658, ECR-C-1503, ECR-A-1502
		Sandy Mud	N/A	N/A	ECR-B-628, ECR-B-632, ECR-B-636, ECR-B-638, ECR-B-640, ECR-B-640-QC, ECR-B-644, ECR-B-648, ECR-B-650

Notes: a/ Sampled stations are designated with the format ECR-<letter>-### (e.g., ECR-B-224). "ECR" denoted stations along the submarine export cable route, the letter (A, B or C) denoted the type of sampling, and the three or four number sequence was a unique sample station identifier. In most instances, the "A" stations were designated as SPI and PV imaging sampling only, the "B" stations were all sampling methods, and "C" stations were most often benthic drop/tow camera sampling to evaluate potential complex habitat based on benthic video analysis.

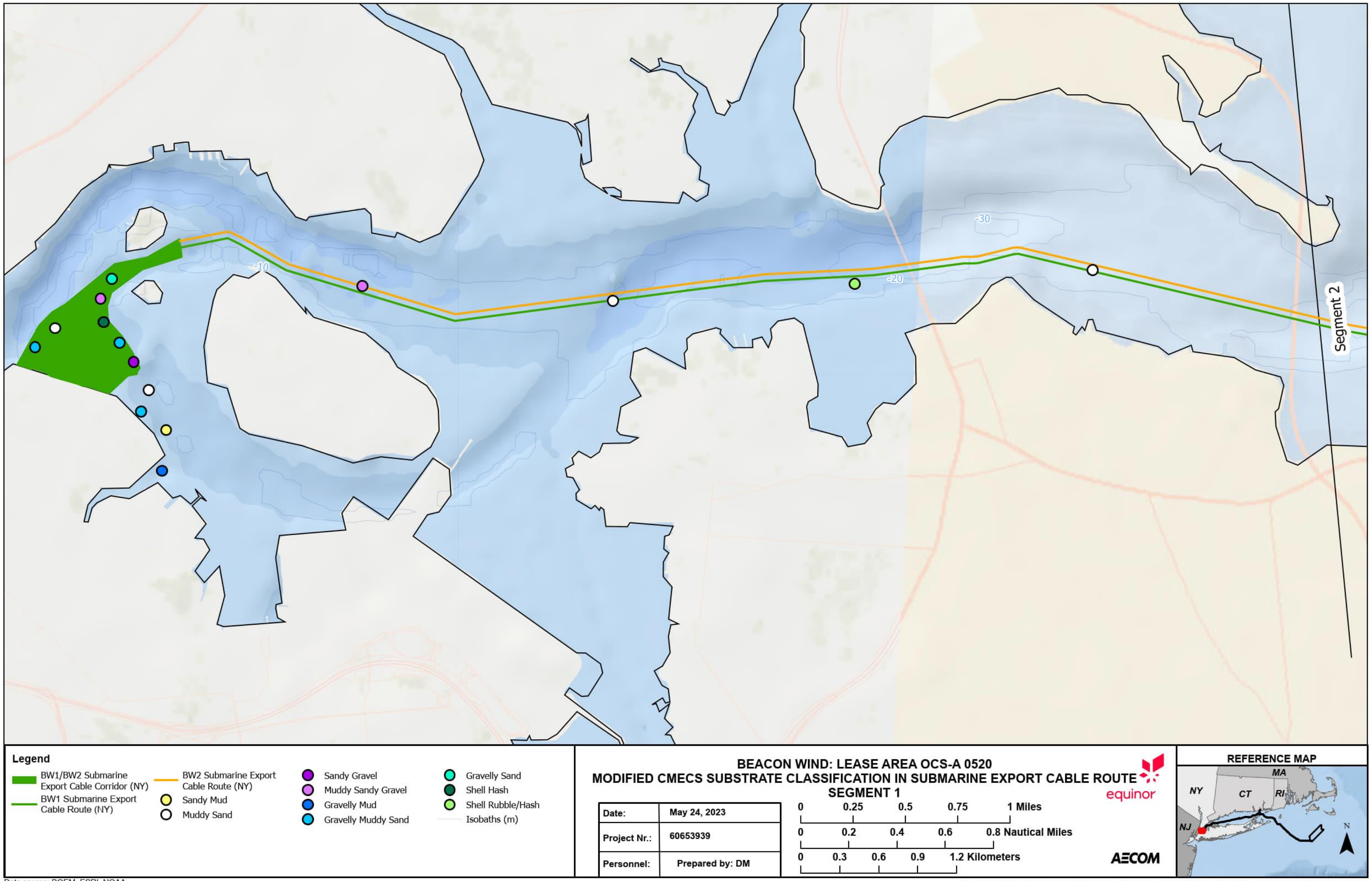
FIGURE 5.5-26. OVERVIEW OF CMECS CLASSIFICATIONS (GEOFORM) IN SEGMENT 1 OF THE SUBMARINE EXPORT CABLE CORRIDOR



Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

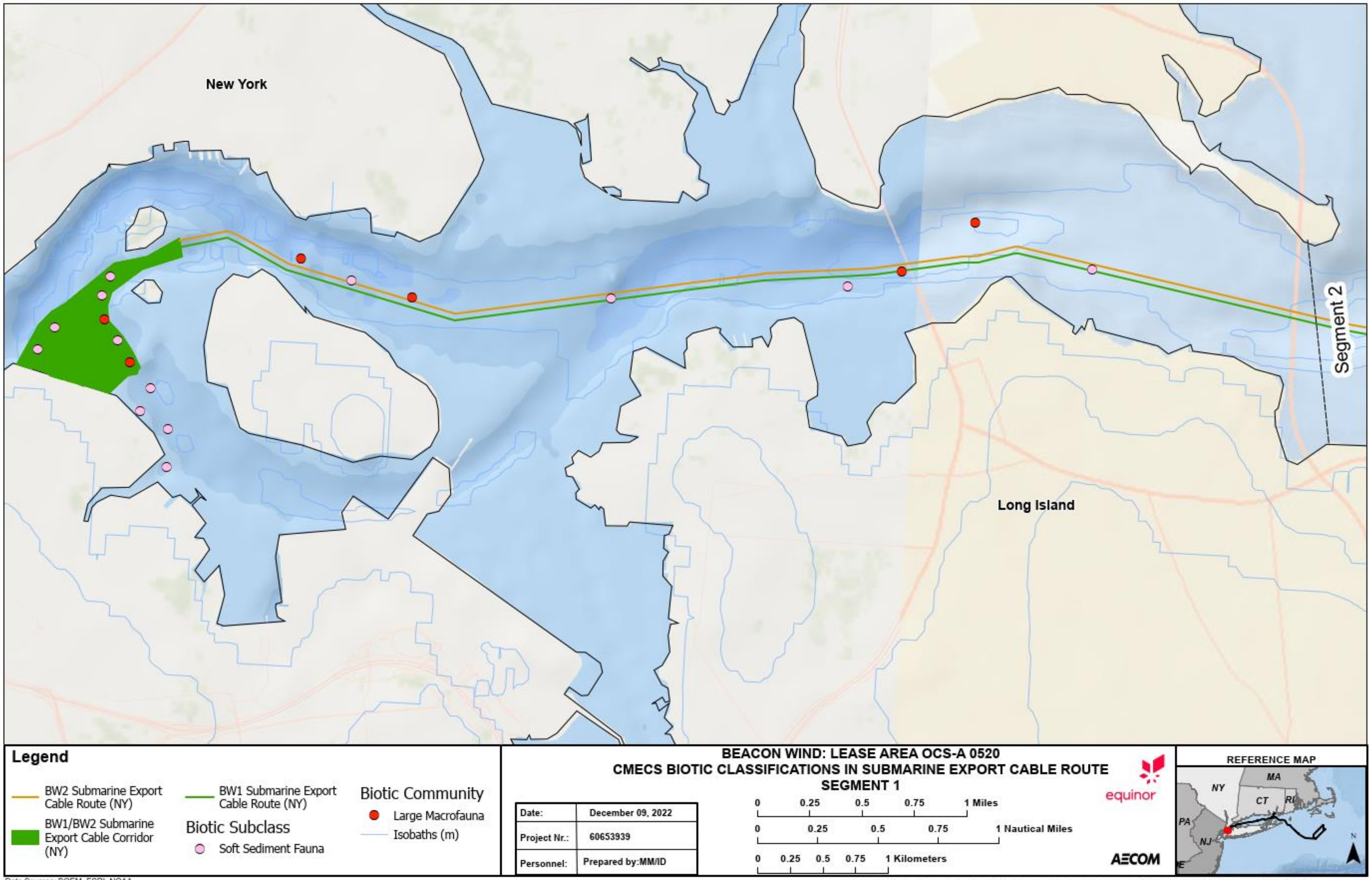
Document Path: C:\Users\MereutaM\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\Section 5.5 - Benthic and Finfish\CMECS_Geoform.mxd

Figure 5.5-27. Overview of NMFS Modified CMECS Classifications (Substrate) in Segment 1 of the Submarine Export Cable Corridor



Data source: BOEM, ESRI, NOAA
Service Layer Credits: World Ocean Base: Esri, DeLorme, NaturalVue

FIGURE 5.5-28. OVERVIEW OF CMECS CLASSIFICATIONS (BIOTIC) IN SEGMENT 1 OF THE SUBMARINE EXPORT CABLE CORRIDOR



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

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FIGURE 5.5-29. OVERVIEW OF CMECS CLASSIFICATIONS (GEOFORM) IN SEGMENT 2 OF THE SUBMARINE EXPORT CABLE CORRIDOR

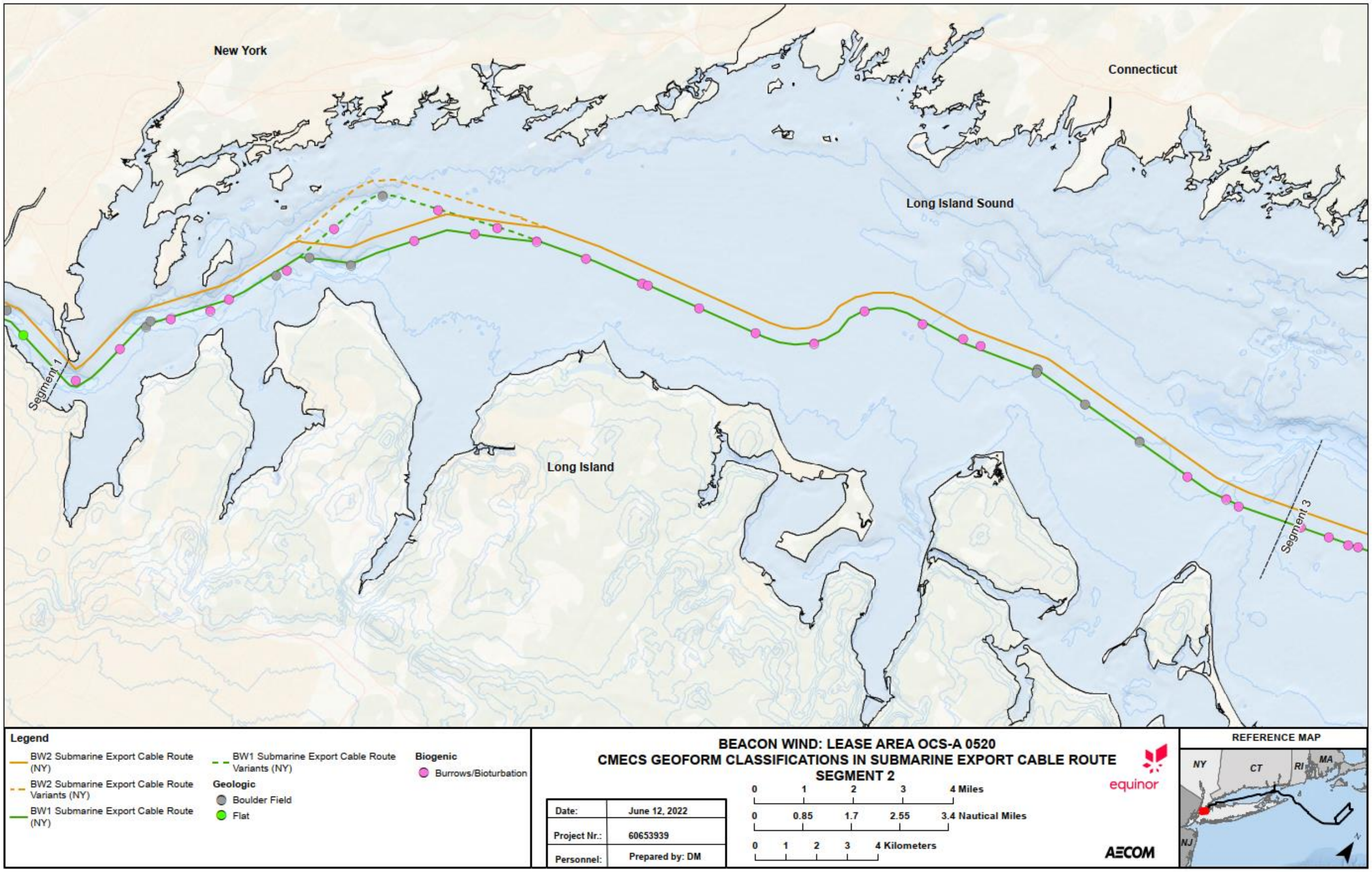
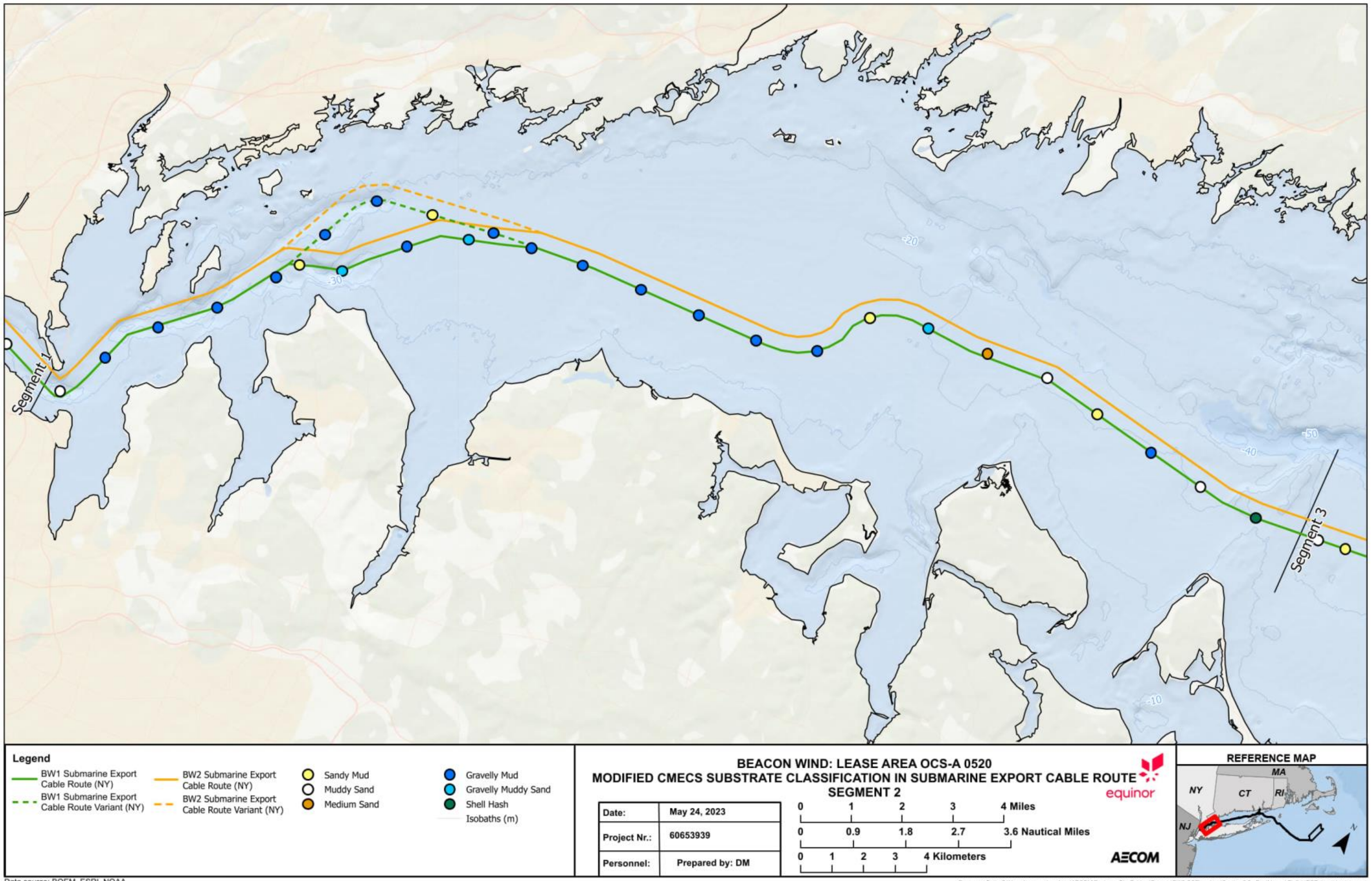


FIGURE 5.5-30. OVERVIEW OF NMFS MODIFIED CMECS CLASSIFICATIONS (SUBSTRATE) IN SEGMENT 2 OF THE SUBMARINE EXPORT CABLE CORRIDOR



Data source: BOEM, ESRI, NOAA
Service Layer Credits: World Ocean Base: Esri, DeLorme, NaturalVue

Document Path: C:\Users\savannah.walters\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\Section 5.5 - Benthic and Finfish\ECR_benthic_data.aprx

FIGURE 5.5-31. OVERVIEW OF CMECS CLASSIFICATIONS (BIOTIC) IN SEGMENT 2 OF THE SUBMARINE EXPORT CABLE CORRIDOR

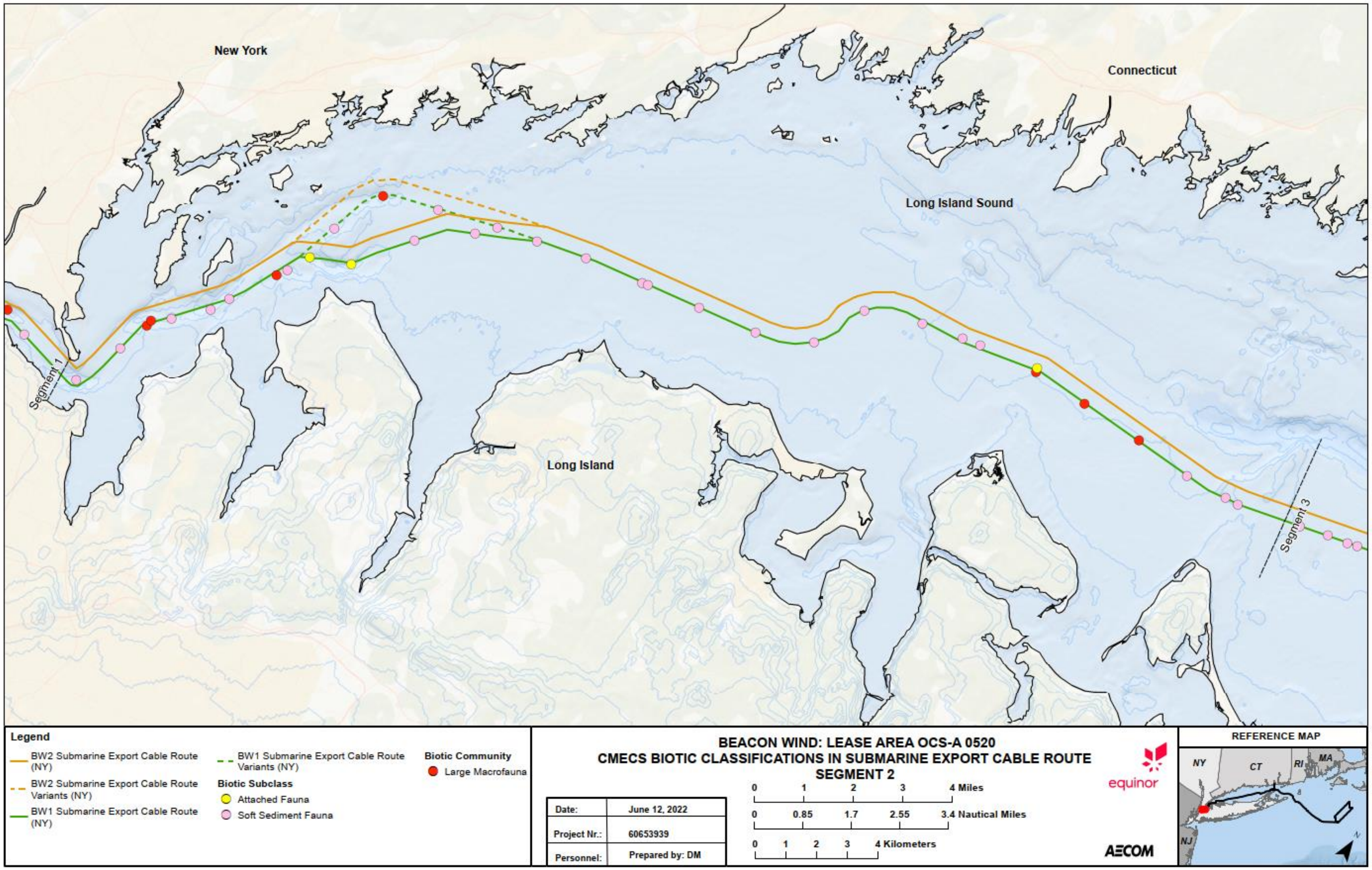


FIGURE 5.5-32. OVERVIEW OF CMECS CLASSIFICATIONS (GEOFORM) IN SEGMENT 3 OF THE SUBMARINE EXPORT CABLE CORRIDOR

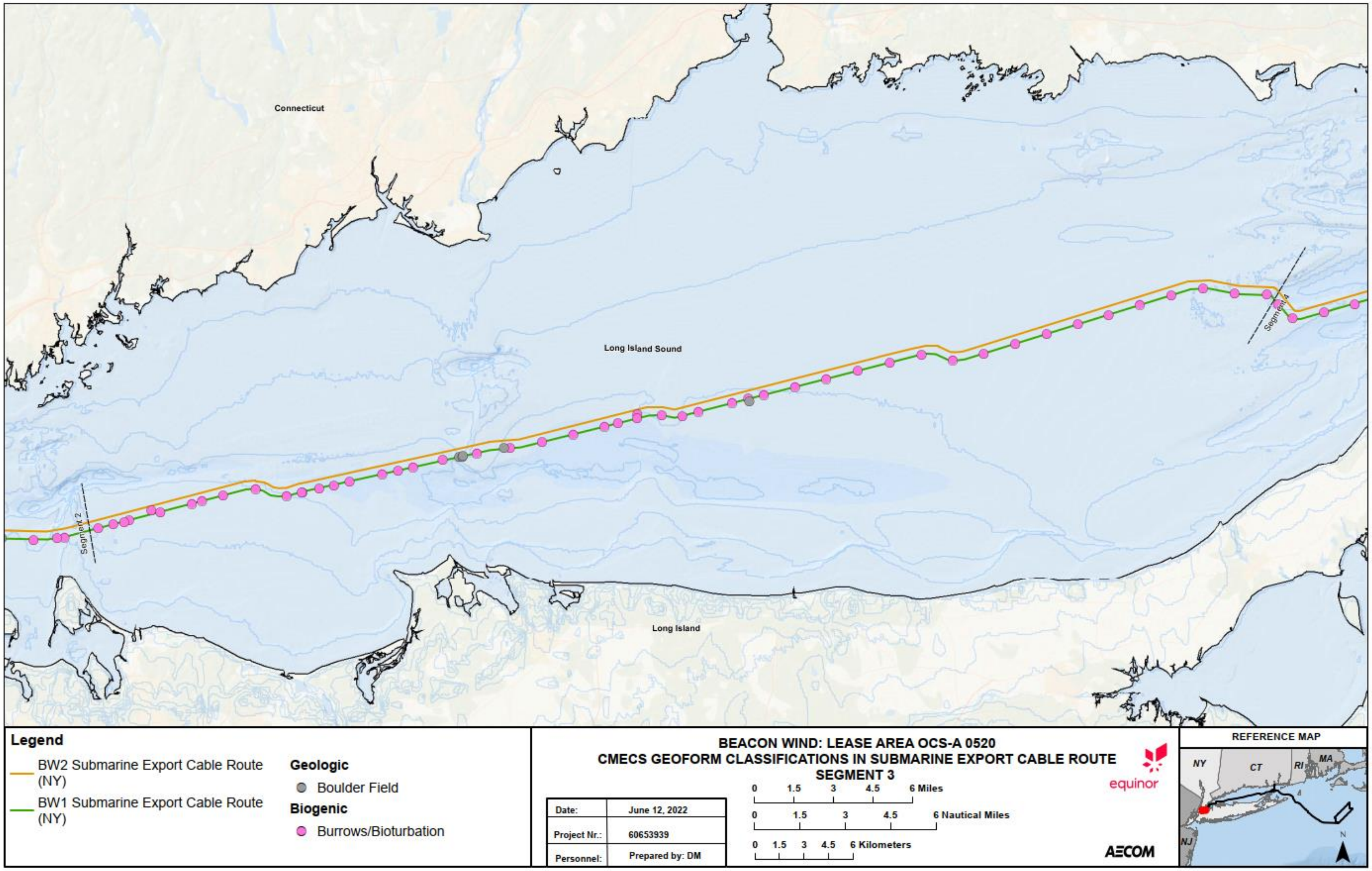


FIGURE 5.5-33. OVERVIEW OF NMFS MODIFIED CMECS CLASSIFICATIONS (SUBSTRATE) IN SEGMENT 3 OF THE SUBMARINE EXPORT CABLE CORRIDOR

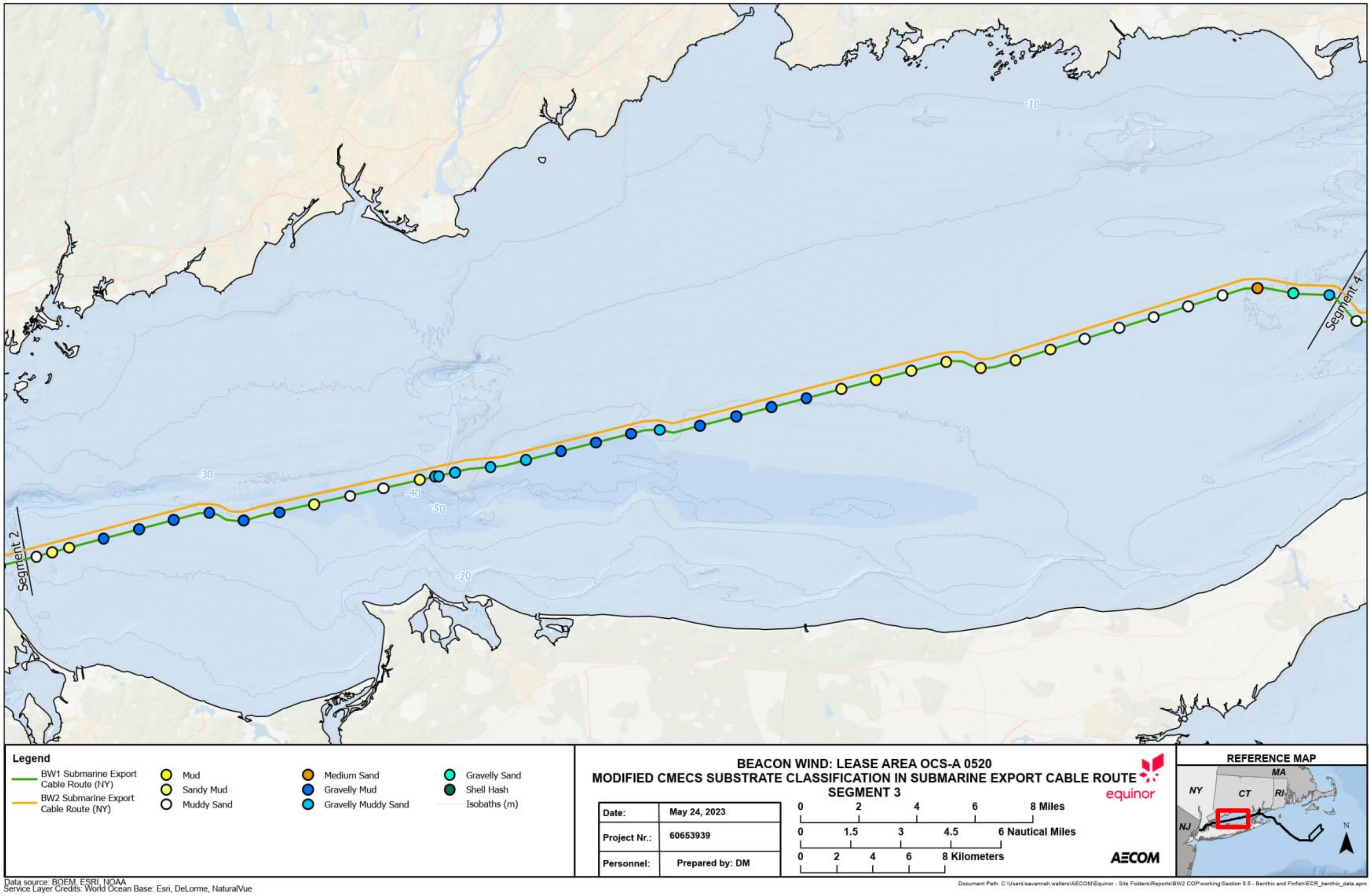


FIGURE 5.5-34. OVERVIEW OF CMECS CLASSIFICATIONS(BIOTIC) IN SEGMENT 3 OF THE SUBMARINE EXPORT CABLE CORRIDOR

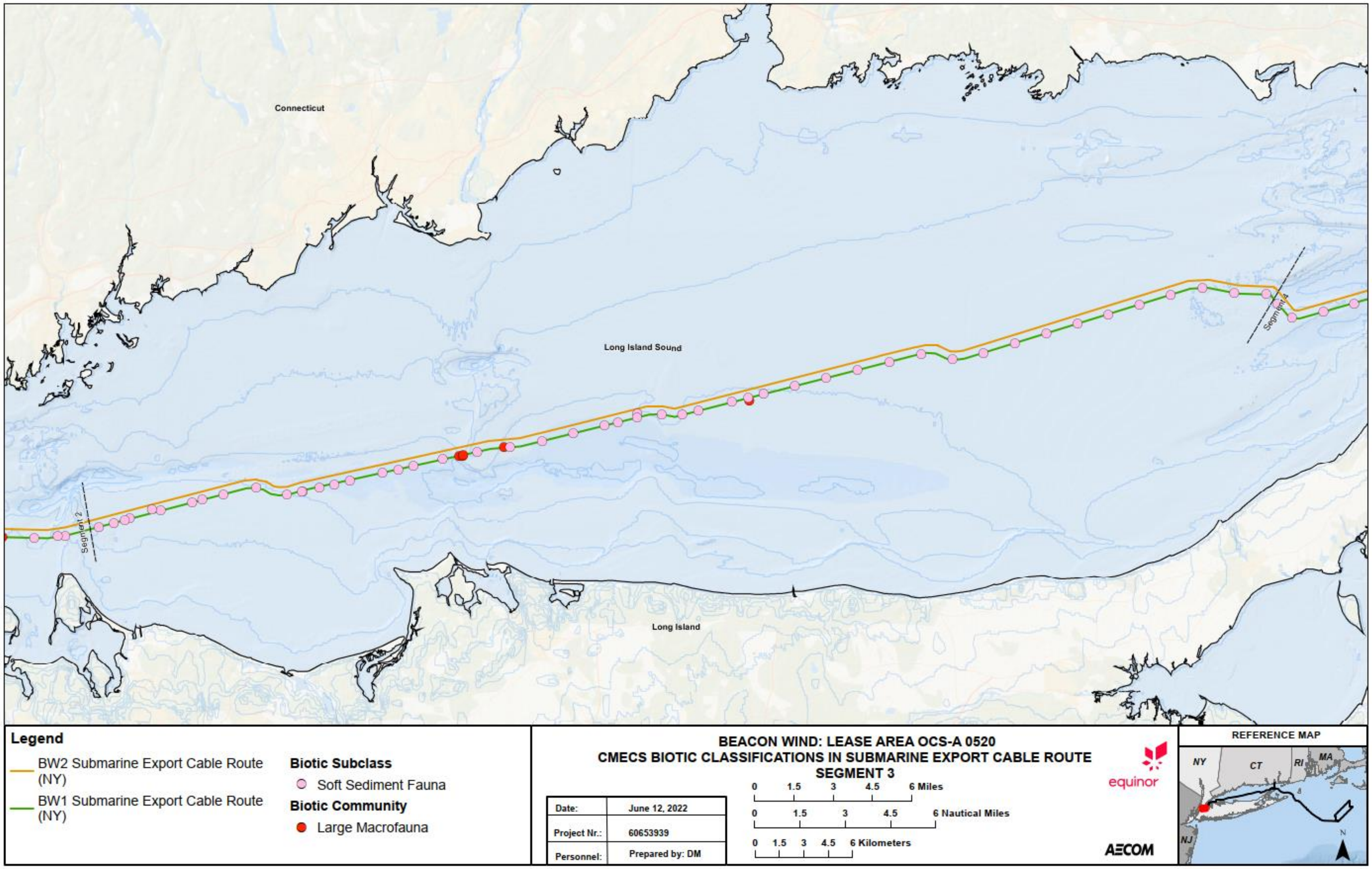


FIGURE 5.5-35. OVERVIEW OF CMECS CLASSIFICATIONS (GEOFORM) IN SEGMENT 4 OF THE SUBMARINE EXPORT CABLE CORRIDOR

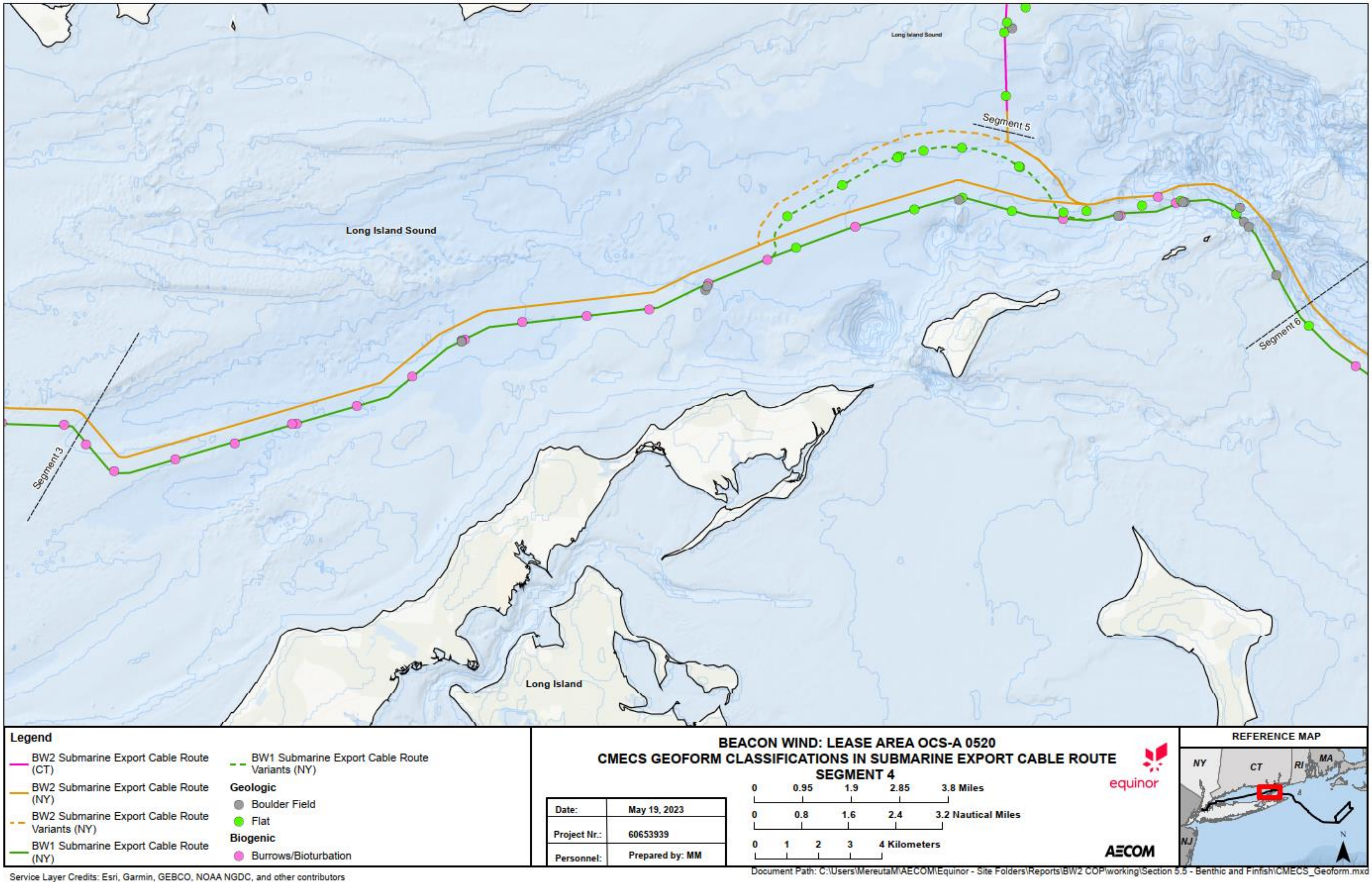
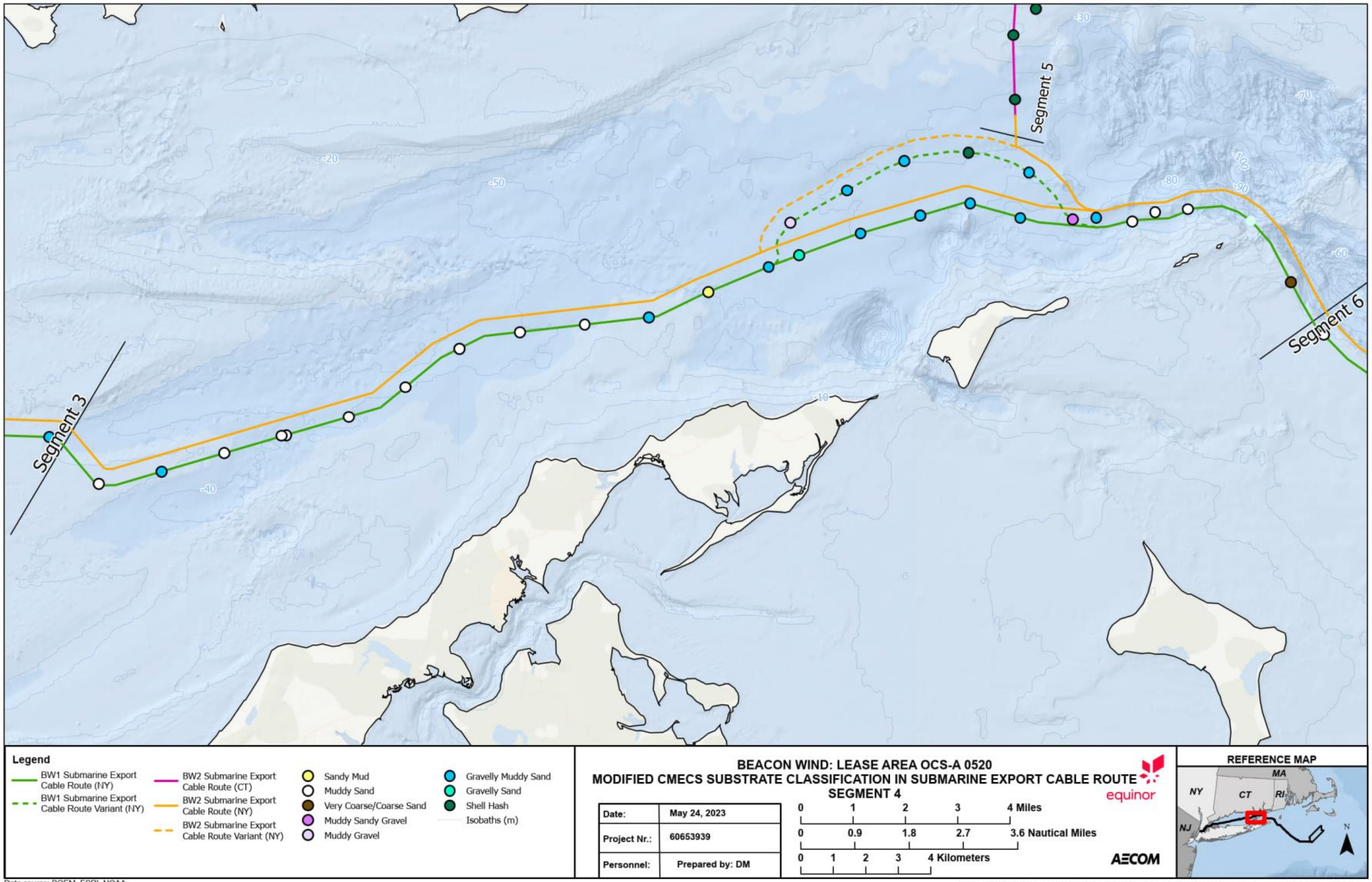


Figure 5.5-36. Overview of NMFS Modified CMECS Classifications (Substrate) in Segment 4 of the Submarine Export Cable Corridor



Data source: BOEM, ESRI, NOAA
Service Layer Credits: World Ocean Base: Esri, DeLorme, NaturalVue

FIGURE 5.5-37. OVERVIEW OF CMECS CLASSIFICATIONS (BIOTIC) IN SEGMENT 4 OF THE SUBMARINE EXPORT CABLE CORRIDOR

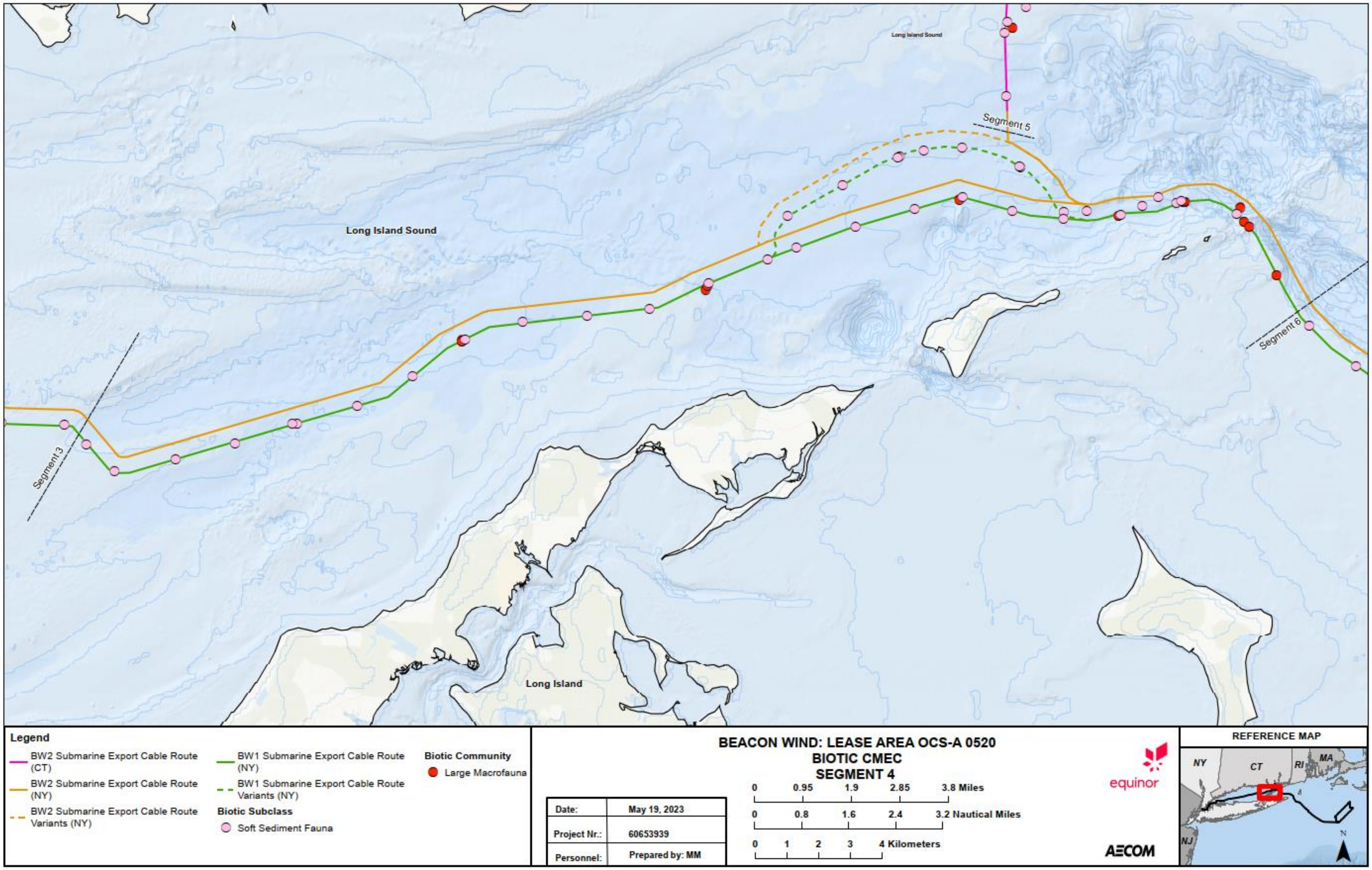


FIGURE 5.5-38. OVERVIEW OF CMECS CLASSIFICATIONS (GEOFORM) IN SEGMENT 5 OF THE SUBMARINE EXPORT CABLE CORRIDOR

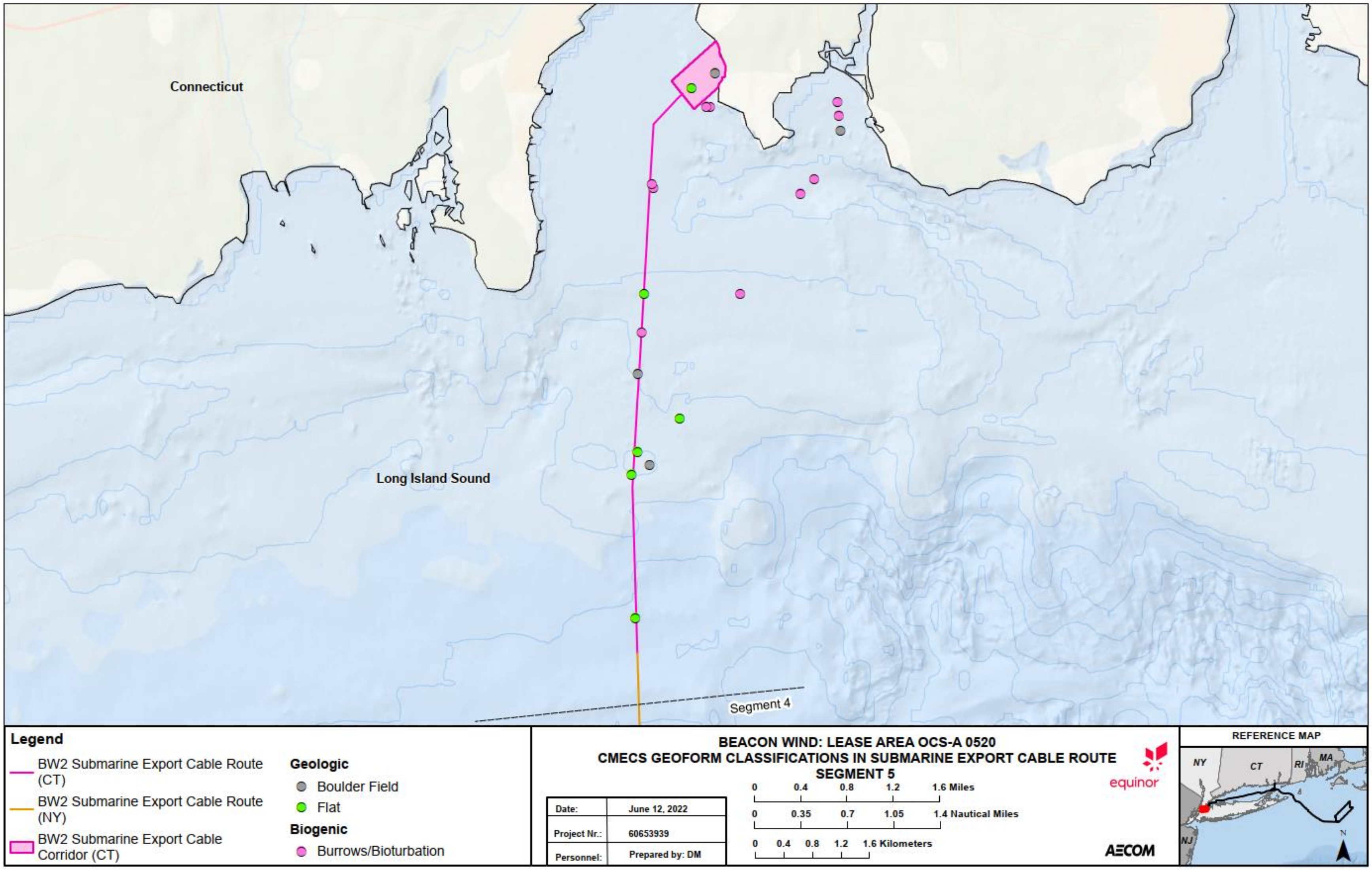
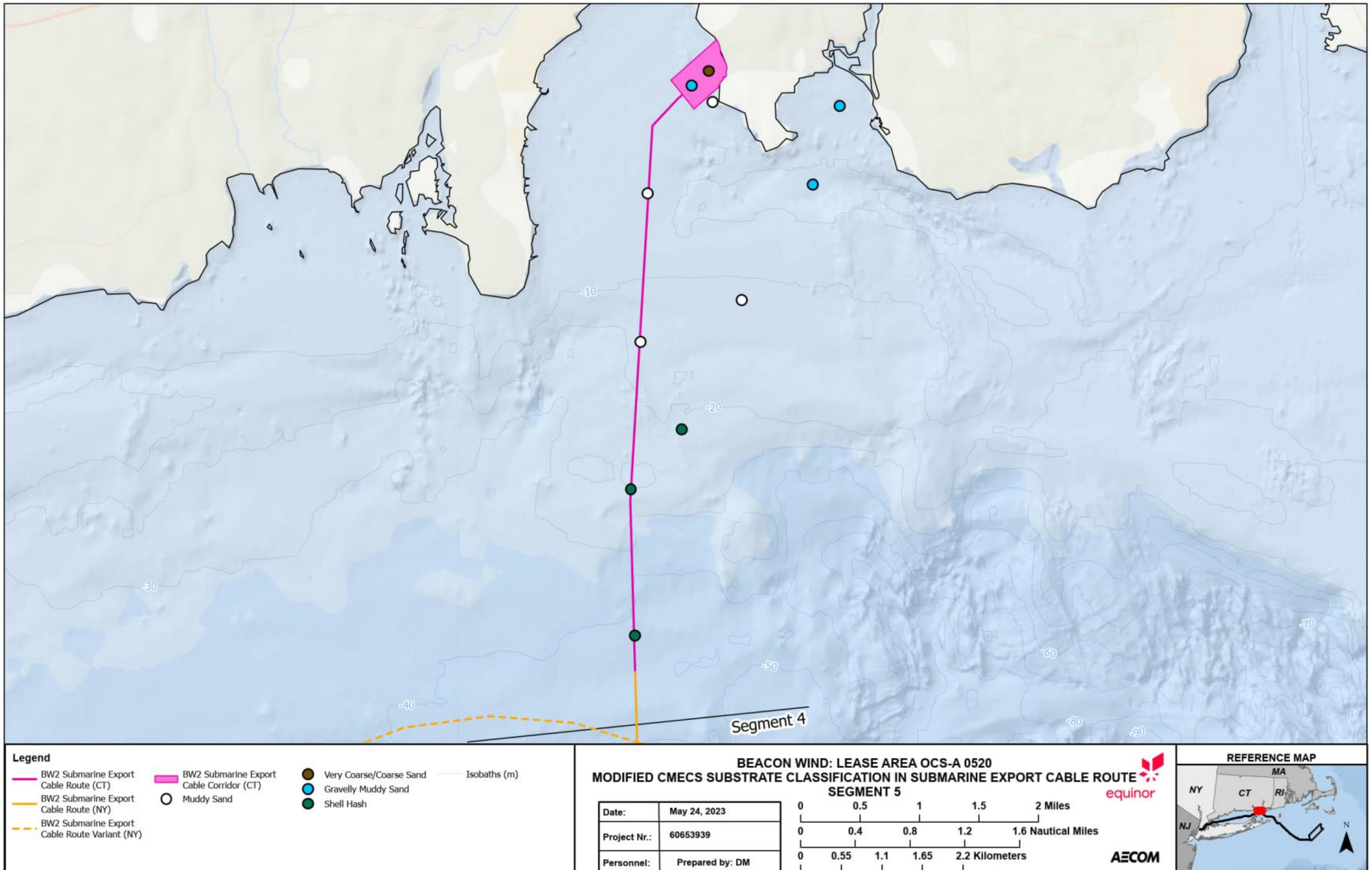


FIGURE 5.5-39. OVERVIEW OF NMFS MODIFIED CMECS CLASSIFICATIONS (SUBSTRATE) IN SEGMENT 5 OF THE SUBMARINE EXPORT CABLE CORRIDOR



Data source: BOEM, ESRI, NOAA
Service Layer Credits: World Ocean Base: NOAA NGDC, Esri, DeLorme, NaturalVue

FIGURE 5.5-40. OVERVIEW OF CMECS CLASSIFICATIONS (BIOTIC) IN SEGMENT 5 OF THE SUBMARINE EXPORT CABLE CORRIDOR

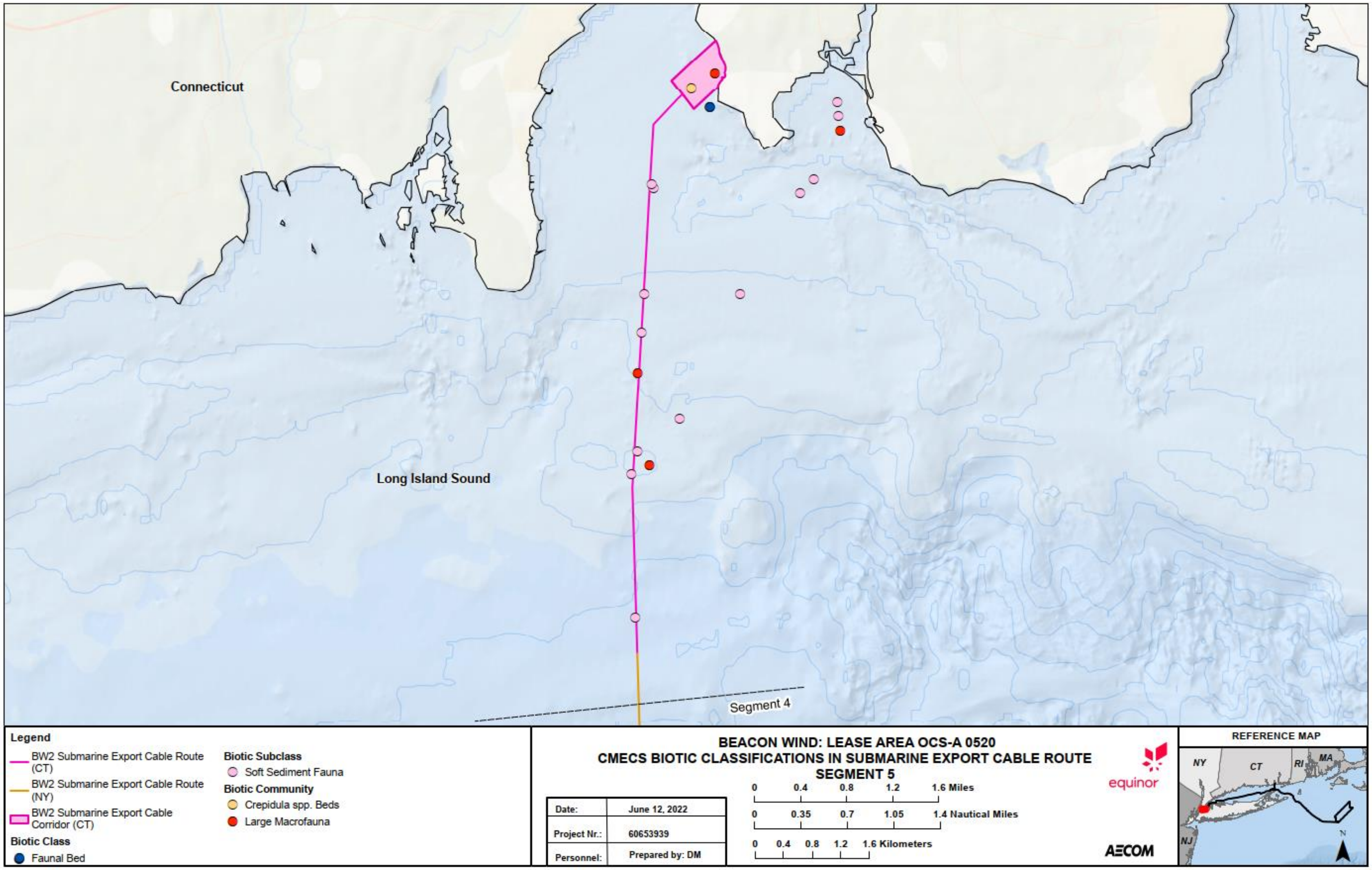


FIGURE 5.5-41. OVERVIEW OF CMECS CLASSIFICATIONS (GEOFORM) IN SEGMENT 6 OF THE SUBMARINE EXPORT CABLE CORRIDOR

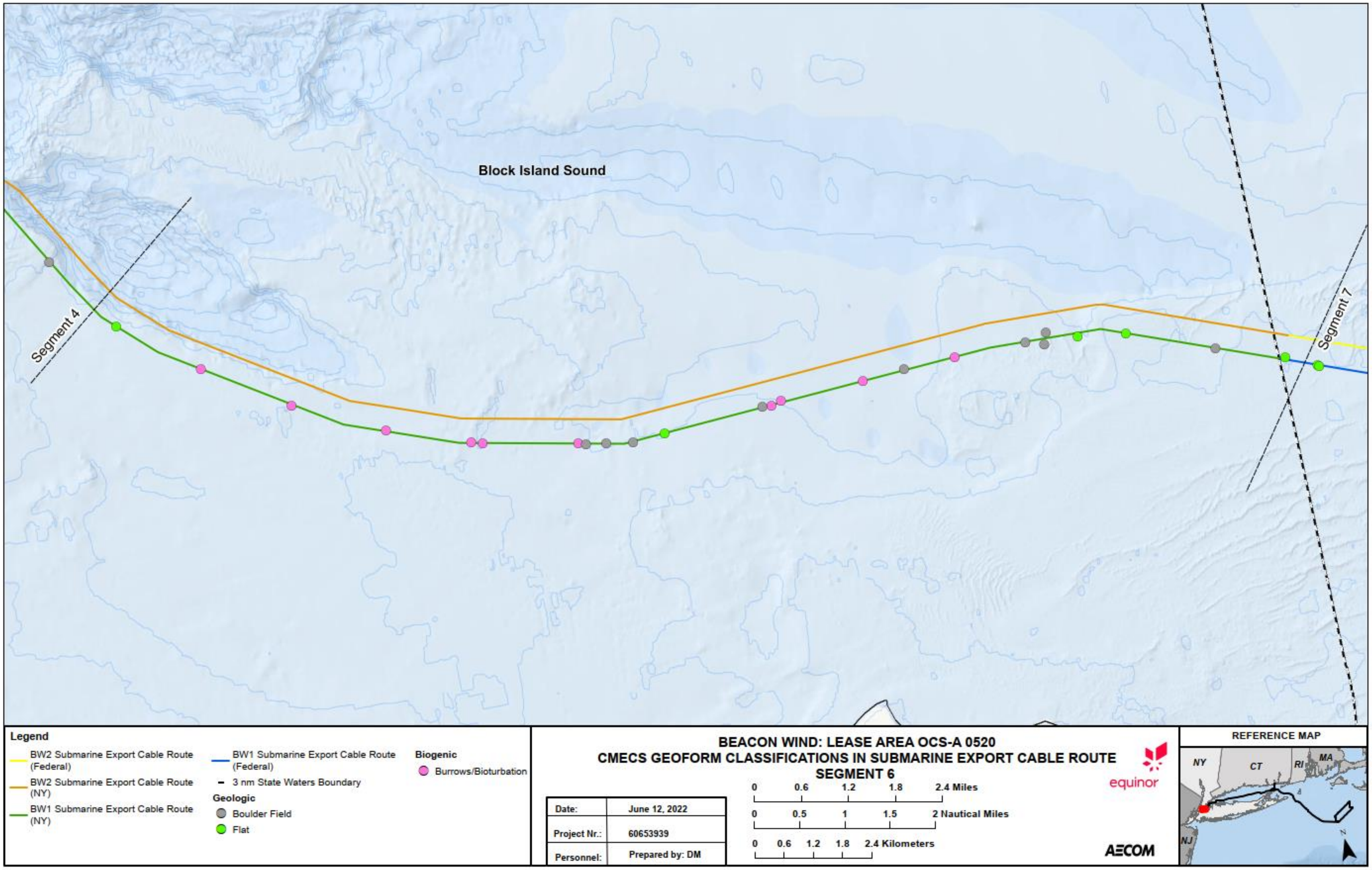


FIGURE 5.5-42. OVERVIEW OF NMFS MODIFIED CMECS CLASSIFICATIONS (SUBSTRATE) IN SEGMENT 6 OF THE SUBMARINE EXPORT CABLE CORRIDOR

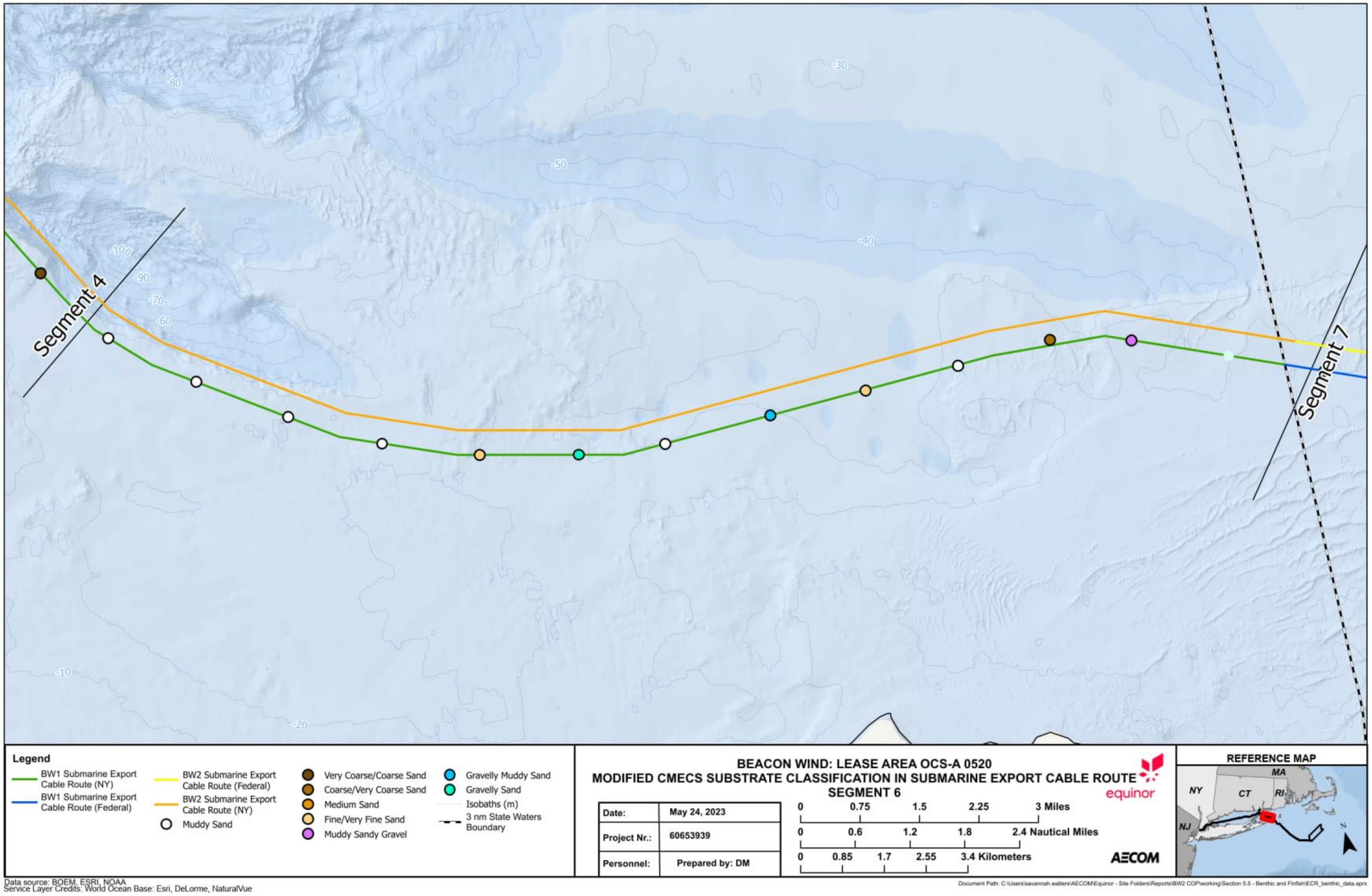


FIGURE 5.5-43. OVERVIEW OF CMECS CLASSIFICATIONS (BIOTIC) IN SEGMENT 6 OF THE SUBMARINE EXPORT CABLE CORRIDOR

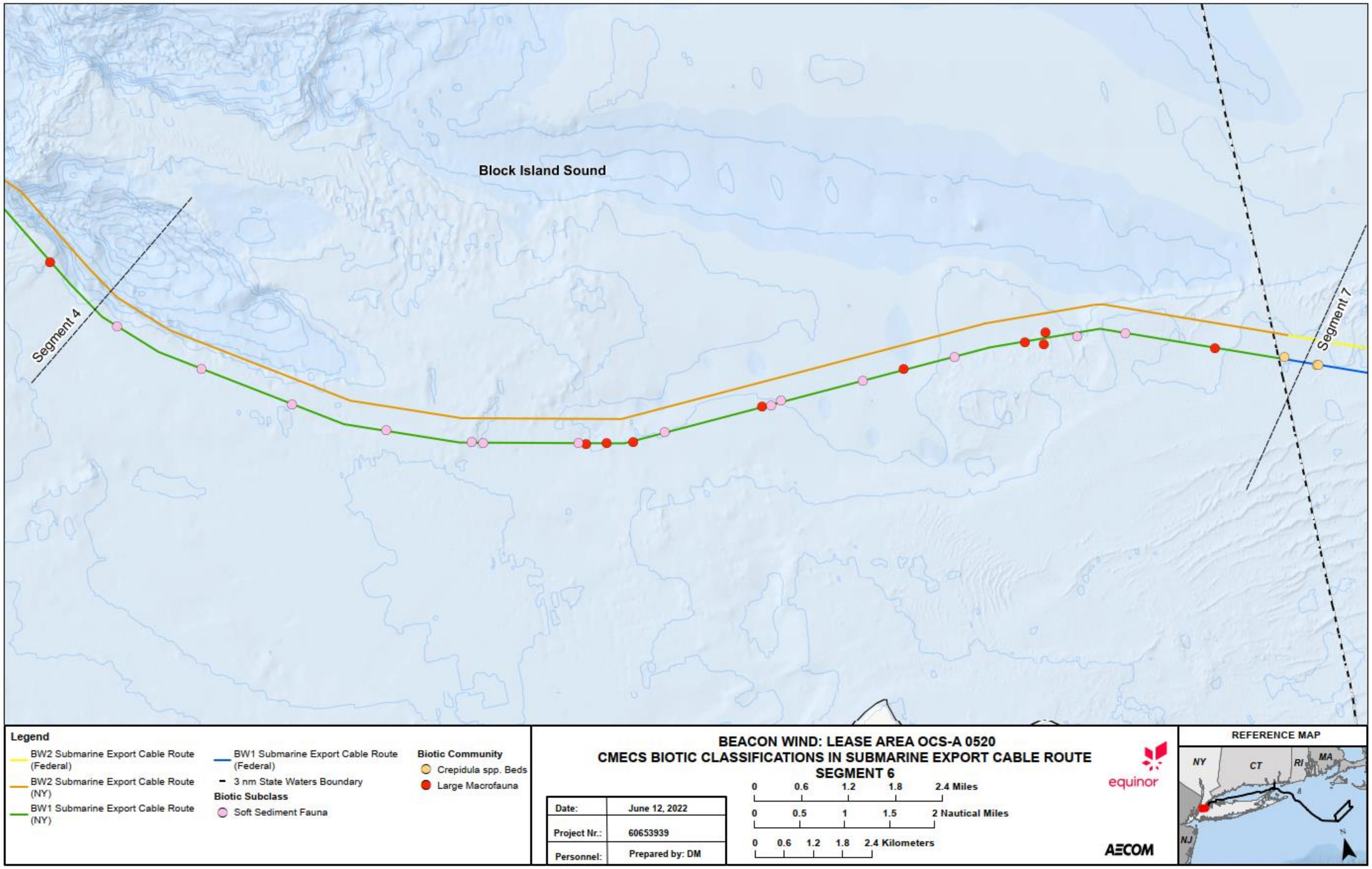


FIGURE 5.5-44. OVERVIEW OF CMECS CLASSIFICATIONS (GEOFORM) IN SEGMENT 7 OF THE SUBMARINE EXPORT CABLE CORRIDOR

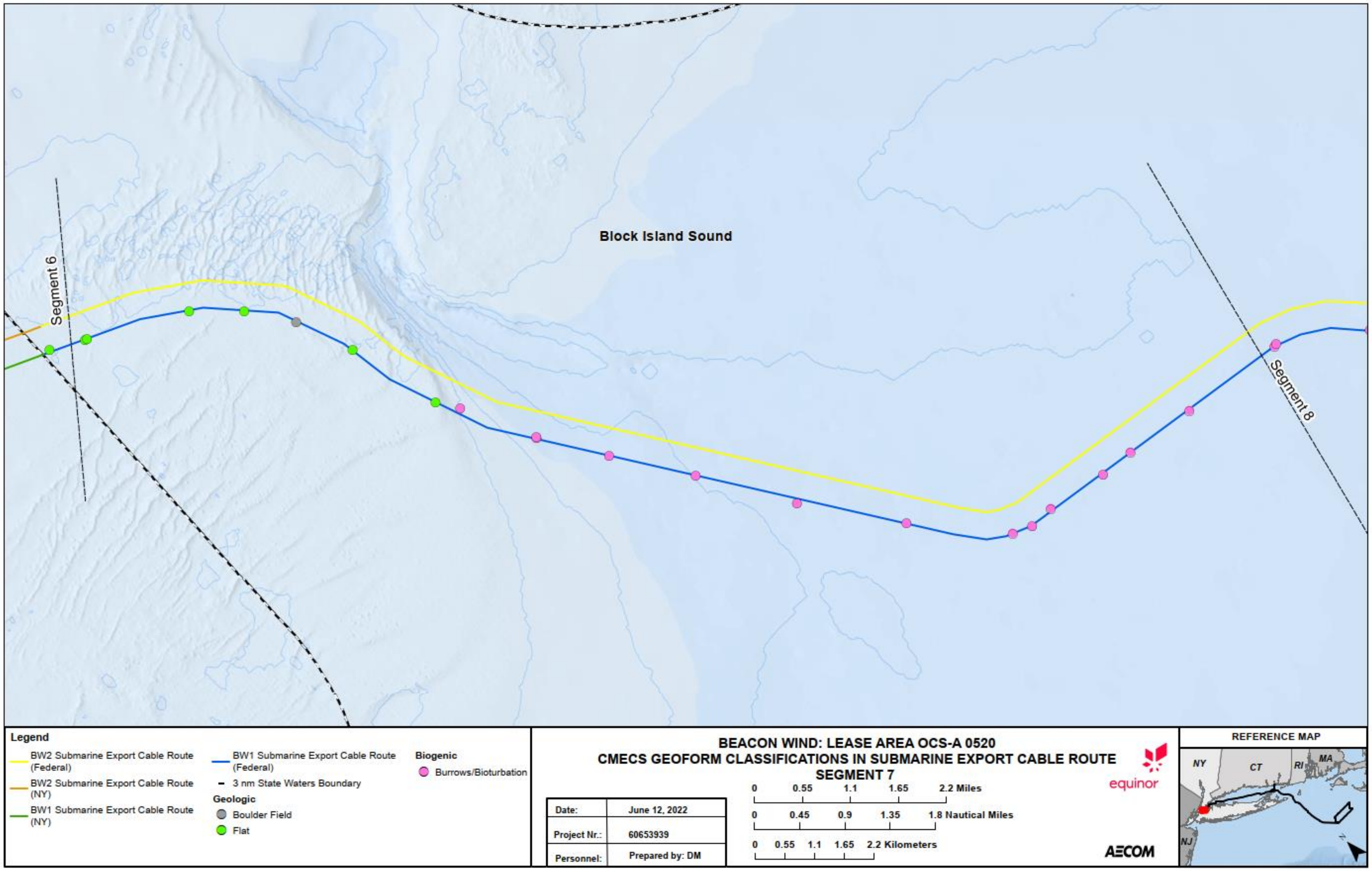


FIGURE 5.5-45. OVERVIEW OF NMFS MODIFIED CMECS CLASSIFICATIONS (SUBSTRATE) IN SEGMENT 7 OF THE SUBMARINE EXPORT CABLE CORRIDOR

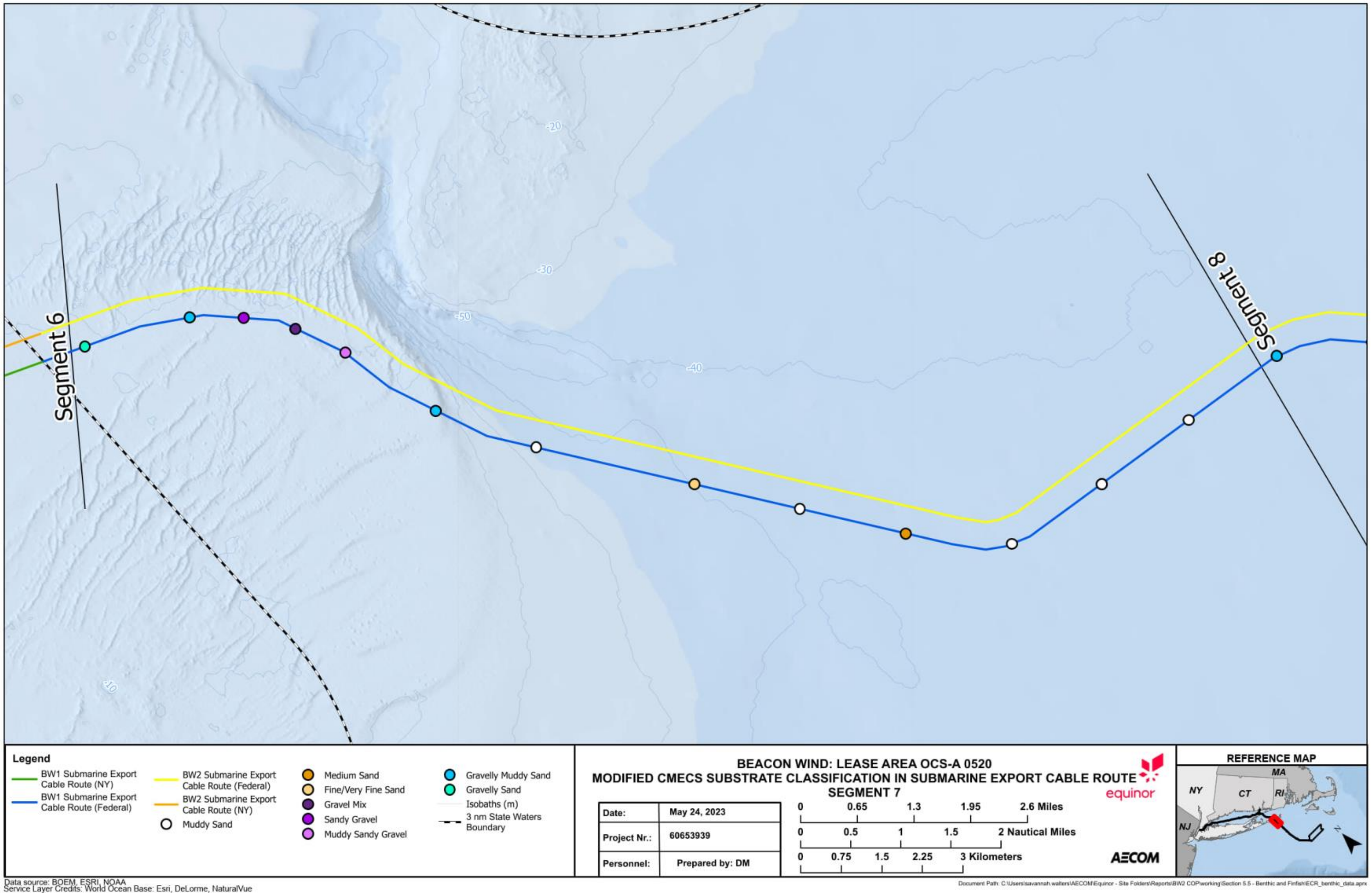


FIGURE 5.5-46. OVERVIEW OF CMECS CLASSIFICATIONS (BIOTIC) IN SEGMENT 7 OF THE SUBMARINE EXPORT CABLE CORRIDOR

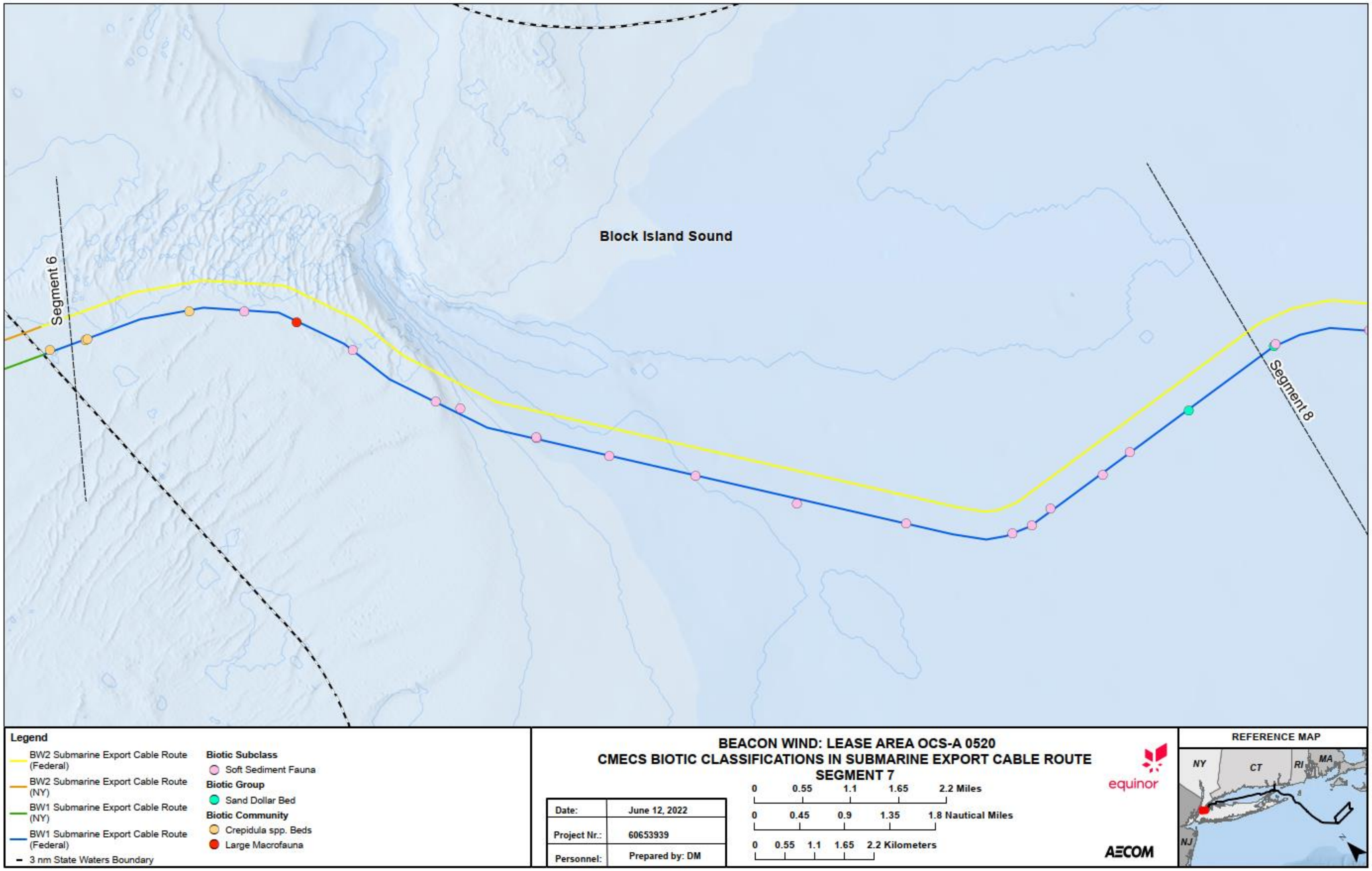


FIGURE 5.5-47. OVERVIEW OF CMECS CLASSIFICATIONS (GEOFORM) IN SEGMENT 8 OF THE SUBMARINE EXPORT CABLE CORRIDOR

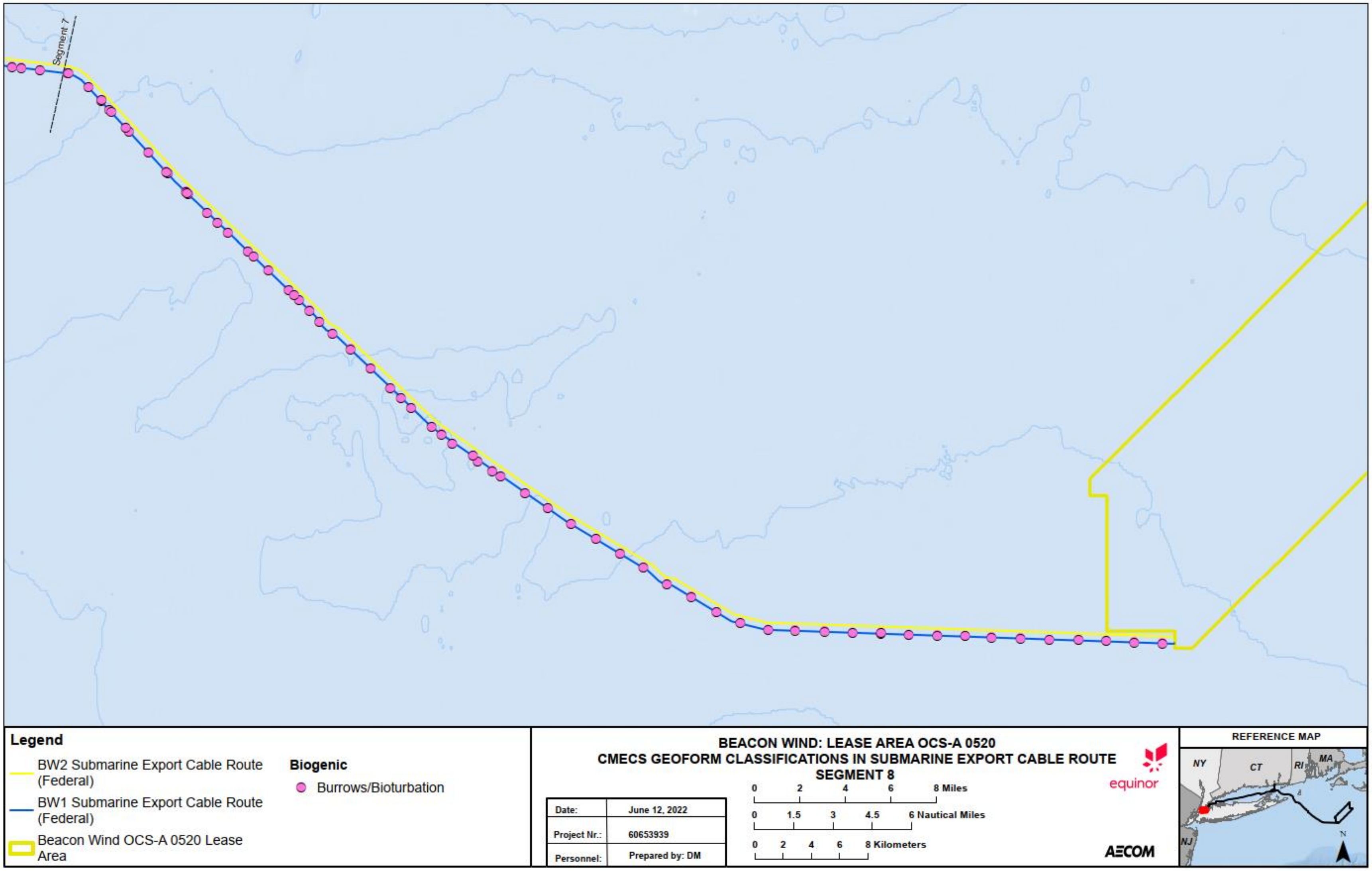


FIGURE 5.5-48. OVERVIEW OF NMFS MODIFIED CMECS CLASSIFICATIONS (SUBSTRATE) IN SEGMENT 8 OF THE SUBMARINE EXPORT CABLE CORRIDOR

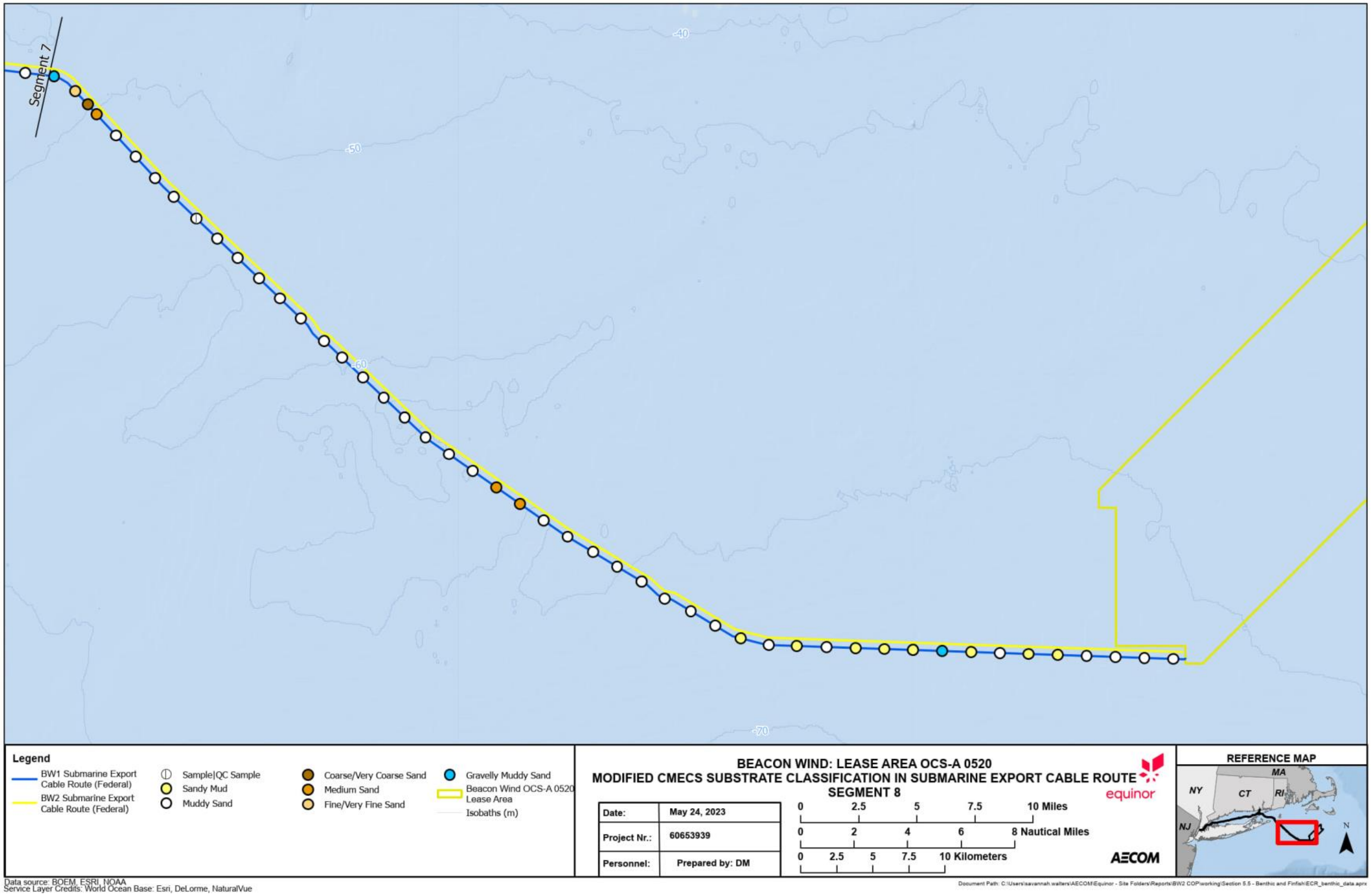


FIGURE 5.5-49. OVERVIEW OF CMECS CLASSIFICATIONS (BIOTIC) IN SEGMENT 8 OF THE SUBMARINE EXPORT CABLE CORRIDOR

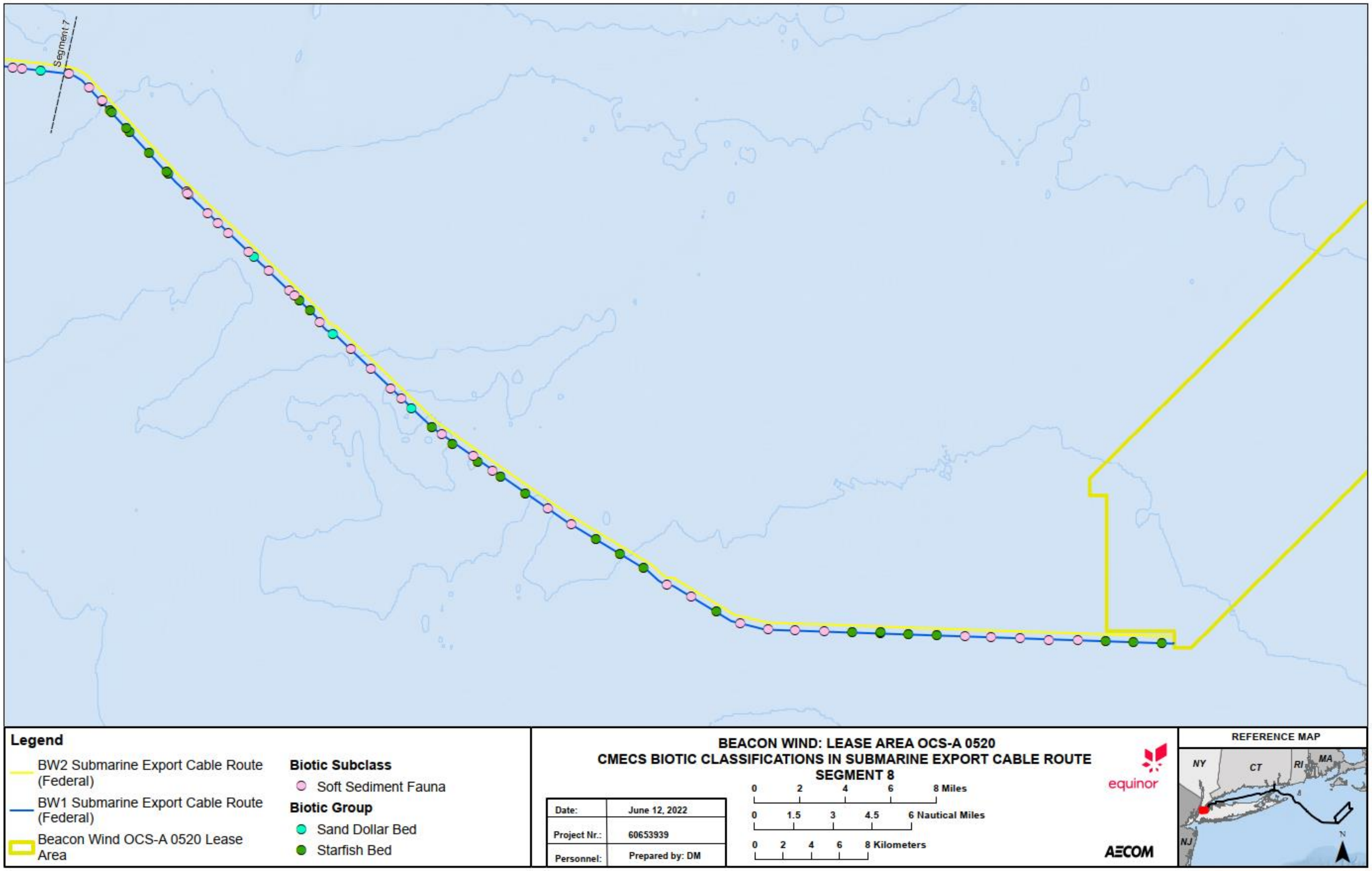
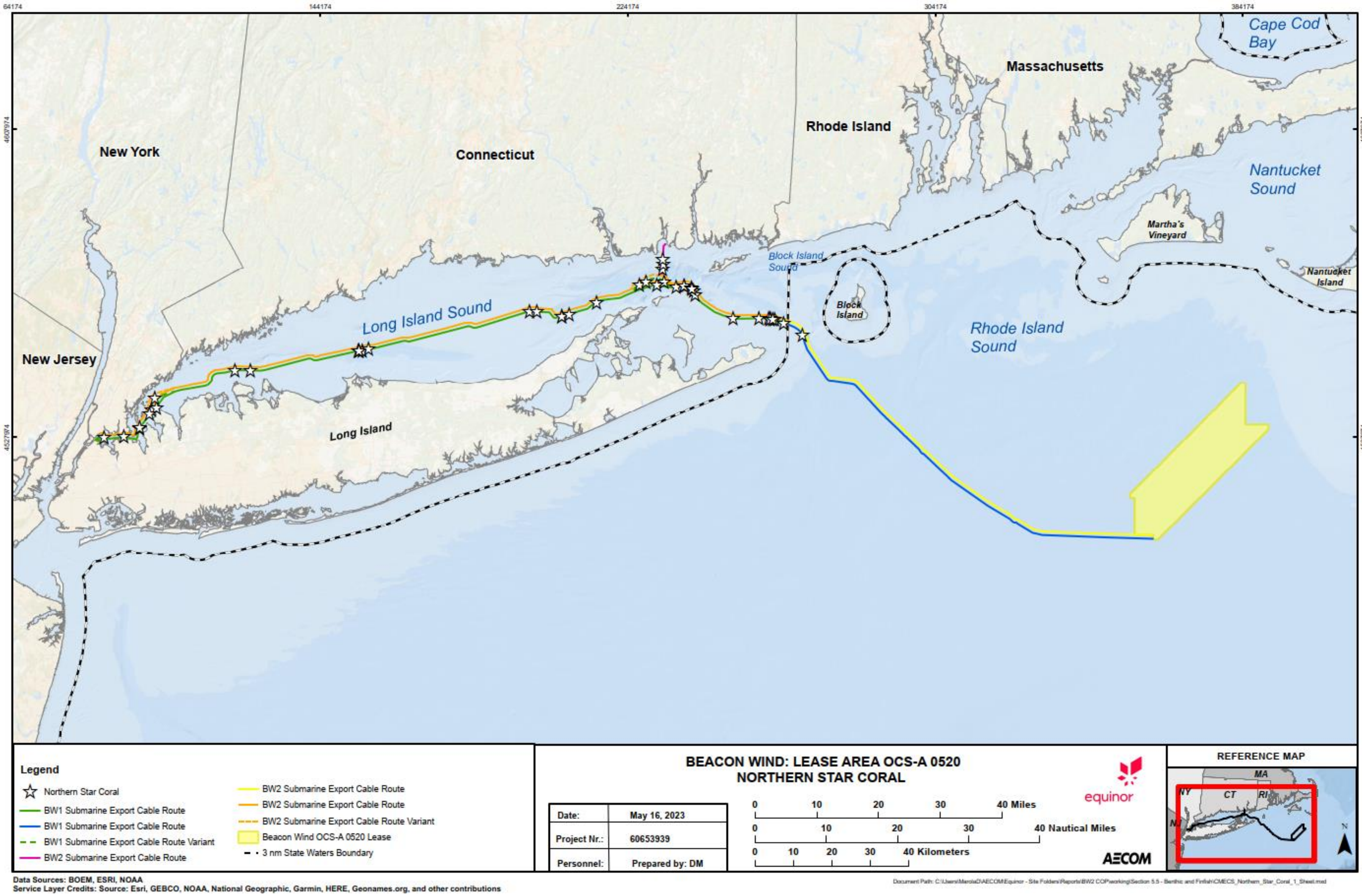


FIGURE 5.5-50. POTENTIALLY VULNERABLE SPECIES OBSERVED IN PV IMAGES



5.5.1.1.4 Pelagic Habitat

As described above, benthic habitats are strongly influenced by the overlying ocean, especially the upper water column of the ocean, known as the photic zone, where sunlight supports photosynthetic phytoplankton (Karleskint et al. 2006). The photic zone in the North Atlantic extends to a water depth of approximately 600 ft (200 m), which includes the Project Area. The water column is particularly important for planktonic eggs and larvae of demersal species and the life stages of planktivorous species (NEFMC 2017; NOAA Fisheries 2017a). Oceanic currents, temperature, conductivity, pH, dissolved oxygen, and other features of the water column influence the occurrence and abundance of marine species in the Project Area (Pineda et al. 2007). Oceanic conditions in the Project Area are described in **Section 4.1 Physical and Oceanographic Conditions** and briefly summarized here.

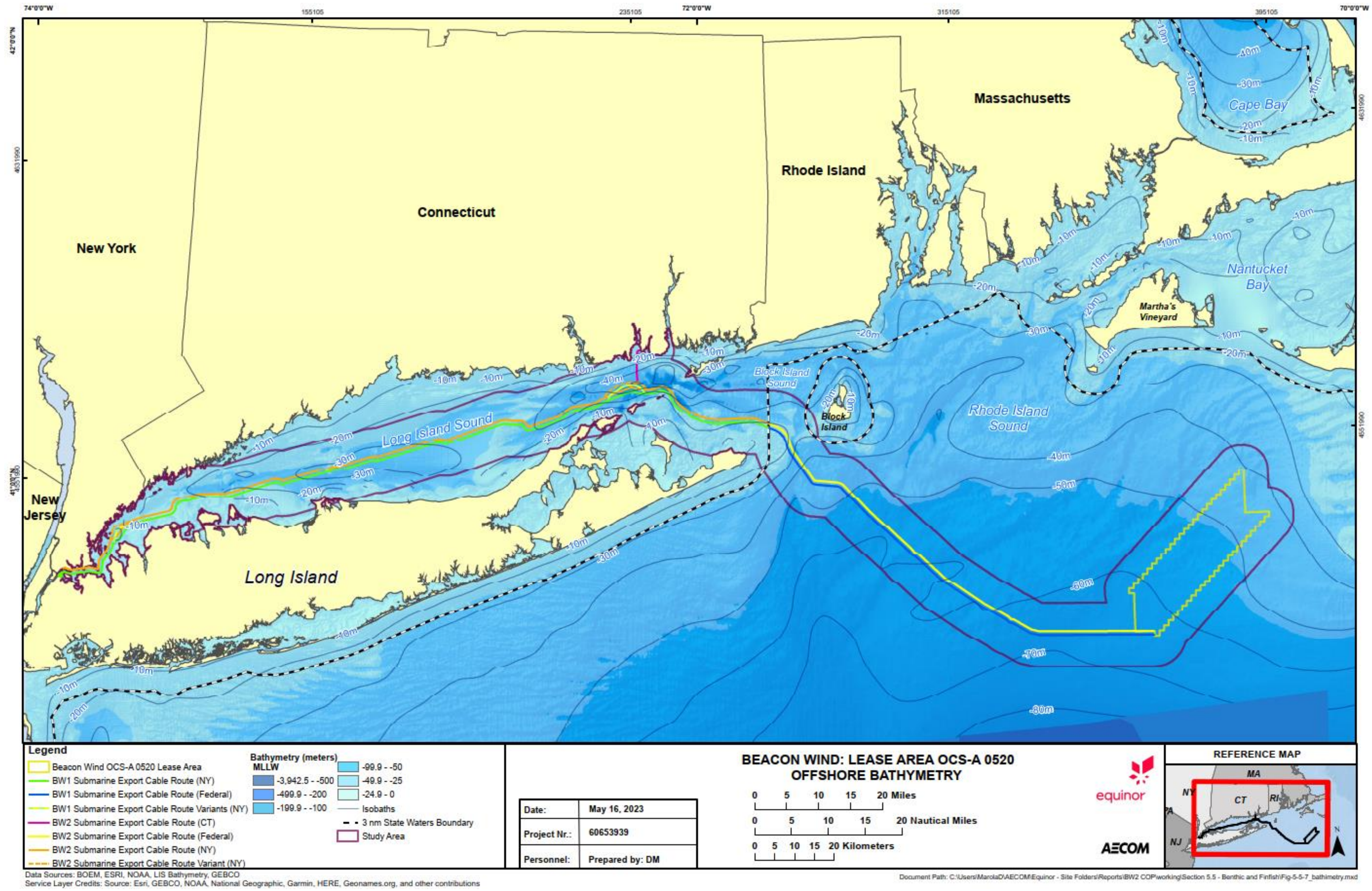
Pelagic habitats extend from the sea surface to near the seafloor; habitats vary by depth, temperature, light penetration, distance from shore, turbidity, and other physical and chemical characteristics. Dynamic water quality parameters such as dissolved oxygen, pH, and conductivity are influenced by currents, human activities onshore, climate and weather, and other processes (see **Section 4.2 Water Quality**). Water depth is a key feature that affects the horizontal and vertical distribution of fish and macroinvertebrates within pelagic habitats. Other important features, such as light penetration, temperature, and dissolved oxygen, generally co-vary with depth, although the relationships can be complex and dynamic (see **Section 5.5.1.4** on climate change). Waters on the continental shelf generally have adequate dissolved oxygen (more than 5 mg/L) to support marine organisms (USEPA 2000).

Water depths within the Lease Area are relatively uniform, ranging from 120 to 200 ft (37 to 61 m). The federal portion of the submarine export cable corridors are in water with depths that range from 65 to 200 ft (20 to 61 m). The submarine export cable installation corridor in New York waters is between 0 (at the shore) and 93 ft (0 and 28 m) deep. In the area of Block Island Sound the channel is deep with a depth of approximately 200 ft (61 m). Approximately 13 percent of the New York portion of the submarine export cable installation corridor is less than 49 ft (15 m) deep. Bathymetric contours are shown on **Figure 5.5-51**.

Water temperatures in the Lease Area vary seasonally and with depth. As described in **Section 4.1.1 Physical Oceanography and Meteorology**, surface waters fluctuate as much as 32 °F (18 °C) and bottom temperatures by at least 14 °F (8 °C) throughout the year. Interannual variability in water temperatures is high, but general patterns are predictable: waters are always warmer at the surface and cooler at the bottom, with the magnitude of vertical difference greatest in spring and summer. Annual and vertical variability in temperatures are strong triggers of seasonal migrations that lead to changes in the distributions of adult benthic organisms and settlement of recruits from the plankton. The Lease Area is not markedly affected by any ocean fronts (Guida et al. 2017).

Water quality data have been collected within Long Island Sound by the NEFSC during seasonal multispecies bottom trawl surveys, and data collected from the sub-set of locations in the vicinity of the submarine export cable corridors between 1963 and 2019 (NEFSC 2021) were compiled. Salinity and temperature were measured at the bottom and surface of the water column during surveys conducted in the spring, fall, and winter. Average water temperatures were lowest in the winter and highest in fall for both the bottom and surface of the water column (trawls were not conducted in the summer). The greatest difference between bottom and surface water temperatures was in the fall (difference of 5.58 °F [3.1 °C]). Salinity varied from a low of 32.4 practical salinity unit (psu) at the surface to a maximum of 33.0 psu also taken at the surface. The greatest difference between bottom and surface water salinities was in the fall with a 0.30 psu difference with a higher salinity at the bottom.

FIGURE 5.5-51. BATHYMETRIC CONTOURS IN THE STUDY AREA



5.5.1.1.5 Benthic-Pelagic Coupling

As discussed above, the benthic habitats in the Project Area are dominated by unconsolidated softbottom sediments (e.g., sand, clay, mud). The pelagic habitats include the vertical extent of the water column from sea floor to the water's surface. Together the benthic substrate and overlying water provide supportive habitat for demersal (associated with the sea floor) and pelagic (associated with the water column) fish and invertebrates.

Marine communities are supported by phytoplankton (diatoms, dinoflagellates, and others) that thrive where nutrients and sunlight are abundant. The coast of New England is known for abundant phytoplankton sustained by nutrients carried to the well-lit surface waters by upwelling (Hofmann et. al. 2018). Phytoplankton are essential food for zooplankton (tiny animals such as copepods and larval forms of crustaceans, bivalves, and other invertebrates) and ichthyoplankton (fish larvae).

Although benthic and pelagic habitats are often discussed separately, many marine species are associated with both habitats. Marine communities are sustained by benthic-pelagic coupling in which energy is continuously transferred between the seafloor and the water column through foraging, animal waste, and decomposition. For example, many invertebrates live relatively sedentary lives buried or burrowed into the softbottom sea floor. These organisms are collectively known as infauna because they live within the top layer of sediment, with only their respiratory or feeding appendage extended into the water column. Infaunal organisms such as amphipods, polychaetes, and clams feed on plankton and nutrient-rich detritus in the overlying water. Organisms that live on or attached to the seabed or submerged objects are known as epifauna – common examples include sponges, sea stars, hermit crabs, and moon snails.

Benthic-pelagic habitat coupling is essential for the sustainability of a healthy ecosystem that supports the species of interest in the Project Area. Many key benthic life stages depend on pelagic habitats for feeding and/or reproducing. For example, the Atlantic sea scallop's eggs are fertilized on the seafloor, then transform within 24 hours to planktonic larvae. After drifting as planktonic larvae for 5 to 6 weeks (generally southward), juvenile scallops recruit to the substrate where they filter-feed on plankton, enrich the sediment with their wastes, and release the next generation to the overlying water (Munroe et al. 2018). The Atlantic surfclam life history is similar, with a 3- to 4-week planktonic larval stage during which the larvae may be transported far to the south (Cargnelli et al. 1999a). After recruiting to the bottom, adult surfclam live out their lives as infauna buried in soft sediment and feeding on plankton filtered from the water column.

The designation of EFH explicitly recognizes the joint contribution of benthic and pelagic habitat components in designating specific bottom types, water depths, and prey sources as essential to managed species (NEFMC 2017). Although many managed fish and invertebrate species are discussed in this section, detailed descriptions and analysis of impacts to EFH can be found in **Appendix T Essential Fish Habitat Technical Report (EFHTR)**.

5.5.1.1.6 Demersal Species and Life Stages

Demersal organisms and/or life stages are those that are physically and behaviorally oriented toward the seafloor; these include the infaunal and epifaunal invertebrates described previously and fishes that preferentially forage on the bottom. Burrowing infaunal organisms (e.g., amphipods, clams, polychaetes, and sand lances) create a complex microhabitat at the sediment-water interface as they filter water, mix, and redistribute sediment, oxygenate subsurface sediment, and recycle nutrients (Rutecki et al. 2014). The infaunal assemblage is eaten by demersal fish and invertebrates such as gastropods (whelks, moon snails), sea stars, horseshoe crab (*Limulus polyphemus*), lobster, crabs, fish (especially flatfish and skates), and other demersal predators.

The most commercially valuable demersal fish and invertebrates in the Project Area include the Jonah crab, longfin squid, and silver hake. Other commercially valuable fish and invertebrates in the Project Area include haddock, flounders, hakes, scup, black sea bass, bluefish, spiny dogfish, skates, species managed under multispecies groundfish plans, horseshoe crab, ocean quahog, surfclam, sea scallops, lobsters, and Atlantic herring (Guida et al. 2017; Petruny-Parker et al. 2015). Although demersal fishes and invertebrates are closely associated with benthic habitats as adults, many species interact with overlying pelagic habitats through predator-prey interactions, early life stage dispersal, or seasonal migrations (Malek et al. 2014).

The ecologically important adult sand lances (*Ammodytes* spp.) burrow in sand but forage on zooplankton carried on currents. Adults are present year-round in the Project Area and are heavily preyed upon by demersal fishes (cod, silver hake [*Merluccius bilinearis*], yellowtail flounder [*Pleuronectes ferrugineus*]), as well as more pelagic predators (bluefish, Atlantic mackerel [*Scomber scombrus*], bluefin tuna [*Thunnus thynnus*], and whales) (MAFMC 2017; NOAA Office of National Marine Sanctuaries 2017). The sand lance lays demersal eggs that hatch into planktonic larvae (Able and Fahay 1998). Similarly, the winter flounder (*Pleuronectes americanus*) is demersal during the adult and egg stages, but planktonic during the larvae stage.

Other fishes are demersal only as adults, releasing pelagic eggs that hatch into planktonic larvae; examples in the Project Area include hakes, windowpane flounder (*Scophthalmus aquosus*), yellowtail flounder, summer flounder, winter flounder, monkfish (*Lophius* spp.), black sea bass, and others (NEFMC 2017 and references within; Able and Fahay 1998). Many of these species, notably black sea bass, hakes, and some flounders, spawn elsewhere but their planktonic larvae drift or juveniles recruit to the bottom within the Project Area.

The fishes in the Project Area with the most consistent demersal exposure are skates, which have no pelagic or planktonic life stage. The little skate (*Leucoraja erinacea*), which dominates the fish fauna year-round in the Project Area, forages almost exclusively on benthic amphipods, crabs, shrimp, and polychaetes, taking a few fish only in later years. The winter skate also eats burrowing sand lance (Smith and Link 2010). The longfin inshore squid (*Doryteuthis pealeii*) illustrates the reverse of the demersal adult-pelagic larvae life cycle. Adult squid live in the water column but attach their eggs (known as squid mops) to hardbottom, empty shells on sandy bottoms, and artificial structures; the squid mops remain on the bottom for up to four weeks before hatching into paralarvae that migrate to the sea surface, where they feed on copepods and other zooplankton (Cargnelli et al. 1999b).

5.5.1.1.7 Pelagic Species and Life Stages

The most numerically abundant component of the pelagic fish community in the open waters of the Project Area is the ichthyoplankton assemblage. Buoyant eggs and larvae of most marine fishes in Southern New England can remain in the plankton for weeks to months (Walsh et al. 2015). The assemblage of species represented in the ichthyoplankton varies seasonally and is strongly influenced by water temperature; patterns of ichthyoplankton assemblages have changed in recent decades, likely in response to climate change (MAFMC 2017; Walsh et al. 2015).

Some species in the Project Area are truly pelagic, living in the water column throughout their lives. Planktivorous coastal pelagic forage species are typically small and shiny, with schooling tendencies, as characterized by the Atlantic menhaden (*Brevoortia harengus*), Atlantic herring (*Clupea harengus*), Atlantic saury (*Scomberesox saurus*), and smaller mackerels (MAFMC 2017). The forage species tend to be short-lived, fast-maturing, and highly fecund, with wide fluctuations in abundances from year to year. Species abundances do not necessarily rise and fall in synchrony, so migratory predators target whichever prey is available in a given place (Suca et al. 2018). Squid and butterfish (*Peprilus triacanthus*) function as foragers as juveniles then shift to a predatory niche as they mature. Interannual variability in recruitment in many species can drive peaks in abundance for a given species unrelated to standing stock (Bethoney et al. 2016). These small pelagic forage fishes transfer energy from zooplankton to top predators such as shortfin mako shark (*Isurus oxyrinchus*), porbeagle shark, thresher shark, Atlantic mackerel, tunas, bluefish, mahi-mahi, and sharks (Suca et al. 2018). For example, the bluefin tuna feeds predominantly on Atlantic mackerel and squid in the Mid-Atlantic Bight (Chase 2002). Most of the highly migratory species migrate to nearshore waters of New York as waters warm in the spring (Able and Fahay 1998; NOAA Fisheries 2017a).

5.5.1.2 *Fish and Macroinvertebrates*

5.5.1.2.1 Managed and Exploited Species: Essential Fish Habitat and Habitat Area of Particular Concern (Lease Area and Submarine Export Cables Siting Corridors Summary)

Essential Fish Habitat is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity" (NOAA Fisheries 1997). Under the Magnuson-Stevens Fishery Conservation and Management Act, as amended, federal agencies are required to consult on activities that may adversely affect Essential Fish Habitat designated in Fishery Management Plans developed by the regional Fishery Management Councils. Several of the species observed are managed by NMFS in collaboration with the New England Fishery Management Council, Mid-Atlantic Fishery Management Council, and/or the Atlantic States Marine Fisheries Commission (see **Table 5.5-10**). The Essential Fish Habitat designation provided in **Table 5.5-10** is also based on the NOAA's Essential Fish Habitat Mapper.

In the Project Area, NEFMC and MAFMC share authority with NOAA Fisheries to manage and conserve fisheries in federal waters. Together with NOAA Fisheries, the councils maintain FMPs for specific species or species groups to regulate commercial and recreational fishing within their geographic regions (see **Table 5.5-11**).

NOAA Fisheries' Highly Migratory Species Division is responsible for tunas and sharks in the Project Area (NOAA Fisheries 2017a). The ASMFC manages more than two dozen fish and invertebrate species in cooperation with the states and NOAA Fisheries. Coastal Migratory Pelagic species are managed jointly by the Gulf of Mexico and South Atlantic Fishery Management Councils from the Mexico/Texas border to New York.

Managed finfish with designated EFH in the Project Area were identified using the EFH data inventory in each FMP and the online EFH Mapper. EFH habitat categories were based on the EFH descriptions within each of the EFH source documents, as summarized in **Appendix T Essential Fish Habitat Technical Report (EFHTR)**.

The spatial overlap of EFH and Project components was evaluated initially using plan-view maps in the EFH Mapper and habitat descriptions in EFH source documents, as described in **Appendix T Essential Fish Habitat Technical Report (EFHTR)**. Managed species in the Project Area are listed in **Table 5.5-11**. Species profiles and maximum acreages of designated EFH for each life stage of managed species in the Project Area are provided in **Appendix T Essential Fish Habitat Technical Report (EFHTR)**.

For most species, EFH is designated by 10-by-10-minute squares based on the analysis of fishery-independent data, habitat features, literature reviews, and best professional judgment of fisheries managers on the occurrence of species and life stages in each square. Fish and invertebrate species with designated EFH in the Project Area were included in the Essential Fish Habitat Technical Report (EFHTR) Appendix (**Appendix T Essential Fish Habitat Technical Report (EFHTR)**) based on descriptions in FMPs, the online EFH Mapper2, and EFH source documents, which are incorporated by reference into the EFHA (**Appendix T Essential Fish Habitat Technical Report (EFHTR)**).

The FMCs classify EFH for managed species in terms of life stages: eggs, larvae, juveniles (neonates), adults, and sometimes spawning adults. Life stages of highly migratory species are grouped into three categories based on common habitat usage: (1) spawning adult, egg, and larvae; (2) juvenile and subadult; and (3) adult. Essential fish habitat life stage categories for sharks are defined as neonate, juvenile, and adult (see **Table 5.5-12**).

TABLE 5.5-10. SUMMARY OF FISHERIES MANAGEMENT IN THE PROJECT AREA

Managing Agency of FMC	Fishery Management Plan	EFH Description Reference
NEFMC	Atlantic Herring FMP	Omnibus Essential Fish Habitat Amendment 2 Including a Final Environmental Impact Statement (NEFMC 2017):
	Atlantic Salmon FMP	Amendment 3 to the Atlantic Herring FMP
	Monkfish FMP	Amendment 3 to the Atlantic Salmon FMP
	Northeast Multispecies FMP (large mesh and small mesh groundfish)	Amendment 4 to the Monkfish FMP
	Northeast Skate Complex FMP	Amendment 14 to the Northeast Multispecies FMP
	Atlantic Sea Scallop FMP	Amendment 2 to the Skate FMP
		Amendment 14 to the Atlantic Sea Scallop FMP
		Amendment 14 to the Atlantic Sea Scallop FMP
MAFMC	Atlantic Mackerel, Squid, and Butterfish FMP	Unmanaged Forage Omnibus Amendment: Including an Environmental Assessment, Regulatory Impact Review, and Regulatory Flexibility Act Analysis (MAFMC 2017):
	Bluefish FMP	Amendment 18 to the Mackerel, Squid, and Butterfish FMP
	Spiny Dogfish FMP	Amendment 6 to the Bluefish FMP
	Summer Flounder, Scup, Black Sea Bass FMP	Amendment 5 to the Spiny Dogfish FMP
	Surf clam and Ocean Quahog FMP	Amendment 20 to the Summer Flounder, Scup, and Black Sea Bass FMP
		Amendment 19 to the Surf clam and Ocean Quahog FMP
NOAA Fisheries	Atlantic Highly Migratory Species	NOAA Fisheries (2017a). Final Amendment 10 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan: Essential Fish Habitat.

Managing Agency of FMC	Fishery Management Plan	EFH Description Reference
ASMFC	American Lobster, Atlantic Croaker, Atlantic Herring, Atlantic Menhaden, Atlantic Striped Bass, Atlantic Sturgeon, Black Sea Bass, Bluefish, Coastal Sharks, Horseshoe Crab, Jonah Crab, Scup, Shad and River Herring, Spanish Mackerel, Spiny Dogfish	ASMFC (2018d). Annual Report.
		Amendment 31 to the Fisheries of the Caribbean, Gulf of Mexico, and South Atlantic; Coastal Migratory Pelagics Resources in the Gulf of Mexico and Atlantic Region-2019
		Numerous stock assessments
Gulf of Mexico and South Atlantic FMCs	Coastal Migratory Pelagics	Coastal Migratory Pelagic (Mackerel) FMP for the Gulf of Mexico and South Atlantic regions

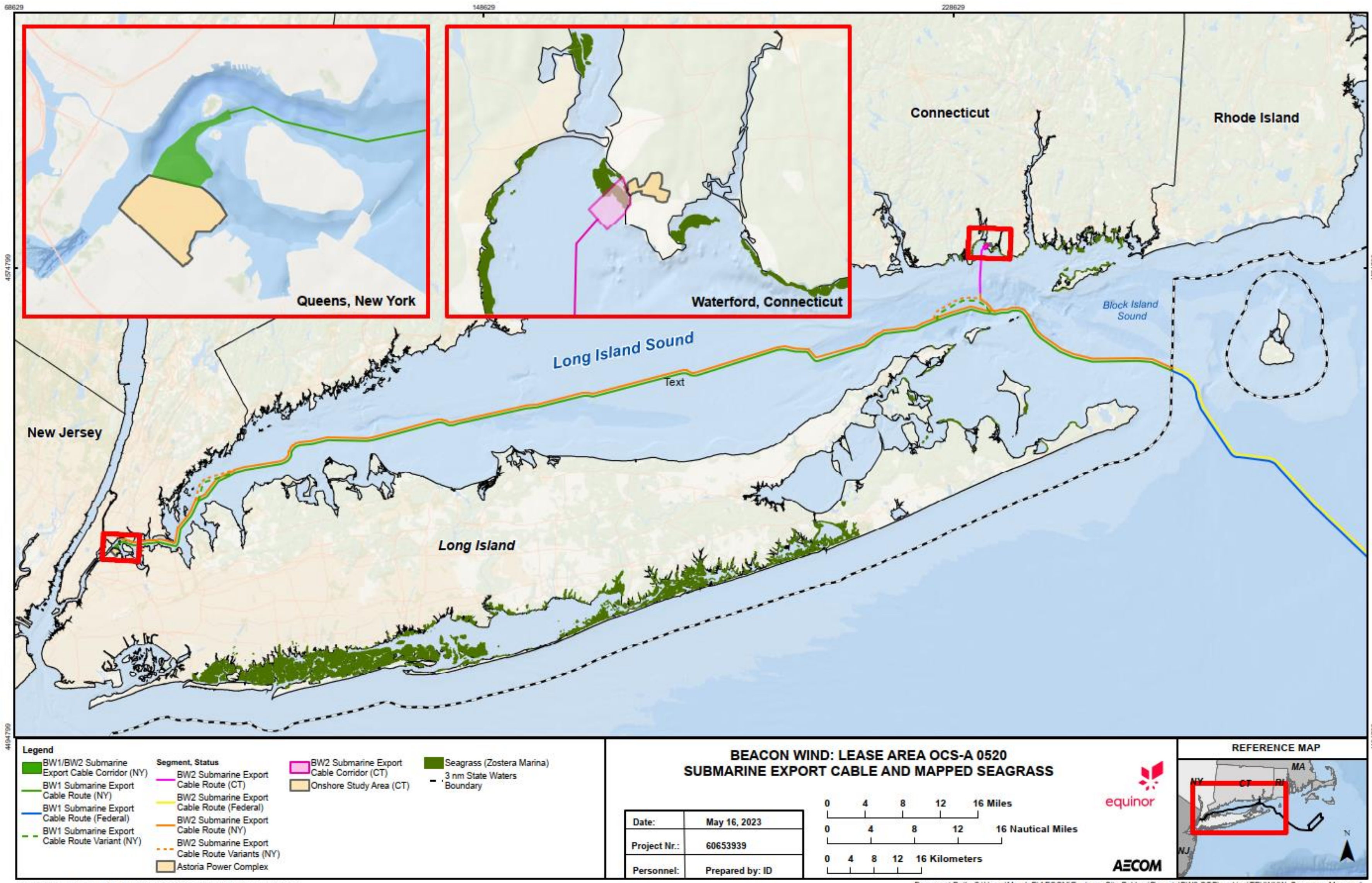
TABLE 5.5-11. MANAGED SPECIES IN THE PROJECT AREA

New England Fishery Management Council	Mid-Atlantic Fishery Management Council	South Atlantic FMCs (Coastal Migratory Pelagics)	NOAA Fisheries (Highly Migratory Species)	Atlantic States Marine Fisheries Commission
American Plaice	Atlantic Butterfish	King Mackerel c/	Atlantic Albacore Tuna	American Lobster
Atlantic Cod	Atlantic Mackerel	Spanish Mackerel c/	Atlantic Bluefin Tuna	Atlantic Croaker
Atlantic Herring b/	Atlantic Surf Clam		Atlantic Skipjack Tuna	Atlantic Menhaden
Atlantic Sea Scallop	Black Sea Bass b/		Atlantic Yellowfin Tuna	Atlantic Striped Bass
Clearnose Skate	Bluefish b/		Blue Shark d/	Horseshoe Crab d/
Haddock	Longfin Inshore Squid		Common Thresher Shark d/	Jonah Crab d/
Little Skate	Northern Shortfin Squid		Dusky Shark d/	River Herring
Monkfish a/	Ocean Quahog		Sand Tiger Shark d/	Shad
Ocean Pout	Scup b/		Sandbar Shark d/	Cobia d/
Pollock	Spiny Dogfish a/ b/		Shortfin Mako Shark d/	
Red Hake	Summer Flounder b/		Smoothhound Shark d/	
Silver Hake			Smooth Dogfish d/	
White Hake			Tiger Shark d/	
Windowpane Flounder			White Shark d/	
Winter Flounder			Basking Shark d/	
Winter Skate				
Witch Flounder Yellowtail Flounder				

Notes:
a/ Joint management by NEFMC and MAFMC
b/ Joint management with ASMFC
c/ Joint management with Gulf of Mexico Fisheries Management Council (GMFMC)
d/ Included in Interstate Fisheries Management Plan

Fisheries Management Councils and NOAA Fisheries may also designate Habitat Areas of Particular Concern (HAPC), defined as a subset of the habitats that a species is known to occupy, to conserve fish habitat in geographical locations particularly critical to the survival of a species (NOAA Fisheries 2021a). HAPC for summer flounder includes all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder (MAFMC and ASMFC 1998). The Project Area intersects with HAPC for summer flounder within seagrass beds located at the shoreline of the Waterford, Connecticut landfall. The total extent of the mapped seagrass bed within Niantic Bay at the area of the landing site is 51.77 ac (20.95 ha) and the extent that falls within the offshore landfall corridor is 19.99 ac (8.09 ha). There is also a seagrass bed across the mouth of the Niantic River from the Waterford, Connecticut landing that is 0.7 nm (1.4 mi) from the landing site and 0.8 nm (1.4 km) from the submarine export cable route. The Waterford, Connecticut landfall seagrass beds will not be disturbed due to the planned use of HDD to accommodate the landfall. The extent of the offshore landfall corridor will be refined to a smaller workspace limit during the final HDD design process. At this time a larger corridor has been depicted that covers the area of potential siting that will become refined. The next closest HAPC to the Project Area for mapped seagrass is located on the southwestern coast of Fishers Island, located 3 nm (5.4 km) to the northeast of the submarine export cable corridors, as well as the southwestern coast of Plum Island, 3.5 nm (6.6 km) to the southwest of the submarine export cable corridors (**Figure 5.5-52**). Additionally, there is HAPC for juvenile inshore cod along the northern coast of Block Island, about 7 nm (13 km) northeast of the submarine export cable corridors.

FIGURE 5.5-52. MAPPED SEAGRASS (*ZOSTERA MARINA*) HABITAT



Data Sources: BOEM, ESRI, NOAA, NYSDEC Seagrass Management Program
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

Document Path: C:\Users\MarolaD\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\EFH\NYW_Seagrass_Map.mxd

Commercial and recreational fisheries in state waters are further managed by state regulatory bodies. Each coastal state has its own structure of agencies and plans governing fisheries resources. Additionally, the New York, Connecticut, Rhode Island, and Massachusetts offices of Coastal Zone Management are responsible for managing impacts to coastal habitat and living resources, including fish and invertebrates (**Section 8.8 Commercial and Recreational Fishing**).

In the Northeast, NMFS works with NEFMC, MAFMC, and the South Atlantic Fishery Management Council (SAFMC) to define essential habitat for key species in New England coastal waters. Essential habitat for highly migratory species is managed through a fishery management plan implemented by NOAA Fisheries to manage the marine fishery resource in the Exclusive Economic Zone (EEZ) that extends from 3 to 200 miles (4.8 to 321.9 kilometers) under the Magnuson Stevenson Act (NOAA Fisheries 2017).

In New York, the NYSDEC Division of Marine Resources administers the laws relating to marine fisheries (NYCRR § 6:1 Subchapter C-Fishing) and is responsible for the development and enforcement of regulations pertaining to Marine Fisheries, Shellfisheries, and Marine Habitat. NYSERDA's (2017) summary report of fish and fisheries resources in the New York WEA identified scallop, squid, monkfish, mackerel, summer and winter flounder, skates, herring, clams, crabs, lobster, whelk, bluefish, black sea bass, spiny dogfish, scup, cod, pollock (*Pollachius virens*), striped bass, tunas, and sharks as important to commercial and recreational fishing interests in the state, although scallop abundance is greatest in waters farther offshore, not in the Long Island Sound.

In anticipation of the development of offshore wind projects, experts from NOAA Fisheries and BOEM characterized fisheries resources within the MA WEA using long-term regional datasets and surveys within the WEA. The resulting habitat assessment highlighted several features of the Project Area relevant to finfish and macroinvertebrates based upon analysis of data collected between 2003 and 2016: (1) the rarity of cod in the Lease Area; (2) the affinity of black sea bass with structures; (3) little skate sliver hake, and winter skate were dominant species for catch in both warm and cold seasons; (4) the other dominant species were seasonal migrants; (5) there has been a substantial seasonal shift in dominant species observed; (6) sea scallops and ocean quahogs were widespread and numerous and egg mops of longfin squid were not detected in the MA WEA (Guida et al. 2017).

Dominant commercially important species collected in NEFSC seasonal trawls (2003–2016) in the Lease Area were identified as Atlantic herring, little skate, sliver hake, and winter skate in the cold season and butterfish, little skate, longfin squid, red hake, scup, silver hake, spiny dogfish, and winter skate in the warm season (Guida et al. 2017). Atlantic herring, butterfish, squid, and scup were seasonal migrants; the other species were year-round residents. Of the 56 taxa collected in cold-season NEFSC trawls, the little skate was dominant by percent catch by weight (greater than 40 percent) and frequency of catch (80 percent) in the cold season. Little skate was also the only species to occur consistently within the cold-season trawls in the Lease Area (Guida et al. 2017). The dominant species by percent of catch by number was Atlantic Herring in the Lease Area (55 percent). Warm-season NEFSC trawls in the Lease Area yielded 65 taxa (NEFSC 2021). The longfin squid was numerically dominant (approximately 35 percent of the total catch), with butterfish and scup making up the next 40 percent. Spiny dogfish were the dominant species by percent of catch by weight with 25 percent of the total species caught. For frequency of catch in the warm season, butterfish, little skate, long-finned squid, sliver hake, and summer flounder had similar occurrences with 80 to 100 percent caught from each trawl (Guida et al. 2017). Squid mops were not collected in beam trawls in the Lease Area (Guida et al. 2017). The submarine export cable siting corridors, however, would intersect with squid egg EFH (see **Appendix T Essential Fish Habitat Technical Report (EFHTR)**) in areas with hardbottom habitat in the eastern portion of Long Island Sound.

During Beacon Wind's benthic survey in the Lease Area, the most abundant fish in the PV imagery were the hake species (silver and red); 18 individuals were observed at 17 stations out of the 375 Stations taken (157 foundation locations and 218 interarray cable) within designated EFH for this species (**Appendix T Essential Fish Habitat Technical Report (EFHTR)**). Jonah crabs were present in 27 of the 375 PV images taken throughout the Lease Area. (see images in **Appendix T Essential Fish Habitat Technical Report (EFHTR)** and **Figure 5.5-53** and **Figure 5.5-54**).

FIGURE 5.5-53. HAKE FROM LEASE AREA (WTG 104)

FIGURE 5.5-54 JONAH CRAB FROM LEASE AREA (IAC-087)

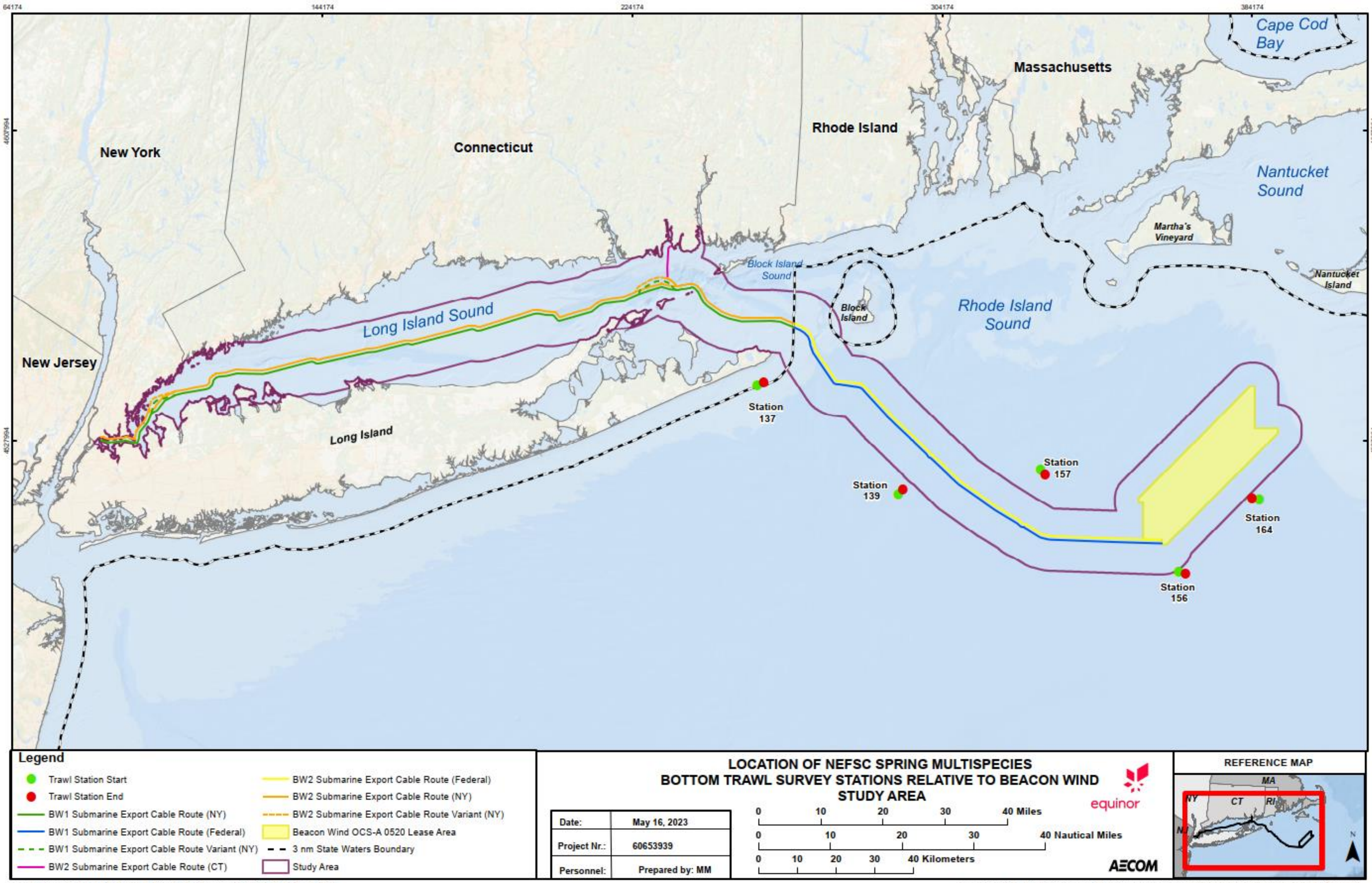
Numerous long-term fisheries surveys and geophysical datasets support the characterization of baseline fisheries resources in the Project Area. Multi-year regional surveys can provide greater certainty than brief surveys performed in the Project Area and may support temporal analysis across seasons or years. For example, analysis of the effects of fishing pressure and water temperatures on summer and winter flounder populations were supported by decades of commercial landing data and fisheries-independent surveys (Bell et al. 2014). However, fisheries distribution throughout the New England and Mid-Atlantic states are undergoing marked changes in response to ocean warming (Hare et al. 2016). Considering the large, regional shifts of numerous species, the most recent 10 to 15 years of long-term trawl data may be more representative of "current" conditions (Guida et al. 2017) with locations of the NEFSC seasonal trawl surveys in the Project Area shown within **Figure 5.5-56**. Note that the Lease Area numbering as shown in figures referring to Guida et al. (2017) have been updated and changed by BOEM since the publication of this report. The updated Lease Area numbering is provided within Beacon Wind **Volume I Section 1.2.1 BOEM OCS Wind Energy Offshore Massachusetts Development**.

Fish were rarely observed in images collected by USGS during the 2017 habitat mapping survey of Stellwagen Bank, a known productive fisheries area in the North Atlantic (Valentine and Cross 2018); therefore, species occurrence may not be accurately represented by this methodology alone. Skate species and winter flounder were the most observed vertebrates during the month of August 2017 for this survey led by USGS. In the Lease Area small pelagic fish were reported to make nightly vertical migrations toward the sea surface, possibly feeding on plankton or avoiding predation in deeper waters, which is similar to what was reported by Battista et al. 2019. The results observed from the Lease Area benthic habitat study are congruent with the summary of resources in the Lease Area in Guida et al. (2017) and other sources, which reported the dominance of skates, specifically little skate and winter skate.

The catch report for the 2021New England Fisheries Science Center (NEFSC) Spring Bottom Trawl, conducted March – May 2021 (NEFSC 2021), included two stations in the MA WEA near the Beacon Wind Study Area (Stations 156 and 164) and three stations in the vicinity of the submarine export cable corridors (137, 139, and 157), in offshore federal waters (see **Figure 5.5-55**). No data was obtained by NEFSC within Long Island Sound. Target species made up most of the catch in pounds (lbs) at these stations which were dominated by hake (silver and red) at Station 156; spiny dogfish was the second most dominant species. At Station 164, hake (silver and red) was also the dominant fish species in lbs with little else caught aside from 5 lbs (80 oz) of flounder and 1 lb (16 oz) of Atlantic herring for catch by important fisheries species. The stations sampled by trawling in the vicinity of the submarine export cable siting corridors had different dominant fish species by catch. Station 137 had few fish caught overall with only 13 lbs (208 oz) of categorized important species, which were comprised of the flounders (winter, windowpane, and summer). At Station 139, the dominant fish species caught in lbs was spiny dogfish with 670 lbs (10720 oz) followed by hake (silver and red) with 95 lbs (1520 oz), 12 lbs (19z oz) of winter flounder, 32 lbs of Atlantic mackerel, 11 lbs (176 oz) of butterfish, and 1 lb (16 oz) of *Loligo* squid. At Station 157 the dominant most important taxa in lbs was spiny dogfish with 193 lbs (3088 oz) with only 18 lbs (288 oz) of other species represented within this sample (silver hake, red hake, goosefish, summer flounder and butterfish) (NEFSC 2021).

Rhode Island Department of Environmental Management (RIDEM) (2017) analyzed vessel monitoring system data, vessel trip reports, and landings data to characterize importance of commercial harvest of manage species in the MA WEA from 2011-2016. The RIDEM (2017) data looked at vessel trips based upon existing categories defined by specific fisheries management plans. Combined, squid, mackerel, and butterfish FMP and associated as well as the Monkfish FMP vessels had the greatest density over the sampling timeframe based upon relative Vessel Management System (VMS) to the Study Area. The Northeast Multispecies FMP and Sea Scallop FMP vessels had the least density of VMS trips to the Study Area. While landings demonstrated the presence of a given species in the Study Area, the data are influenced by regulatory closures and quotas as well as independent economic variables (e.g., weather, demand, fuel costs), and thus are not considered representative of the underlying distribution and abundance of any given fish or invertebrate species.

FIGURE 5.5-55. LOCATION OF NEFSC SPRING MULTISPECIES BOTTOM TRAWL SURVEY STATIONS RELATIVE TO BEACON WIND STUDY AREA



Data Sources: BOEM, ESRI, NOAA, Northeast Fisheries Science Center (NEFSC). 2021
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

TABLE 5.5-12. DESIGNATED EFH BY SPECIES AND LIFE STAGE IN THE STUDY AREA

Managed Species	Lease Area				Beacon Wind Submarine Export Cable Corridors											
					Federal Waters				New York				Connecticut			
	E	L	J	A	E	L	J	A	E	L	J	A	E	L	J	A
Atlantic Cod (*Gadus morhua*)	X	X	X	X	X	X	X	X	X	X	X	X	-	-	X	-
Atlantic Herring (*Clupea harengus*)	X	X	X	X	X	X	X	X	-	-	X	X	-	-	-	-
Atlantic Sea Scallop (*Placopecten magellanicus*)	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-
Atlantic Clearnose Skate (*Raja eglanteria*)	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-
Haddock (*Melanogrammus aeglefinus*)	-	X	X	X	-	X	X	X	-	X	-	-	-	-	-	-
Little Skate (*Leucoraja erinacea*)	-	-	X	X	-	-	X	X	-	-	X	X	-	-	X	X
Monkfish (*Lophius americanus*)	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-
Ocean Pout (*Macrozoarces americanus*)	X	-	X	X	X	-	X	X	X	-	X	X	-	-	-	-
Pollock (*Pollachius virens*)	X	X	X	-	X	X	X	-	X	-	X	X	-	-	X	X
Red Hake (*Urophycis chuss*)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Silver Hake (*Merluccius bilinearis*)	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-
White Hake (*Urophycis tenuis*)	-	-	X	X	-	-	X	X	-	-	X	-	-	-	-	-
Windowpane Flounder (*Scophthalmus aquosus*)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

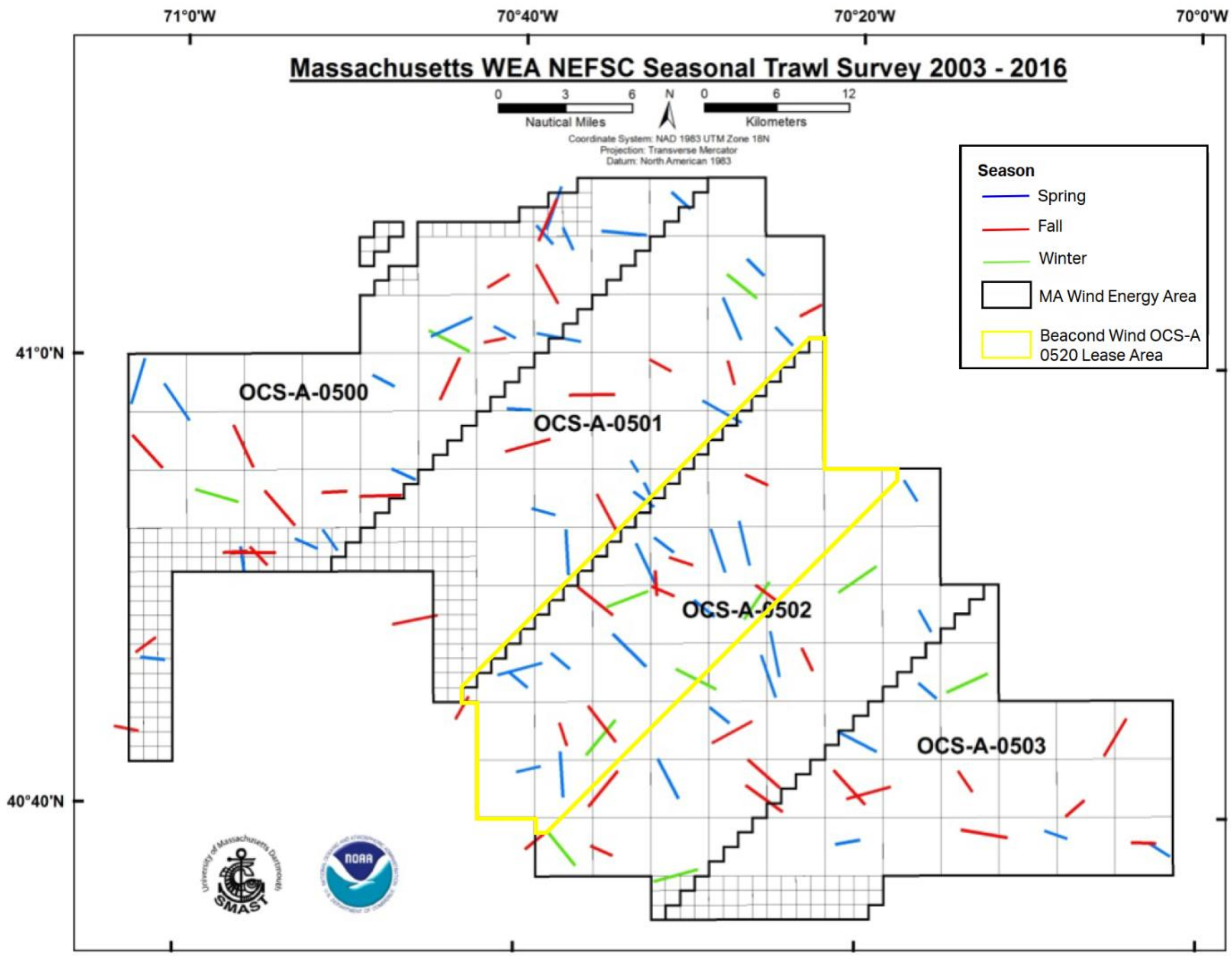
Managed Species	Lease Area				Beacon Wind Submarine Export Cable Corridors											
					Federal Waters				New York				Connecticut			
	E	L	J	A	E	L	J	A	E	L	J	A	E	L	J	A
Winter Flounder (*Pseudopleuronectes americanus*)	-	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X
Winter Skate (*Leucoraja ocellata*)	-	-	X	X	-	-	X	X	-	-	X	X	-	-	X	X
Witch Flounder (*Glyptocephalus cynoglossus*)	X	X	+	X	X	X	X	X	X	X	-	-	-	-	-	-
Yellowtail Flounder (*Limanda ferruginea*)	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-
Atlantic Butterfish (*Peprilus triancanthus*)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Atlantic Mackerel (*Scomber scombrus*)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Atlantic Surfclam (*Spisula solidissima*)	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-
Black Sea Bass (*Centropristis striata*)	+	+	X	X	+	+	X	+	+	+	X	+	+	+	X	X
Bluefish (*Pomatomus saltatrix*)	-	X	X	X	X	X	X	X	X	-	X	X	X	X	X	X
Longfin Inshore Squid (*Doryteuthis [Amerigo] pealeii*)	X	-	X	X	X	-	X	X	X	-	X	X	X	-	X	X
Northern Shortfin Squid (*Illex illecebrosus*)	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-
Ocean Quahog (*Arctica islandica*)	-	-	X	X	-	-	X	X	-	-	-	-	-	-	-	-
Scup (*Stenotomus chrysops*)	-	-	X	X	-	X	-	X	X	X	X	X	X	X	X	X
Spiny Dogfish (*Squalus acanthias*)	-	-	-	X	-	-	-	X	-	-	-	X	-	-	-	-

Managed Species	Lease Area				Beacon Wind Submarine Export Cable Corridors											
					Federal Waters				New York				Connecticut			
	E	L	J	A	E	L	J	A	E	L	J	A	E	L	J	A
Summer Flounder (*Paralichthys denatus*)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Atlantic Albacore Tuna (*Thunnus alalonga*)	-	-	X	X	-	-	X	X	-	-	X	-	-	-	X	X
Atlantic Bluefin Tuna (*Thunnus thynnus*)	-	-	X	X	-	-	X	X	-	-	X	X	-	-	-	-
Atlantic Skipjack Tuna (*Katsuwonus pelamis*)	-	-	X	X	-	-	X	X	-	-	-	X	-	-	-	-
Atlantic Yellowfin Tuna (*Thunnus albacres*)	-	-	X	+	-	-	X	X	-	-	X	-	-	-	-	-
Blue Shark (*Prionace glauca*)	N/A	-	X	X	N/A	-	X	X	N/A	-	-	-	N/A	-	-	-
Common Thresher Shark (*Alopias vulpinus*)	N/A	X	X	X	N/A	X	X	X	N/A	X	X	X	N/A	-	-	-
Dusky Shark (*Carcharhinus obscurus*)	N/A	-	X	X	N/A	-	X	X	N/A	-	-	-	N/A	-	-	-
Sand Tiger Shark (*Carcharhinus taurus*)	N/A	-	X	-	N/A	-	X	-	N/A	X	X	-	N/A	-	X	-
Sandbar Shark (*Carcharhinus plumbeus*)	N/A	-	X	X	N/A	-	X	X	N/A	-	X	X	N/A	-	-	-
Shortfin Mako Shark (*Isurus oxyrinchus*)	N/A	X	X	X	N/A	X	X	X	N/A	-	-	-	N/A	-	-	-
Smoothhound Shark/Smooth Dogfish (*Mustelus canis*)	N/A	X	X	X	N/A	X	X	X	N/A	X	X	X	N/A	X	X	X
Tiger Shark (*Galeocerdo cuvier*)	N/A	-	X	X	N/A	-	X	X	N/A	-	-	-	N/A	-	-	-
White Shark (*Carcharodon carcharias*)	N/A	-	X	X	N/A	-	X	X	N/A	X	-	-	N/A	-	-	-

Managed Species	Lease Area				Beacon Wind Submarine Export Cable Corridors											
					Federal Waters				New York				Connecticut			
	E	L	J	A	E	L	J	A	E	L	J	A	E	L	J	A
American Plaice (*Hippoglossoides platessoides*)	X	X	-	-	X	X	-	-	-	-	-	-	-	-	-	-

Note:
E = Eggs, L= Larvae, J= Juvenile, A= Adults
X= Presence per GARFO EFH Mapper
+= Presence suggested based on habitat preference

FIGURE 5.5-56. LOCATIONS OF NEFSC SEASONAL TRAWL SURVEYS IN THE LEASE AREA



Source: Guida et al. 2017

5.5.1.2.2 Shellfish Species of Concern (Lease Area)

Independent surveys of shellfish conducted since the 2017 NEFSC summary reports did not capture any ocean quahog (**Figure 5.5-57**) or Atlantic surfclam (**Figure 5.5-58**) within or around the Lease area (NEFSC 2018). The center of the surfclam stock has been shifting north and offshore for several decades, notably since early 2000, and landings of surfclam per unit effort have declined during this period in in the northwestern Atlantic Ocean (Timbs et al. 2018; Hofmann et al. 2018). Only a single qualitative detection of surfclam was made from the western extremity of OCS-A-0500, where there is no overlap with surfclam EFH (**Figure 5.5-62**).

As sea scallops and ocean quahogs were widespread and numerous, these are clearly species worth considering in terms of potential for habitat disturbance in spite of only a small overlap with the currently designated sea scallop EFH (**Figure 5.5-59**). The egg mops of longfin squid were not detected in the MA WEA, but this may be attributable to sampling in early spring (March/cold season), rather than in summer, when longfin squid lay eggs. Beam trawling is capable of catching them if they are present, but Guida et al. (2017) did not encounter them so far out of season.

Documentation of shellfish species of concern in the MA WEA include quantitative records of sea scallops from NEFSC seasonal trawl surveys and qualitative records from beam trawls, bottom grabs, and bottom imagery. Sea scallops were clearly widespread in the MA WEA, occurring across the entire Lease Area (**Figure 5.5-60**).

Ocean quahog records (qualitative) were also widespread, documenting primarily bottom grab samples. In some cases, this distribution exceeded the limits for ocean quahog EFH in the area (**Figure 5.5-61**).

Analysis of VMS data, vessel trip reports, and landings data to characterize the importance of the commercial harvest of managed species in the Lease Area, indicated that sea scallop landings were by far the most economically valuable, followed by squid, mackerel, and butterfish (combined landings). While landings demonstrate the presence of a given species in the Project Area, the data are influenced by regulatory closures and quotas as well as independent economic variables (e.g., weather, demand, fuel costs); therefore, they are not considered to be representative of the underlying distribution and abundance of any given fish or invertebrate species. Moreover, scallop abundance and distribution vary substantially from year to year for reasons such as predation pressure and water conditions that are not well understood but are likely extrinsic to scallops (Bethoney et al. 2016). The socioeconomics of commercial and recreational fisheries resources are discussed further in **Section 8.8 Commercial and Recreational Fishing**.

FIGURE 5.5-57. NUMBER OF OCEAN QUAHOG PER SAMPLING STATION DURING NOAA NORTHEAST FISHERIES SCIENCE CENTER ATLANTIC SURFCLAM AND OCEAN QUAHOG SURVEY 2018

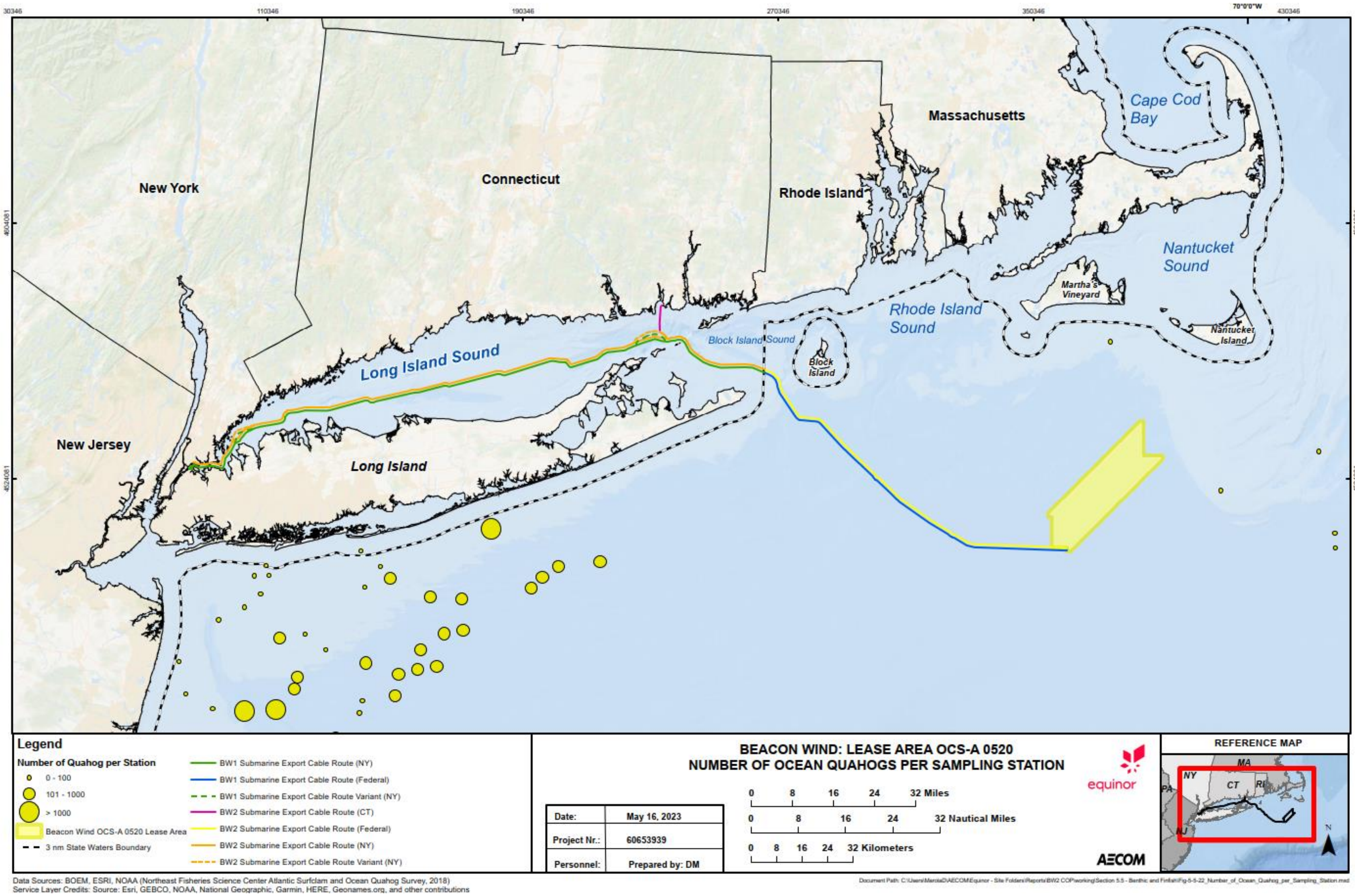
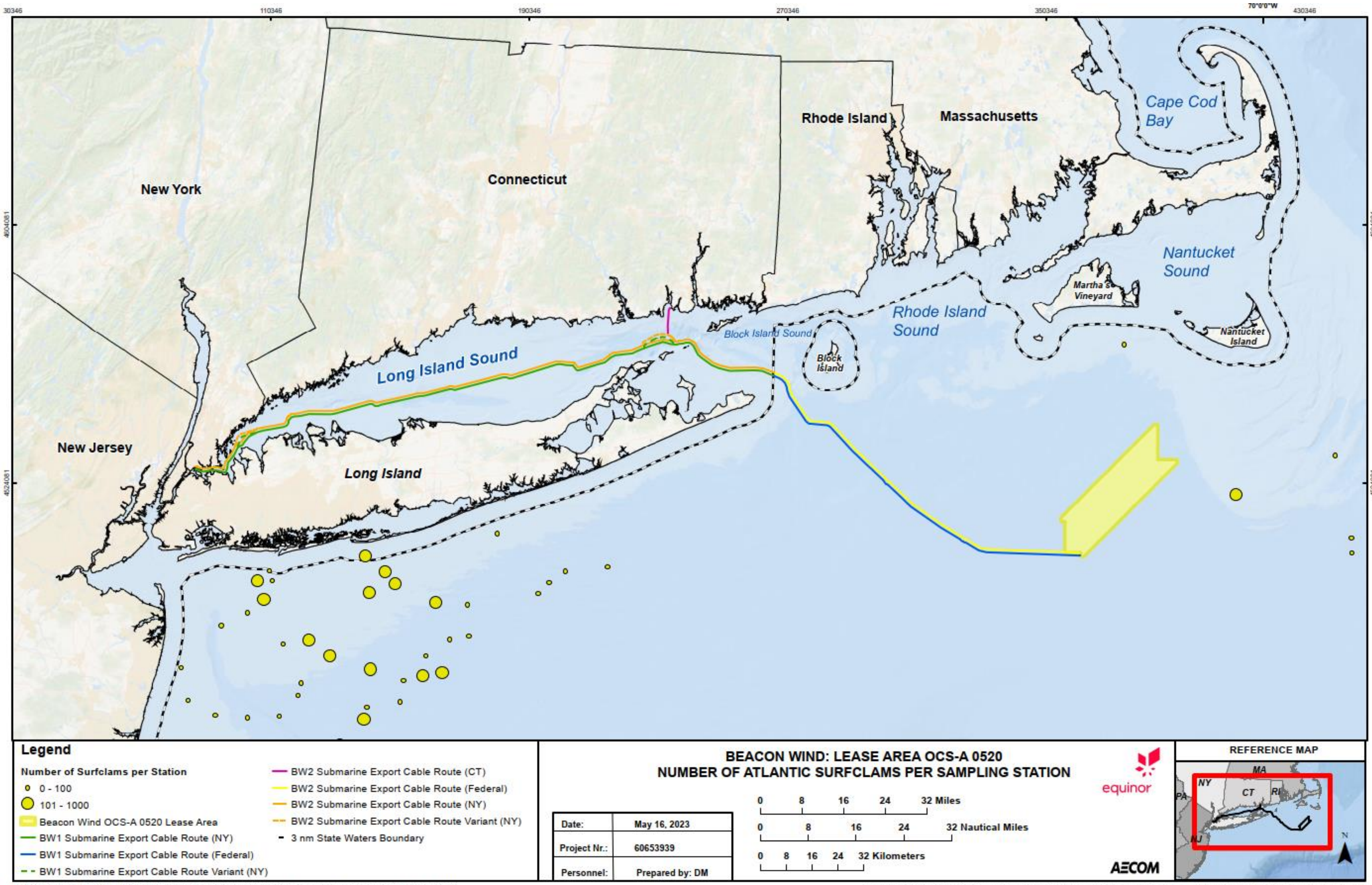


FIGURE 5.5-58. NUMBER OF ATLANTIC SURFCLAM PER SAMPLING STATION DURING NOAA NORTHEAST FISHERIES SCIENCE CENTER ATLANTIC SURFCLAM AND OCEAN QUAHOG SURVEY 2018



Data Sources: BOEM, ESRI, NOAA (Northeast Fisheries Science Center Atlantic Surfclam and Ocean Quahog Survey, 2018)
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

FIGURE 5.5-59. ATLANTIC SEA SCALLOP (*PLACOPECTEN MAGELLANICUS*) DESIGNATED EFH IN THE FEDERAL WATERS OF THE PROJECT AREA

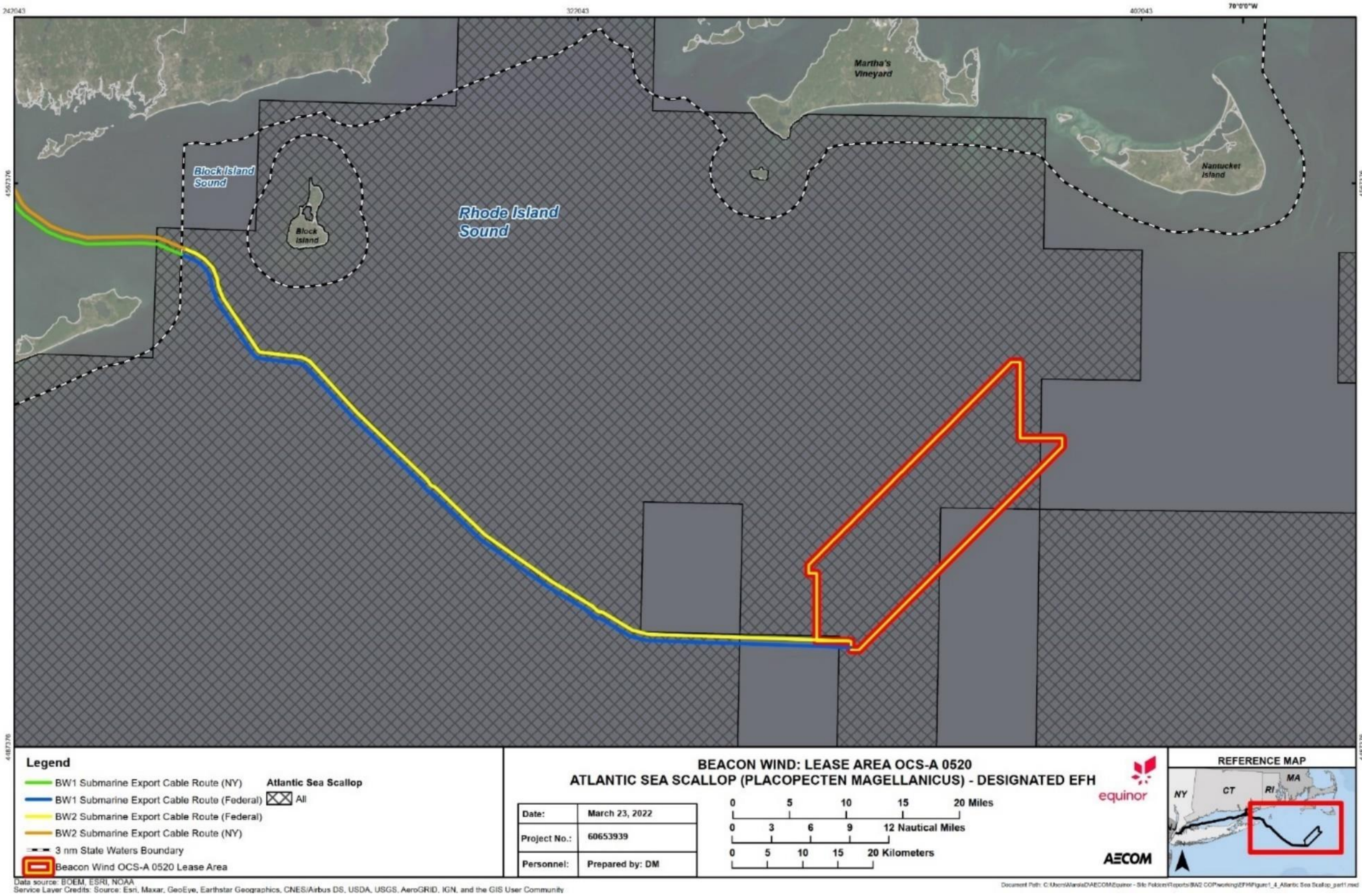
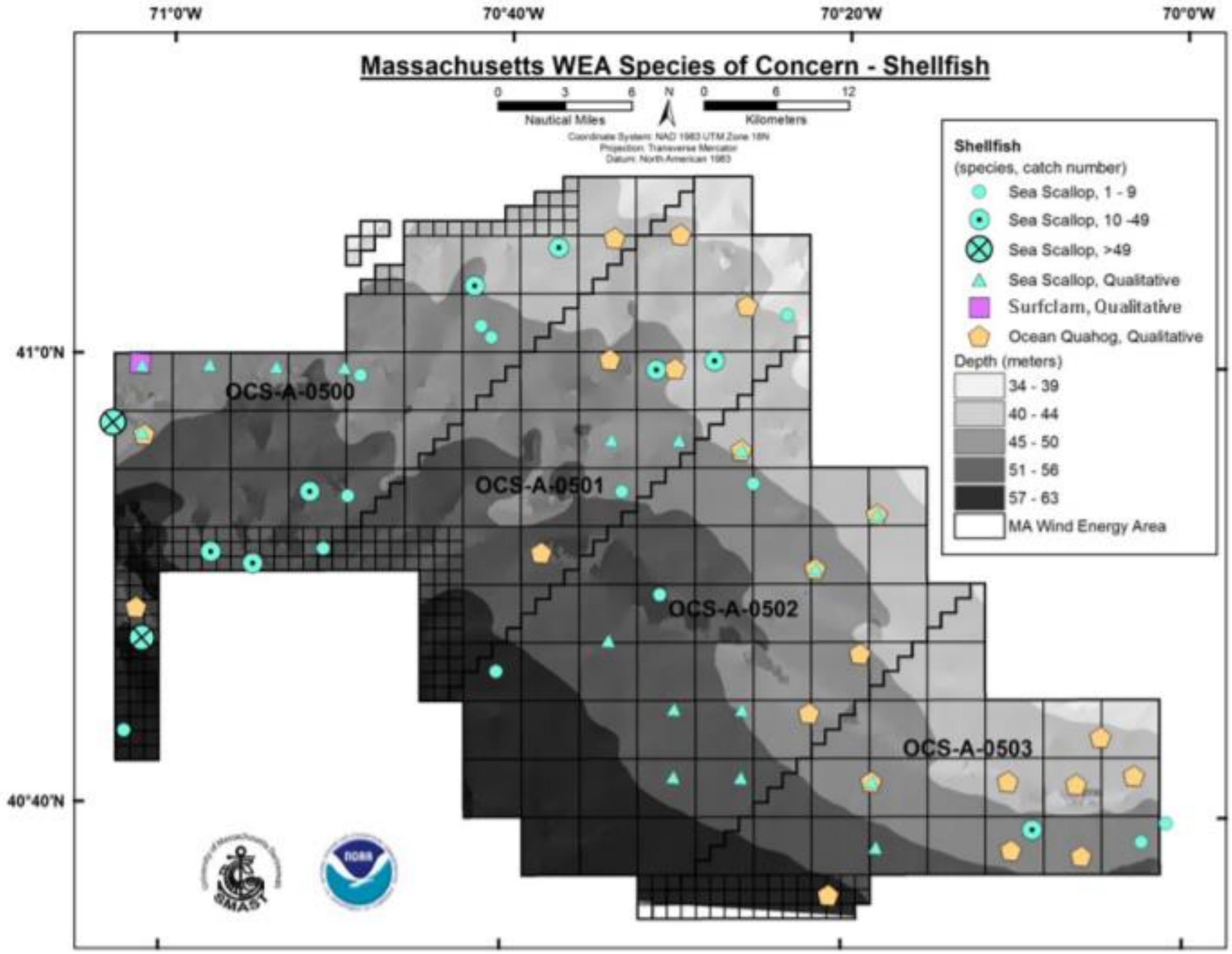


FIGURE 5.5-60. SHELLFISH SPECIES OF CONCERN RECORDS WITHIN AND NEAR THE MA WEA



Source: Guida et al. 2017

FIGURE 5.5-61. OCEAN QUAHOG (*ARCTICA ISLANDICA*) DESIGNATED EFH IN THE FEDERAL WATERS OF THE PROJECT AREA

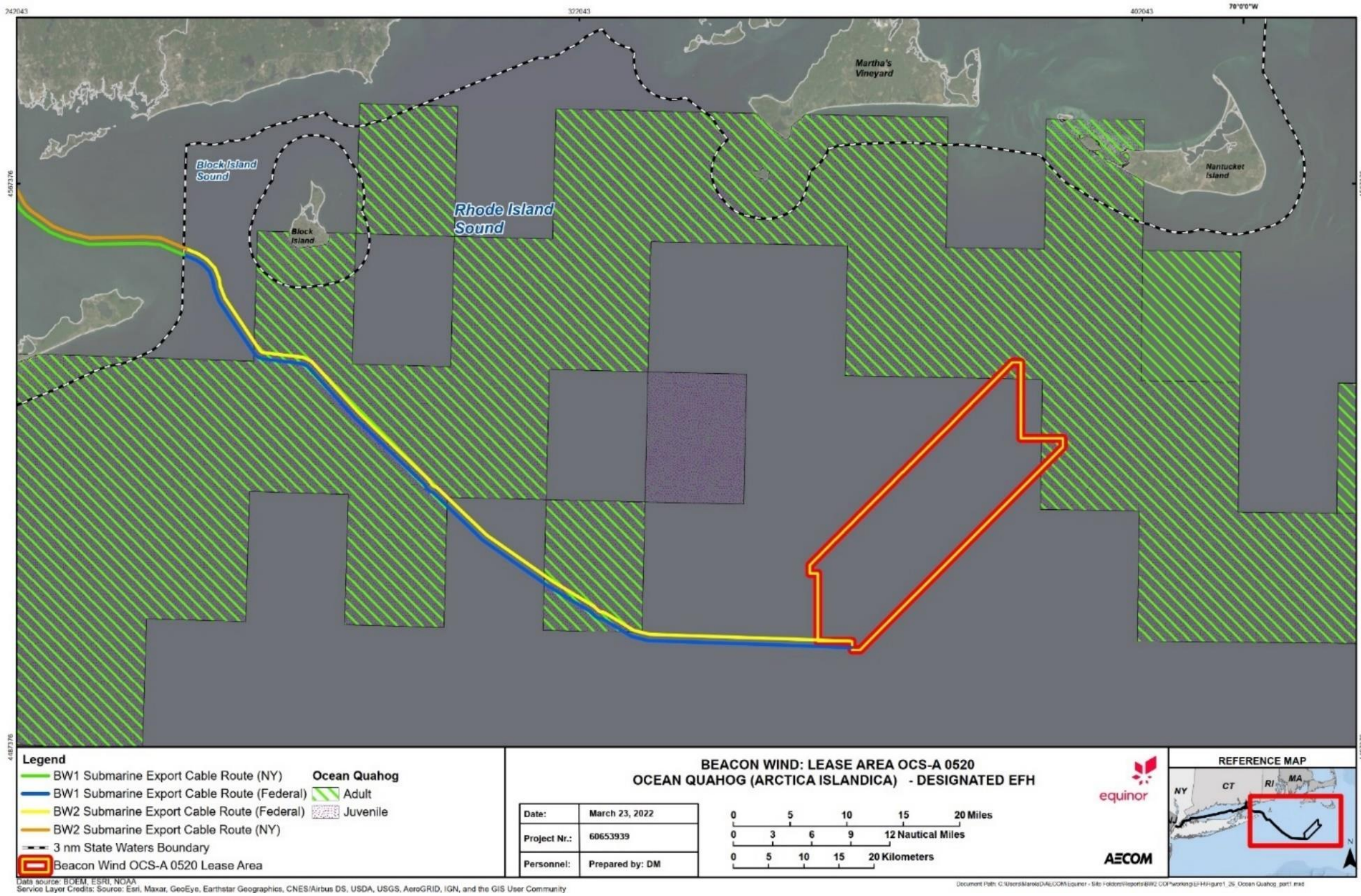
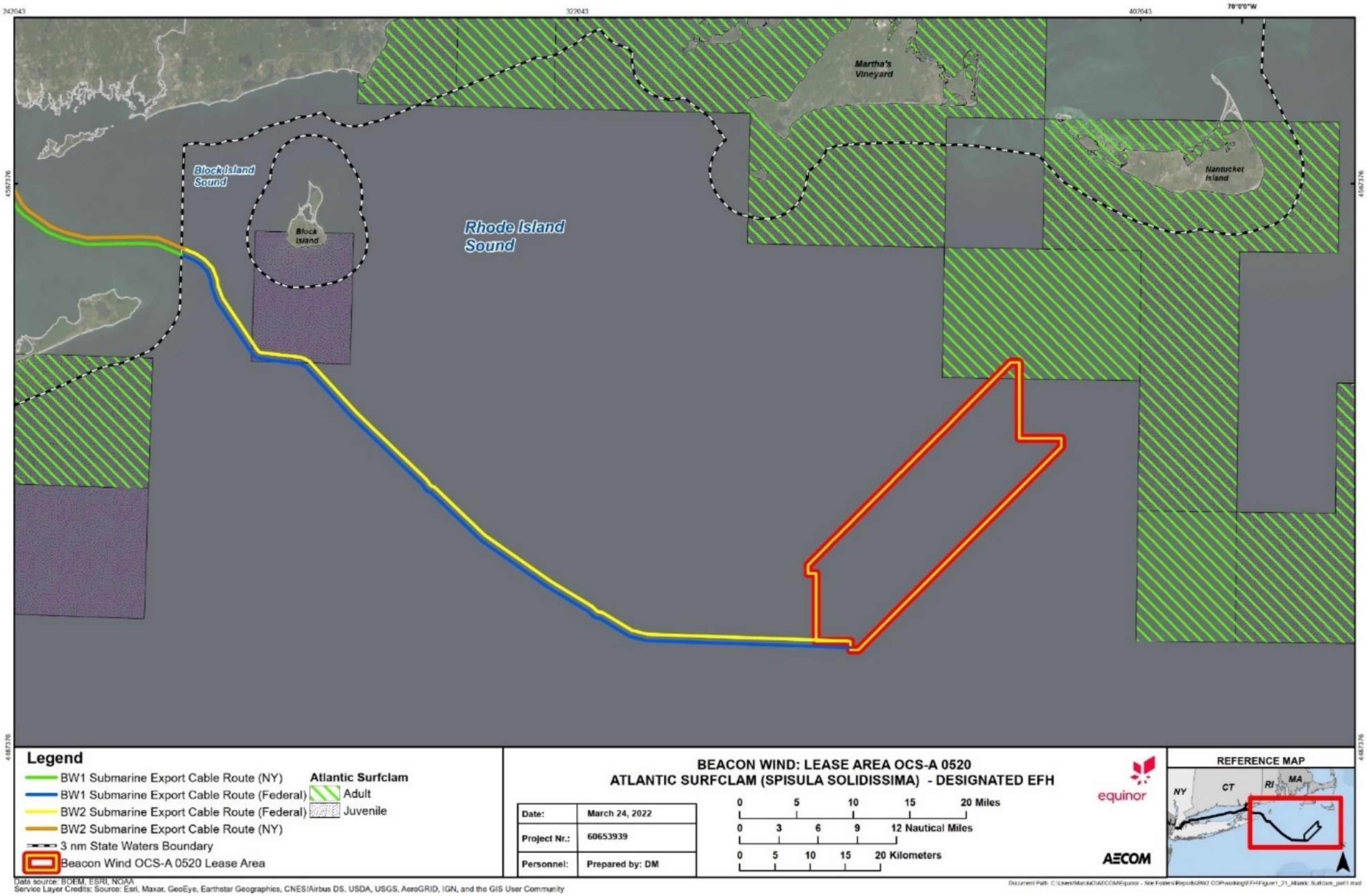


FIGURE 5.5-62. ATLANTIC SURFCLAM (*SPISULA SOLIDISSIMA*) DESIGNATED EFH IN THE FEDERAL WATERS OF THE PROJECT AREA



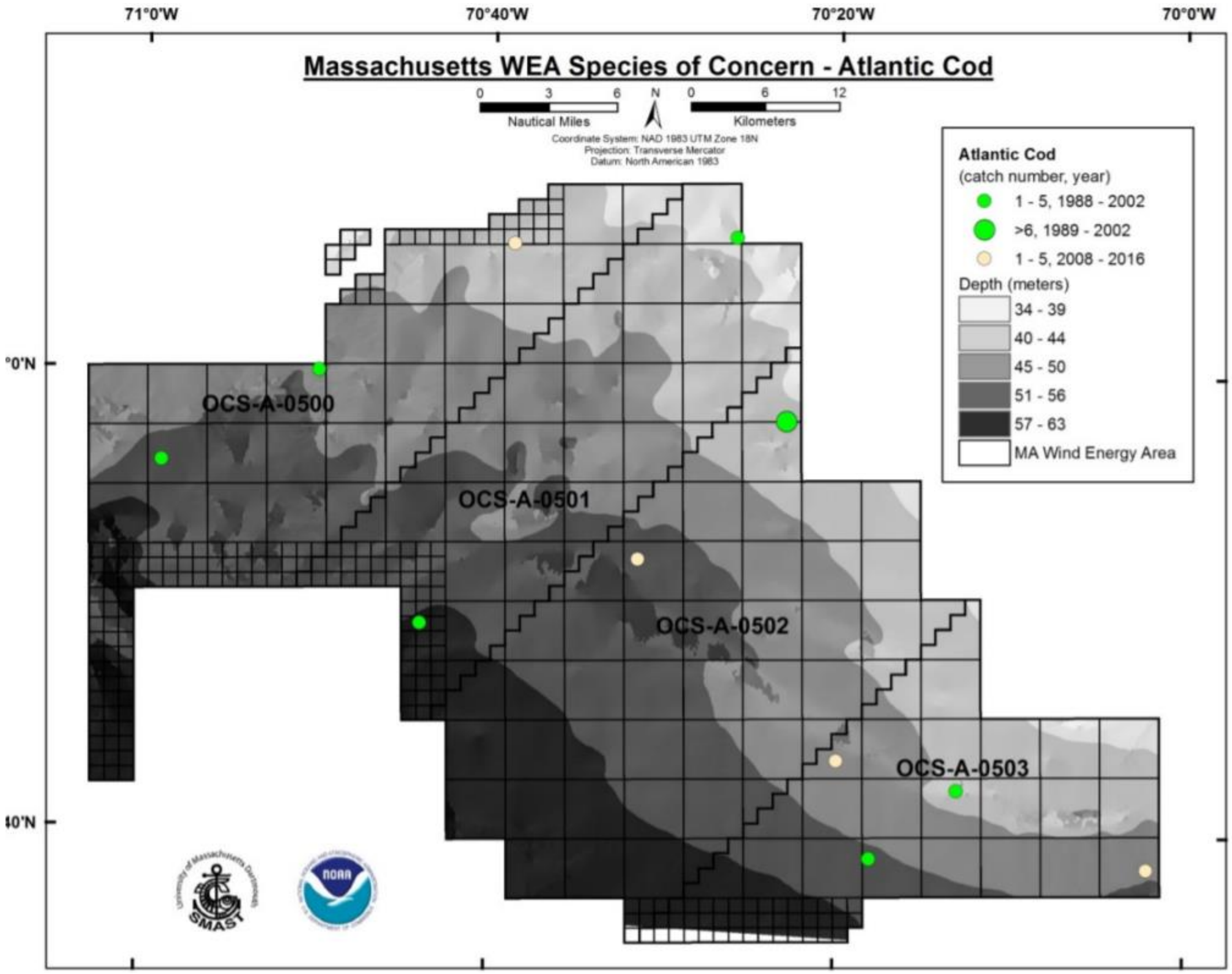
5.5.1.2.3 Fish Species of Concern (Lease Area)

Atlantic cod were rarely caught by the NEFSC seasonal survey in the MA WEA between 2008 and 2016, and only in small numbers (see **Figure 5.5-63**, depicted by the yellow circles): once in lease area OCS-A-500, once in OCS-A-502 (now Beacon Wind Lease Area OCS-0520 and Mayflower Wind Lease Area OCS-0521), and twice in OCS-A 503. The study reasoned that this rarity might be connected to the large decline in cod stocks in the 1990s. To further investigate, NEFSC added catch records from the previous 14 years, extending back to 1989 (**Figure 5.5-63**, depicted by the green circles) (Guida et al. 2017). This increased the small catches to six: two each in OCS-A-500, OCS-A-501, and OCS-A-503, and one large catch, possibly an aggregation, in OCS-A-502 (now Beacon Wind Lease Area OCS-0520 and Mayflower Wind Lease Area OCS-0521) (Guida et. al. 2017).

EFH for adult Atlantic cod overlaps with 98.7 percent of the Lease area. EFH for juvenile Atlantic cod overlaps with 53.4 percent of the Lease Area, and eggs and larvae EFH overlap with 50.4 percent of the Lease Area (**Figure 5.5-64)**. Current EFH designations for adult and juvenile Atlantic cod do not include the southern half of the MA WEA (across the four lease areas), where some catches have been recorded. While fine sediments are likely the cause of the paucity of cod in the south and their exclusion from the cod EFH zone, this is not the cause of poor cod catches in the north, which is more gravelly. Unless their presence is very transient or very focused on specific locations, it is unlikely that the presence of cod is being missed by the NEFSC season survey in the MA WEA. The survey regularly samples both sediment regimes (fine and gravelly) during the cold season (winter and spring), averaging about twice each in the north and south during each annual cold season (see **Figure 5.5-56**). Therefore, NEFSC low frequency (7 percent of cold season trawls since 2003) and low numbers in survey catches, especially in the north, remains an open question (Guida et al. 2017).

Both young-of-the-year (YOY) and sub-adult to adult-sized black sea bass were also detected in the MA WEA, entirely via NEFSC seasonal survey trawl (see **Figure 5.5-65**). The distinction is important because YOY black sea bass are thought to have bottom habitat refuge requirements. Their pattern of distribution suggests that adult and sub-adult black sea bass may prefer habitats at depths of 148 ft (45 m) or less. YOY appear to occur through a wider depth range (to at least 60 m) but may also be found at depths of 131 ft (40 m) in the WEA. This depth-related distribution is suggested by EFH maps and text descriptions for the species (see**, Figure 5.5-66)** (MAFMC and ASMFC 1998). This is another species where there may be potential for habitat disturbance (Guida et al. 2017).

FIGURE 5.5-63. RECORDS OF ATLANTIC COD (*GADUS MORHUA*) IN THE MA WEA



Source: Guida et al. 2017

FIGURE 5.5-64. ATLANTIC COD (*GADUS MORHUA*) DESIGNATED EFH IN THE FEDERAL WATERS OF THE PROJECT AREA

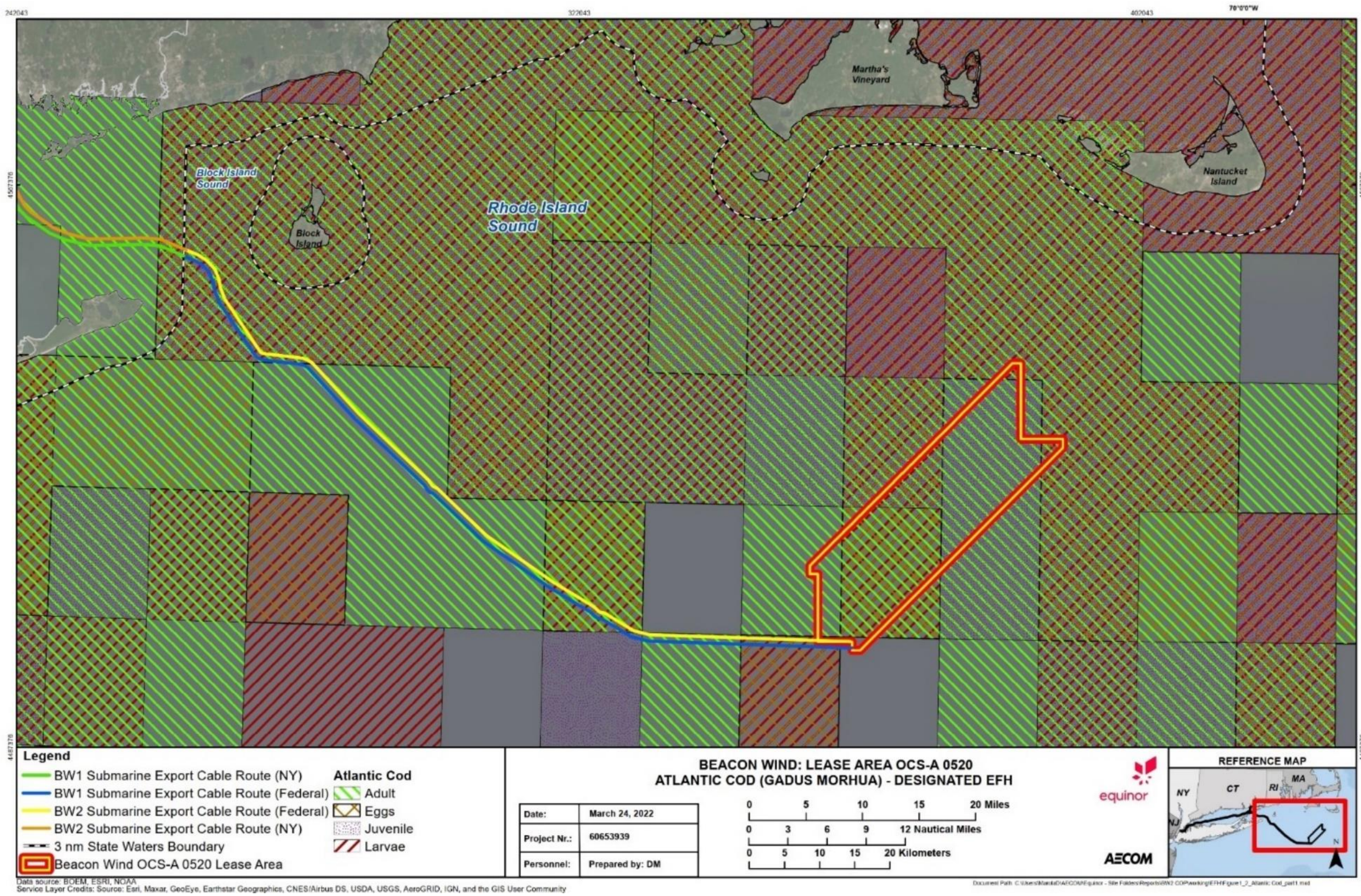
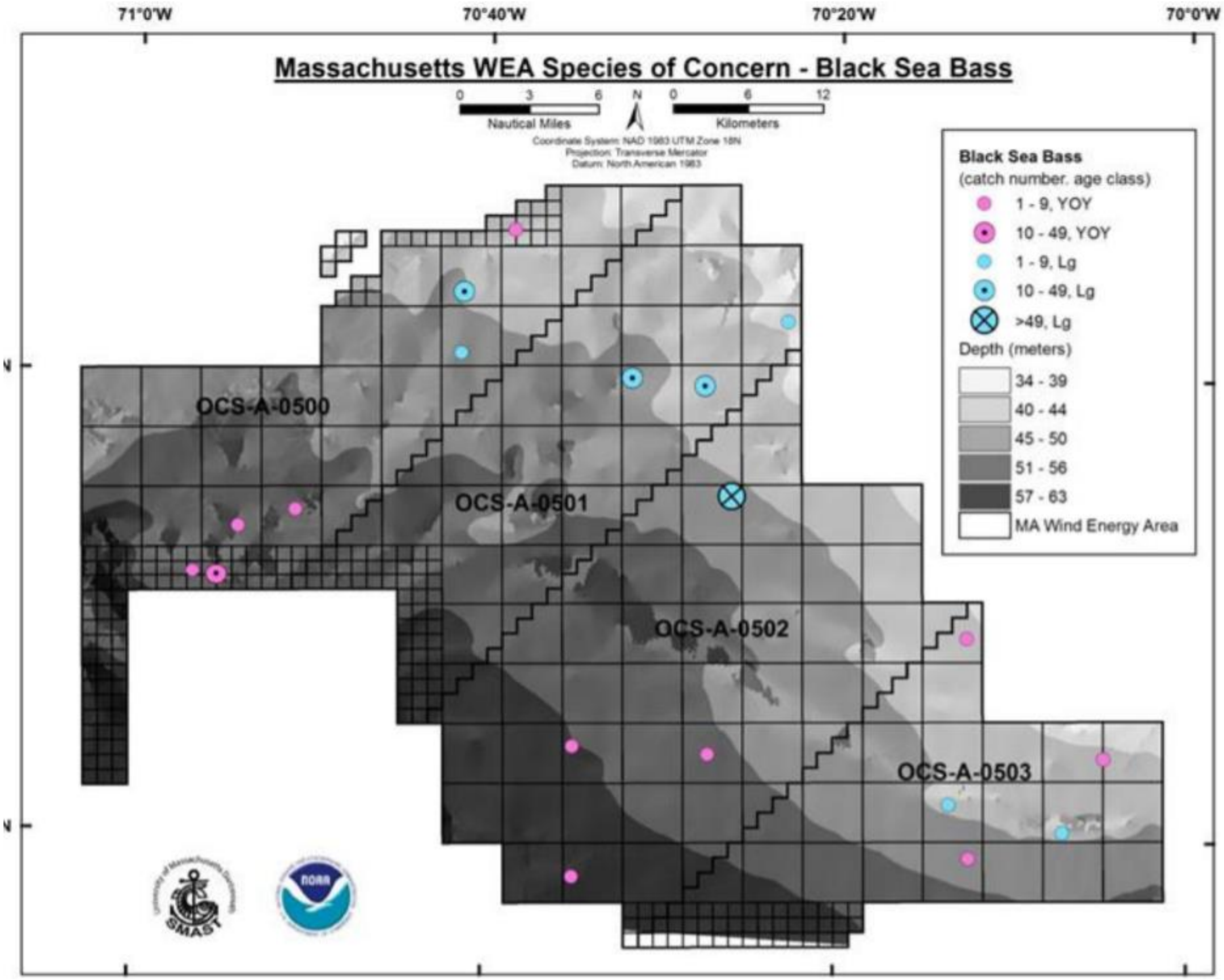
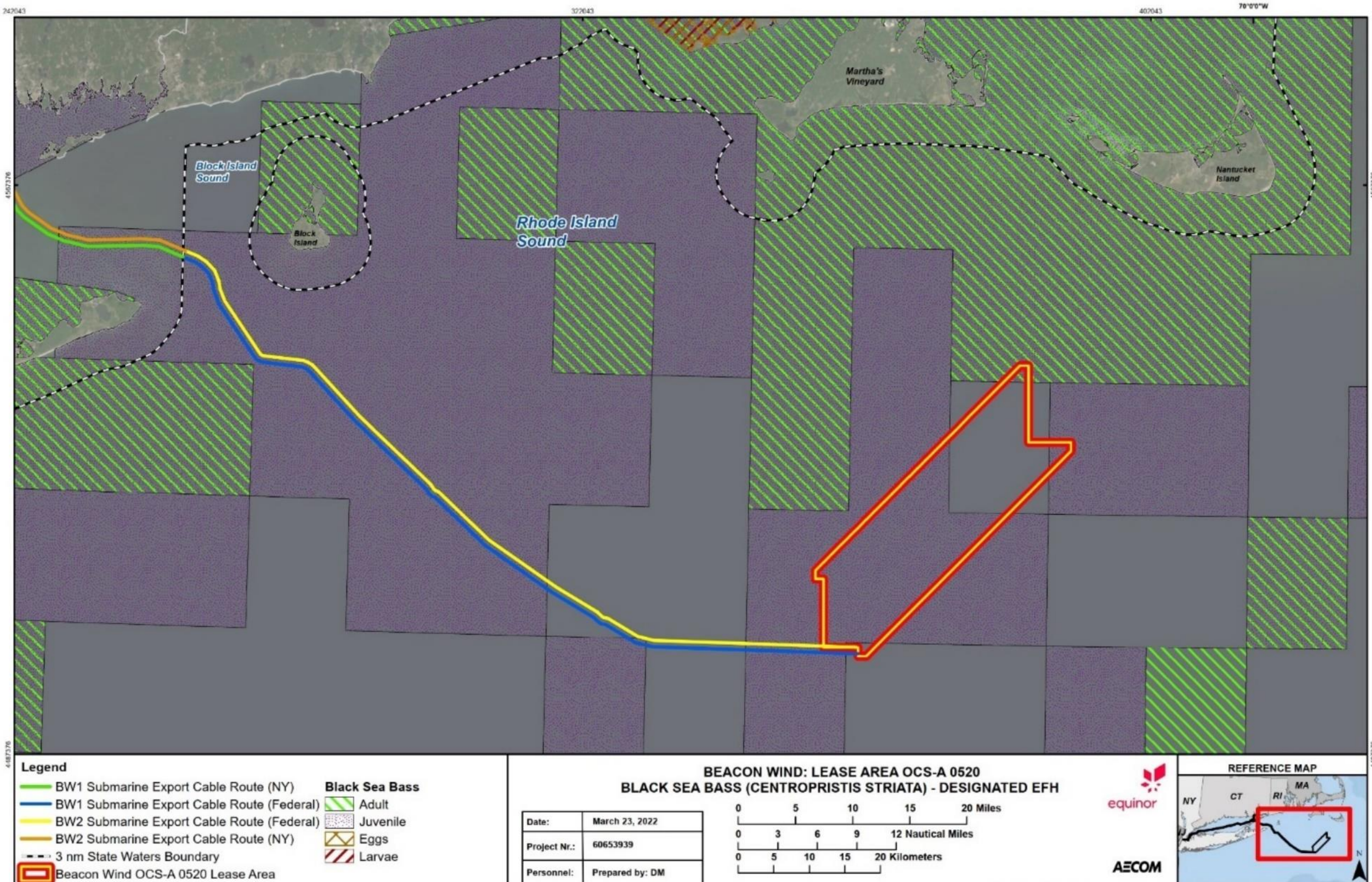


FIGURE 5.5-65. RECORDS OF YOUNG-OF-THE-YEAR (YOY) AND LARGER BLACK SEA BASS (*CENTROPRISTIS STRIATA*) IN THE MA WEA



Source: Guida et al. 2017

FIGURE 5.5-66. BLACK SEA BASS (*CENTROPRISTIS STRIATA*) DESIGNATED EFH IN THE FEDERAL WATERS OF THE PROJECT AREA



Data source: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

5.5.1.2.4 Ecologically Important Fish and Invertebrate Forage Species (Lease Area)

The commercially and recreationally valuable species managed under the MSA rely on prey ranging in size from single-celled plankton to large conspecifics; the diets of most managed species change throughout the life cycle as they mature and grow (Able et al. 2018). In recognition of the role of invertebrate and fish forage species in maintaining sustainable stocks of managed species, the MAFMC summarized predator-prey relationships involving unmanaged forage species and proposed management measures to protect these species from directed harvest and unintentional impacts (MAFMC 2017). Virtually all species in the Project Area function as forage at some point in their lives; however, this section focuses on those species that were identified in digital images, collected in benthic grabs and beam trawls, or otherwise reported to occur in the Project Area. The discussion below includes direct sampling by Beacon Wind as well as reports from Guida et al. (2017), Battista et al. (2019), and NEFSC (2021).

Beacon Wind conducted a series of Benthic Surveys within the Lease Area in 2020 in 2021 collecting more than 1,000 Plan View and Sediment Profile Images within the Project Area as well as over 100 video transects and analyzed over 150 benthic samples as well as site specific benthic habitat assessment along the submarine export cable corridors. **Appendix S Benthic Resources Characterization Reports and Mapbooks**, which includes data that was obtained in 2021. The data for the Lease Area and submarine export cable corridors are included with **Appendix S Benthic Resources Characterization Reports and Mapbooks**. The CMECS Biotic Component was classified to the LPIL based on the drop camera benthic video with verification from the grab camera and faunal analyses (**Table 5.5-4**). The entire Lease Area was classified as Benthic/Attached Biota, Faunal Bed, and Soft Sediment Fauna and the majority of the Lease Area was further subclassified into the Biotic Group of Small Tube Building Fauna. The benthic grab infaunal taxonomic data was used to refine the classification of benthic habitat based upon the analysis of 44 benthic infaunal taxonomy priority Station locations and included identification of dominant taxa such as presence of *Ampelisca vadorum* (Crustacea, Amphipoda). The southern Stations within the Lease Area in deeper water had a classification grouping of Starfish Bed (*Asterias* or *Astropecten* Bed) and six of the nine northernmost stations in the Lease Area displayed a classification grouping of Sand Dollar Bed.

Several macrobenthos species were observed throughout the Lease Area. Sea stars (*Asterias* sp. and *Astropecten* sp.) were more abundant in the southern portion of the sampling area but were observed throughout (43 of 157 stations). Sand dollars were observed in the northwestern portion of the Lease Area with greatest abundance at 6 stations in this area (see **Figure 5.5-67, Figure 5.5-68**).

Numerous fish species were observed. Skates were observed at 30 stations (Rajidae, winter skate [*Leucoraja ocellata*], thorny skate [*Amblyraja radiata*], little skate [*Leucoraja erinacea*]). Other species included hake at 82 stations (merluccid hakes [*Merluccidae*], silver hake [*Merluccius bilinearis*], phycid hakes [*Phycidae*], red hake [*Urophycis chuss*], spotted hake [*Urophycis regia*]), butterfish at 14 stations (*Stromateidae*, *Peprilus triacanthus*), and flounder at 14 stations (sand flounder [*Paralichthyidae*], fourspot flounder [*Paralichthys oblongus*], summer flounder [*Paralichthys dentatus*]). The primary crustacean observed was the Jonah crab (*Cancer borealis*) at 110 stations. Representative images show in **Figure 5.5-69** and **Figure 5.5-70**.

The complete record of observations by sample location is provided in **Appendix S Benthic Resources Characterization Reports and Mapbooks**. Overall results of the Beacon Wind benthic biological surveys are consistent with the findings of previous independent studies in the MA WEA (RIDEM 2017, NEFSC 2021, Guida et al. 2017, and Battista et al. 2019). As part of the BOEM/NOAA Fisheries Habitat Mapping conducted to characterize baseline conditions of benthic resources in the

MA WEA, 23 beam trawls were obtained by NEFSC in spring, fall, and winter seasons between 2003 and 2016. Only one triplicate grab sample was collected in the Lease Area (**Figure 5.5-52, Figure 5.5-56**, Guida et al. 2017). The grab samples were sieved through a 1.0 mm mesh and infauna were classified using CMECS. The dominant classification from this sample as well as from thirteen other benthic grab samples obtained throughout the MA WEA were classified as Amphiopod beds (*Ampelisca* sp.) with a group classification as Clam Bed (*Nuclua proxima*), The Beacon Wind field collected benthic sample results from 2021 agree with the habitat designations and dominant taxa identified from the Guida et al. (2017) samples (**Figure 5.5-67, Figure 5.5-68**). Amphipods and polychaetes were a major component of the samples obtained in the MA WEA including the triplicate sample in the Beacon Wind Lease Area with *Ampelisca* sp. Representing 40 percent, *Nucula proxima* 15 percent, and polychaetes with approximately 30 percent of the taxonomic abundance. The remaining 15 percent of the taxa were represented by multiple major taxonomic groups such as nemerteans, echinoderms and other miscellaneous Phyla (Guida et al. 2017). The Guida et al. (2017) study found that ocean quahogs and sea scallops were widespread and numerous across the entirety of the MA WEA. However, surfclams were not abundant and only a single qualitative detection of surf clams was made from a western extremity of OCS-A-0500, where there was no overlap with surfclam EFH.

Figure 5.5-67. Representative Surficial Grab Image From Station WTG-002 Displaying Sand Dollars

Figure 5.5-68. Representative Surficial Grab Image From Station WTG-154 Displaying A Sea Star (*Astropecten sp.*)

FIGURE 5.5-69. REPRESENTATIVE IMAGE DISPLAYING A SKATE (RAJIDAE)

FIGURE 5.5-70. REPRESENTATIVE IMAGE DISPLAYING SEA STARS (*ASTERIAS* SP.) WITH A JONAH CRAB (*CANCER BOREALIS*)

TABLE 5.5-13. MANAGED FISH SPECIES OBSERVED IN THE LEASE AREA

Group	Species (EFH life stage)	Management Council		
		NEFMC	MAFMC	ASMFC
Sharks and Rays	Little skate (juvenile, adult)	X	--	--
Sharks and Rays	Thorny skate	X	--	--
Sharks and Rays	Winter skate (juvenile, adult)	X	--	--
Invertebrate	Atlantic sea scallop (all)	X	--	--
Invertebrate	American lobster	--	--	X
Invertebrate	Jonah crab	--	--	X
Bony Fish	Monkfish (eggs/larvae, adult)	X	--	--
Bony Fish	Red hake (egg, larvae, juvenile, adult)	X	--	--
Bony Fish	Silver hake (eggs/larvae, juvenile)	X	--	--
Bony Fish	Summer flounder (eggs, larvae, adult)	--	X	--

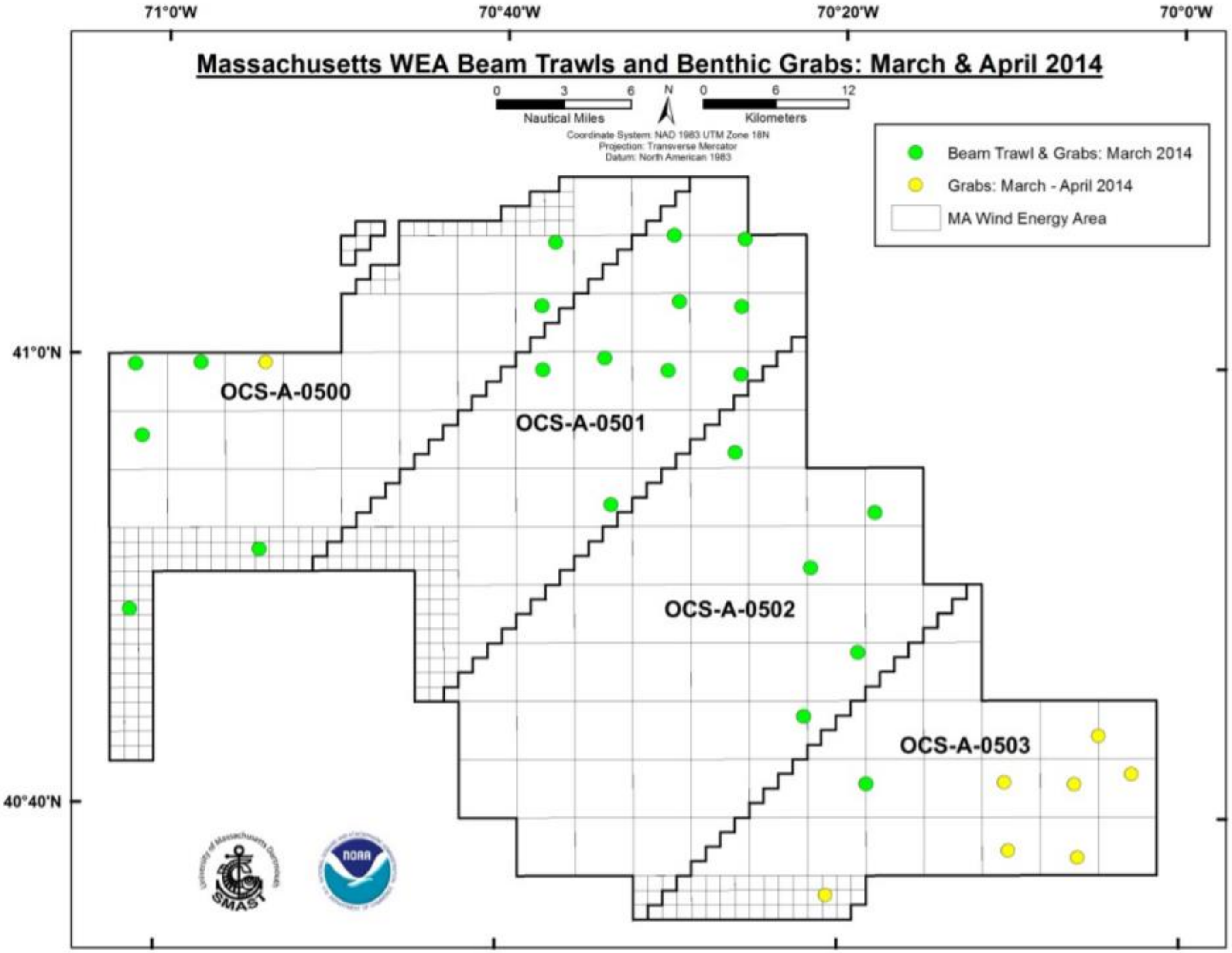
5.5.1.2.5 Benthic Epifauna and Infauna (Lease Area)

Benthic samples were collected during two NEFSC–sponsored cruises (AMAPPS GU14-02 parts 1 and 2) (Guida et al. 2017) in the MA WEA in March and April in 2014, including 23 beam trawls for benthic epifauna and 30 triplicate Van Veen grabs for benthic infauna (**Figure 5.5-71)**. Priority was given to areas with depths <165 ft (50 m) as this was considered to be the maximum depth for placement of offshore wind facilities under the present technology. No subsequent benthic sample-capable cruises visited the MA WEA.

NEFSC beam trawl catches and the contents (58 taxa) of the benthic grab samples (151 taxa) are summarized in **Figure 5.5-71**. Among the epibenthic fauna as obtained in beam trawls, there were no dominant species, but sand shrimp and sand dollars were combined the most dominant taxa (see **Figure 5.5-72)**. These results were anticipated as the area was documented by Guida et al. (2017) as consisting of largely sandy sediments particularly in the northern most portions of the MA WEA. The deeper, southern station locations showed a mix of sands and silts, habitat that is preferred by amphipods and polychaetes

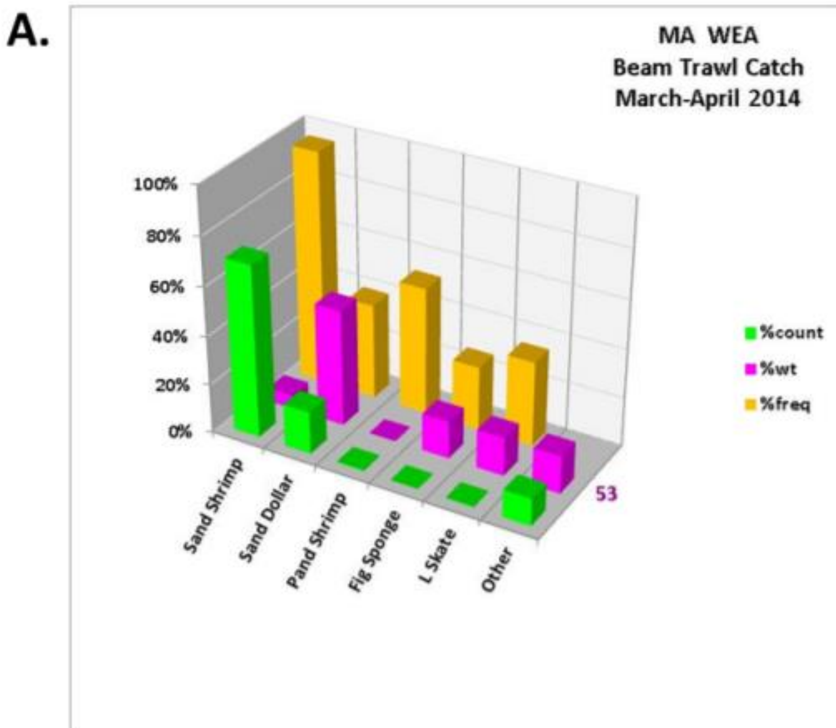
One hundred and fifty-one (151) taxa of infaunal benthos were captured in grab samples from the MA WEA (see **Figure 5.5-72**). The benthic infaunal assemblages resembled those observed and found to be common among OceanSAMP stations, described by LaFrance et al. (2010) as dominated by *Ampelisca agassizi* and *Nucula annulata* (*N. annulata* is an unaccepted synonym for *N. proxima*), and to the benthic infaunal collection from a sandy region of the Massachusetts and Rhode Island (MA/RI) WEA also numerically dominated by *A. agassizi* and *N. proxima*). This pattern points to the observation that barring serious disturbance, benthic infaunal assemblages can be stable over periods of many years (LaFrance, 2010). The large number of “core” taxa in these MA WEA samples (Guida et al. 2017) suggested that benthic epifaunal assemblages from this area are closely related to those in the Rhode Island SAMP and MA/RI WEA.

FIGURE 5.5-71. LOCATIONS OF BEAM TRAWLS AND BENTHIC GRABS IN THE BEACON WIND AND OTHER MA WEA

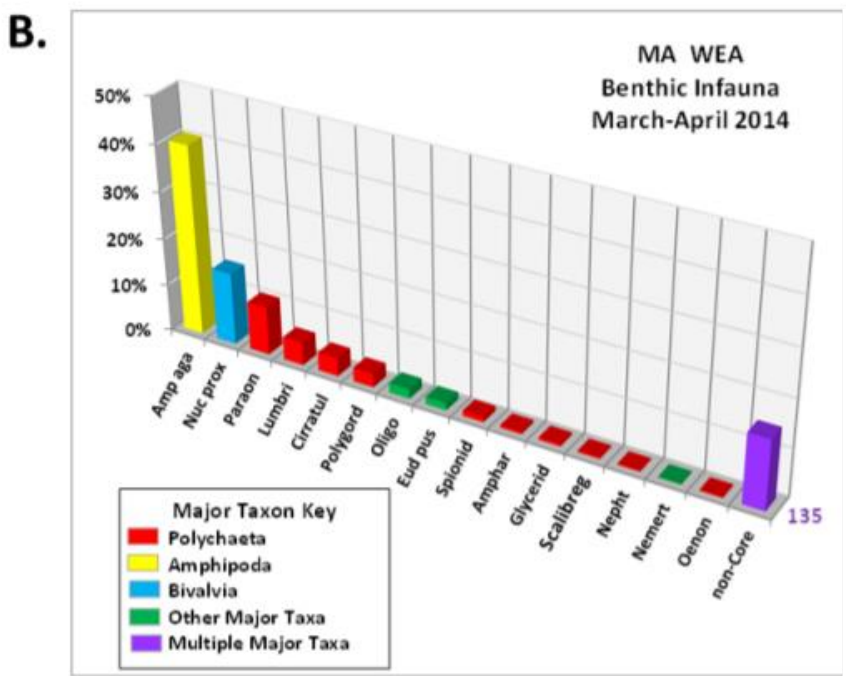


Source: Guida et al. 2017

FIGURE 5.5-72. BEAM TRAWL CATCHES AND GRAB SAMPLE CATCH WITHIN THE MA WEA



A. Beam trawl catches by percentage of total catch numbers, weights, and frequency within WEA; Abbreviated common names for taxa in A.: Pand Shrimp – pandalid shrimp, L Skate – little skate



B. Grab sample catch by percentage of total catch numbers, color-coded by major taxonomic group. Abbreviated taxonomic names in B: Amp aga – *Ampelisca agassizi*, Nuc prox – *Nucula proxima*, Paraon – *paraonidae,* Lumbri – *Lumbrinereidae*, cirratul – *Cirratulidae*, Polygord – *Polygordiidae*, Oligo – *Oligochaeta*, Eud pus – *Eudorella pusilla*, Spionid – *Spionidae*, Amphar – *Ampharetidae*, Glycerid – *Glyceridae*, Scalibreg – *Scalibregmatidae*, Nepht - *Nephtydae*, Nemert – *Nemertea*, Oenon - *Oenonidae*. Numbers to the right of the “other” and “non-core” taxa bars represent additional taxa in samples not displayed individually among the bars.

Source: Guida et al. 2017

5.5.1.2.6 Summary of Fish and Invertebrates (Lease Area)

Several species and life stages of fish have EFH that overlap with the Lease Area. Ecologically, commercially, and recreationally important invertebrates such as ocean quahogs, Atlantic sea scallops, and Atlantic surfclam overlap with the Lease Area. EFH for each life stage of Atlantic sea scallops overlaps with 91.4 percent of the Lease Area (**Figure 5.5-73**). Adult EFH for Atlantic surfclam overlaps with 1 percent of the Lease Area (**Figure 5.5-74**). EFH for adult and juvenile ocean quahogs overlaps with 2.51 percent of the Lease Area (**Figure 5.5-75**). Therefore, these species, especially Atlantic sea scallops, may have the potential for habitat disturbance in the Lease Area.

Fish species of concern (as defined by Guida et al. 2017) where there may be potential for habitat disturbance in the Lease Area include Atlantic cod and black sea bass. EFH for each life stage of Atlantic cod overlap with some portion of the Lease Area (Adults, 98.7 percent; Juveniles, 53.4 percent; Larvae and Eggs, 50.4 percent) (see **Figure 5.5-5.5-76, Figure 5.5-77**). EFH for juvenile black sea bass overlap with 65 percent of the Lease Area (see **Figure 5.5-78**). Both of these species occur where there may be the potential for habitat disturbance in the Lease Area. The other species EFH and life stages overlap with the Lease Area are summarized below and are discussed in more detail in the EFHTR (**Appendix T**) (see **Table 5.5-14**).

TABLE 5.5-14. EFH OVERLAP BY SPECIES WITH THE LEASE AREA

Species	Life Stage	Lease Area		
		Acres of EFH	Hectares of EFH	Percent of Total EFH
Atlantic cod	Adult	135,408.5	54,798.1	98.7
	Eggs	69,085.84	27,958.2	50.4
	Juvenile	73,146.74	29,601.6	53.3
	Larvae	69,086.06	27,958.2	50.4
Atlantic herring	Adult	59,098.58	23,916.4	43.1
	Eggs	1,848.46	748	1.35
	Juvenile	76,684.28	31,033.2	55.9
	Larvae	51,850.89	20,983.4	37.8
Atlantic sea scallop	All	12,5394.7	50,745.7	91.4
Haddock	Adult	51,852.05	20,983.9	37.8
	Juvenile	72,750.17	29,441.1	53
	Larvae	53,188.75	21,524.8	38.8
Little skate	Adult	137,224	55,532.8	100
	Juvenile	124,496	50,381.7	90.7
Monkfish	Adult	133,777.8	54,138.2	97.5
	Eggs-Larvae	137,224.1	55,532.9	100
	Juvenile	86,985.58	35,202	63.4
Ocean pout	Adult	135,882.4	54,989.9	99

Species	Life Stage	Lease Area Acres of EFH	Hectares of EFH	Percent of Total EFH
	Eggs	135,889.8	54,992.9	99
	Juvenile	24,723.49	10,005.3	18
Pollock				
	Eggs	51,294.24	20,758.1	37.4
	Juvenile	13,787.93	5,579.8	10.1
	Larvae	67,192.17	27,191.8	49
Red hake	Adult	65,381.28	26,459	47.7
	Eggs-Larvae-Juvenile-Adult	137,224.1	55,532.9	100
Silver hake	Adult	53,093.04	21,486.1	38.69
	Eggs-Larvae	135,120	54,681.3	98.5
	Juvenile	133,594.2	54,063.9	97.4
White hake	Adult	1,238.38	501.2	0.9
	Juvenile	79,495.56	32,170.8	57.9
Windowpane flounder	Adult	137,224.1	55,532.9	100
	Eggs	13,778.51	5,576	10
	Juvenile	130,570	52,840	95.2
	Larvae	113,221.4	45,819.2	82.5
Winter flounder				
	Juvenile	122,518.6	4,9581.7	89.3
	Larvae-Adult	137,224.1	55,532.9	100
Winter skate	Adult	65,170.66	26,373.7	47.5
	Juvenile	136,669	55,308.2	99.6
Witch flounder	Adult	135,905.3	54,999.1	99
	Eggs	51,295.62	20,758.7	37.4
	Larvae	77,824.39	31,494.5	56.7
Yellowtail flounder	Adult	137,224.1	55,532.9	100
	Eggs	67,746.56	27,416.2	49.4
	Juvenile	137,224.1	55,532.9	100
	Larvae	88,588.5	35,850.6	64.6
Atlantic butterfish	Adult	135,120.6	54,681.6	98.5
	Eggs	76,579.02	30,990.6	55.8
	Juvenile	135,984.5	55,031.2	99.1

Species	Life Stage	Lease Area		
		Acres of EFH	Hectares of EFH	Percent of Total EFH
	Larvae	77,818.65	31,492.2	56.7
Atlantic mackerel	Adult	61,708.65	24,972.7	45
	Eggs	76,579.02	30,990.6	55.8
	Juvenile	72,647.06	29,399.3	52.9
	Larvae	53,093.28	21,486.2	38.7
Atlantic surfclam	Adult	1,340.96	542.7	0.98
Black sea bass	Adult	1,340.96	542.7	0.98
	Juvenile	89,193.32	3,6095.4	65
Bluefish	Adult	78,256.41	31,669.4	57
	Juvenile	1,340.73	542.6	0.98
	Larvae	555.13	224.7	0.4
Longfin inshore squid	Adult	67,743.49	27,414.9	49.4
	Eggs	3,446.12	1,394.6	2.51
	Juvenile	557.71	225.7	0.41
Northern shortfin squid	Juvenile	557.71	225.7	0.41
Ocean quahog	Adult	3,445.35	1,394.3	2.51
	Juvenile	3,445.35	1,394.3	2.51
Scup	Adult	84,686.36	34,271.5	61.7
	Juvenile	12,5732.7	50,882.4	91.6
Spiny dogfish	Sub-Adult Male	3,448.93	1,395.7	2.51
	Sub-Adult Female	38,583.26	15,614.2	28.1
	Adult Male	38,583.26	15,614.2	28.1
	Adult Female	38,583.26	15,614.2	28.1
Summer flounder	Adult	126,288.5	51,107.4	92
	Eggs	51,296.92	20,759.2	37.4
	Juvenile	1,239.43	501.6	0.9
	Larvae	65,639.61	26,563.5	47.8
Atlantic albacore tuna	Adult	13,7224.1	55,532.9	100
	Juvenile	13,7224.1	55,532.9	100
Atlantic bluefin tuna	Adult	13,7224.1	55,532.9	100
	Juvenile	13,7224.1	55,532.9	100

Species	Life Stage	Lease Area		
		Acres of EFH	Hectares of EFH	Percent of Total EFH
Atlantic skipjack tuna	Adult	13,7224.1	55,532.9	100
	Juvenile	13,7224.1	55,532.9	100
Atlantic yellowfin tuna				
	Juvenile	13,7224.1	55,532.9	100
Blue shark	Juvenile-Adult	137,224.1	55,532.9	100
	Neonate	137,224.1	55,532.9	100
Common thresher shark	All	137,224.1	55,532.9	100
Dusky shark	Neonate	112,019.8	45,333	81.6
	Adult-Juvenile	137,224.1	55,532.9	100
Sand tiger shark	Neonate-Juvenile	58,845.36	23,814	42.9
Sandbar shark	Adult	86,093.76	3,4841	62.7
	Juvenile	61,049.13	24,705.8	44.5
Shortfin mako shark	All	137,224.1	55,532.9	100
Smoothhound shark/Smooth dogfish	All	114,567.8	46364.1	83.5
Tiger shark	Juvenile-Adult	136,970.6	55,430.2	99.8
White shark	Juvenile-Adult	137,224.1	55,532.9	100
	Neonate	137,224.1	55,532.9	100
American Plaice	Eggs	553.95	224.2	0.4
	Larvae	51,291.96	20,757.2	37.4

5.5.1.2.7 Fish and Invertebrates in the Federal Portion of the Submarine Export Cable Siting Corridors

Several species and life stages of fish have EFH that overlap with the Federal water's portion of the Beacon Wind submarine export cable siting corridors. The division between New York and Connecticut State and Federal waters is drawn at 3 nm from the coastline. Ecologically, commercially, and recreationally important invertebrates such as ocean quahogs, Atlantic sea scallops, and Atlantic surfclam overlap with the offshore cable corridors. EFH for adult and juvenile ocean quahogs overlaps with 48.5 percent of the offshore submarine export cable corridors in federal waters. EFH for each life stage of Atlantic sea scallops overlaps with 88.2 percent of the offshore submarine export cable corridors in federal waters. Adult EFH for Atlantic surfclam overlaps with 4.6 percent of the offshore submarine export cable corridors in Federal waters.

Fish species of concern (as defined by Guida et al. 2017) where there may be potential for habitat disturbance include Atlantic cod and black sea bass. EFH for each life stage of Atlantic cod overlap with some portion of the submarine export cable corridors in federal waters (Adults, 84.3 percent; Juveniles, 23 percent; Larvae, 43.6 percent; and Eggs, 43.8 percent) (see **Figure 5.5-64**). EFH for juvenile black sea bass overlap with 75.4 percent of the federal portion of the offshore submarine export cable corridors (see **Figure 5.5-66)**. Both of these species occur where there may be potential for habitat disturbance in the federal waters of the Beacon Wind submarine export cable corridor. The other species EFH and life stages overlap with the Federal portion of the submarine export cable corridors are summarized below and are discussed in more detail in the EFHTR (**Appendix T**) (see **Table 5.5-15**).

TABLE 5.5-15. EFH OVERLAP BY SPECIES WITH THE FEDERAL SUBMARINE EXPORT CABLE CORRIDORS

Species	Life Stage	Submarine Export Cable Corridors		
		Acres of EFH	Hectares of EFH	Percent of Total EFH
Atlantic cod	Adult	12,482.9	5,051.7	84.4
	Eggs	6,497.9	2,629.6	43.9
	Juvenile	3,416.6	1,382.7	23.1
	Larvae	6,470.9	2,618.7	43.7
Atlantic herring	Adult	10,698.7	4,329.6	72.3
	Eggs	1,970.4	797.4	13.3
	Juvenile	13,142.9	5,318.8	88.8
	Larvae	3,394.8	1,373.8	22.9
Atlantic sea scallop	All	1,3054.7	5,283.1	88.2
Haddock	Adult	5,576.5	2,256.7	37.7
	Juvenile	10,281.7	4,160.9	69.5
	Larvae	5,825.3	2,357.4	39.4
Little skate	Adult	14,796.2	5,987.8	100.0
	Juvenile	10,733.0	4,343.5	72.5
Monkfish	Adult	14,796.2	5,987.8	100.0
	Eggs-Larvae	14,796.2	5,987.8	100.0
	Juvenile	12,366.4	5,004.5	83.6
Ocean pout	Adult	14,165.2	5,732.5	95.7
	Eggs	14,796.2	5,987.8	100.0
	Juvenile	12,825.5	5,190.3	86.7
Pollock	Eggs	4,083.3	1,652.5	27.6
	Juvenile	2,429.8	983.3	16.4
	Larvae	3,096.6	1,253.2	20.9
Red hake	Adult	12,366.4	5,004.5	83.6
	Eggs-Larvae-Juvenile-Adult	14,118.6	5,713.6	95.4
Silver hake	Adult	4,061.9	1,643.8	27.5
Silver Hake	Eggs-Larvae	14,796.2	5,987.8	100.0
	Juvenile	13,003.4	5,262.3	87.9
White hake	Adult	229.1	92.7	1.6
	Juvenile	11,765.3	4,761.3	79.5
Windowpane flounder	Adult	14,529.6	5,879.9	98.2
	Eggs	6,666.6	2,697.9	45.1
	Juvenile	9,799.5	3,965.7	66.2

Species	Life Stage	Submarine Export Cable Corridors		
		Acres of EFH	Hectares of EFH	Percent of Total EFH
	Larvae	7,547.8	3,054.5	51.0
Winter flounder	Eggs	669.6	271.0	4.5
	Juvenile	7,540.4	3,051.5	51.0
	Larvae-Adult	14,796.2	5,987.8	100.0
Winter skate	Adult	10,734.8	4,344.2	72.6
	Juvenile	11,404.1	4,615.1	77.1
Witch flounder	Adult	9,571.2	3,873.3	64.7
	Eggs	5,527.2	2,236.8	37.4
	Juvenile	3,926.2	1,588.9	26.5
	Larvae	6,628.8	2,682.6	44.8
Yellowtail flounder	Adult	14,796.2	5,987.8	100.0
	Eggs	6,843.5	2,769.5	46.3
	Juvenile	14,796.2	5,987.8	100.0
	Larvae	6,878.2	2,783.5	46.5
Atlantic butterfish	Adult	11,690.2	4,730.9	79.0
	Eggs	7,535.0	3,049.3	50.9
	Juvenile	12,385.4	5,012.2	83.7
	Larvae	9,508.5	3,848.0	64.3
Atlantic mackerel	Adult	2,207.2	893.2	14.9
	Eggs	6,500.3	2,630.6	43.9
	Juvenile	12,712.9	5,144.7	85.9
	Larvae	10,593.2	4,286.9	71.6
Atlantic surfclam	Juvenile	676.5	273.8	4.6
Black sea bass	Juvenile	11,169.3	4,520.1	75.5
Bluefish	Adult	10,498.9	4,248.8	71.0
	Eggs	2,429.8	983.3	16.4
	Juvenile	3,105.9	1,256.9	21.0
	Larvae	4,094.7	1,657.1	27.7
Longfin inshore squid	Adult	4,876.6	1,973.5	33.0
	Eggs	3,107.4	1,257.5	21.0
	Juvenile	7,306.7	2,956.9	49.4
Northern shortfin squid	Juvenile	2,083.9	843.3	14.1
Ocean quahog	Adult	6,128.0	2,479.9	41.4
	Juvenile	6,128.0	2,479.9	41.4
Scup	Adult	12,822.6	5,189.1	86.7

Species	Life Stage	Submarine Export Cable Corridors		
		Acres of EFH	Hectares of EFH	Percent of Total EFH
	Juvenile	6,900.3	2792.5	46.6
Spiny dogfish	Sub-Adult Male	913.9	369.8	6.2
	Sub-Adult Female	6,885.7	2,786.6	46.5
	Adult Male	5,444.9	2,203.5	36.8
	Adult Female	8,539.4	3,455.8	57.7
Summer flounder	Adult	14,796.2	5,987.8	100.0
	Eggs	4,424.4	1,790.5	29.9
	Juvenile	2,658.9	1,076.0	18.0
	Larvae	8,962.1	3,626.8	60.6
Atlantic albacore tuna	Adult	11,109.2	4,495.8	75.1
	Juvenile	14,796.2	5,987.8	100.0
Atlantic bluefin tuna	Adult	14,796.2	5,987.8	100.0
	Juvenile	14,796.2	5,987.8	100.0
Atlantic skipjack tuna	Adult	14,796.2	5,987.8	100.0
	Juvenile	12,548.4	5,078.2	84.8
Atlantic yellowfin tuna	Adult	5,957.2	2,410.8	40.3
	Juvenile	1,4796.2	5,987.8	100.0
Blue shark	Juvenile-Adult	12,314.7	4,983.6	83.2
	Neonate	12,630.5	5,111.4	85.4
Common thresher shark	All	14,796.2	5,987.8	100.0
Dusky shark	Neonate	6,184.9	2,503.0	41.8
	Adult-Juvenile	13,540.4	5,479.6	91.5
Sand tiger shark	Neonate-Juvenile	6,857.7	2,775.2	46.4
Sandbar shark	Adult	14,796.2	5,987.8	100.0
	Juvenile	14,796.2	5,987.8	100.0
Shortfin mako shark	All	12,283.9	4,971.1	83.0
Smoothhound shark/Smooth dogfish	All	5,272.5	2,133.7	35.6
Tiger shark	Juvenile-Adult	11,451.7	4,634.4	77.4
White shark	Juvenile-Adult	13,970.9	5,653.8	94.4
	Neonate	14,796.2	5,987.8	100.0
American Plaice	Eggs	1,741.6	704.8	11.8
	Larvae	1,886.8	763.6	12.8

New York State and Connecticut State Waters of the Submarine Export Cable Corridors

Several species and life stages of fish have EFH that overlap with the New York and Connecticut State water's portion of the submarine export cable corridors. Ecologically, commercially, and recreationally important invertebrates such as quahogs and surfclam do not have any overlap in the New York or Connecticut State waters of the cable corridors (see **Figure 5.5-74** and **Figure 5.5-75**). Atlantic sea scallop EFH (see **Figure 5.5-73)** overlaps with 1.9 percent of the total project area acreage in New York State waters and does not overlap with any portion of the submarine export cable corridors in Connecticut State waters. Therefore, the New York and Connecticut State portion of the offshore submarine cable corridors is not expected to impact ecologically, recreationally, or commercially important invertebrate forage species. Areas designated by NYSDEC for growing and harvesting commercial shellfish as well as aquaculture lease areas are shown in **Figure 5.5-5.5-76**. Recreational shellfishers can also harvest from any verified water as long as they follow the guidelines of the town in which they are shellfishing.

Fish species of concern (as defined by Guida et al. 2017) where there may be potential for habitat disturbance include Atlantic cod and black sea bass. EFH for adult Atlantic cod overlaps with 15.8 percent of the New York portion of the offshore cable corridors. EFH for eggs, juvenile, and larvae Atlantic cod overlaps with 1.9 percent of the New York portion of the submarine export cable corridors. Atlantic cod EFH is not designated in the submarine export cable installation corridors in Connecticut State waters (see **Figure 5.5-77**). EFH for juvenile black sea bass overlap with 93.7 percent of the submarine export cable corridors in New York State waters and 98.8 percent of the offshore submarine export cable corridors in Connecticut State waters (see **Figure 5.5-78**). This is a species where there may be potential for habitat disturbance in the New York and Connecticut waters of the Beacon Wind submarine export cable corridors. Other species EFH and life stages that overlap with the New York and Connecticut portion of the submarine export cable corridors are summarized below and are discussed in more detail in the EFHTR (**Appendix T**) (see **Table 5.5-16**).

FIGURE 5.5-73. ATLANTIC SEA SCALLOP (*PLACOPECTEN MAGELLANICUS*) DESIGNATED EFH IN NEW YORK AND CONNECTICUT PROJECT AREA

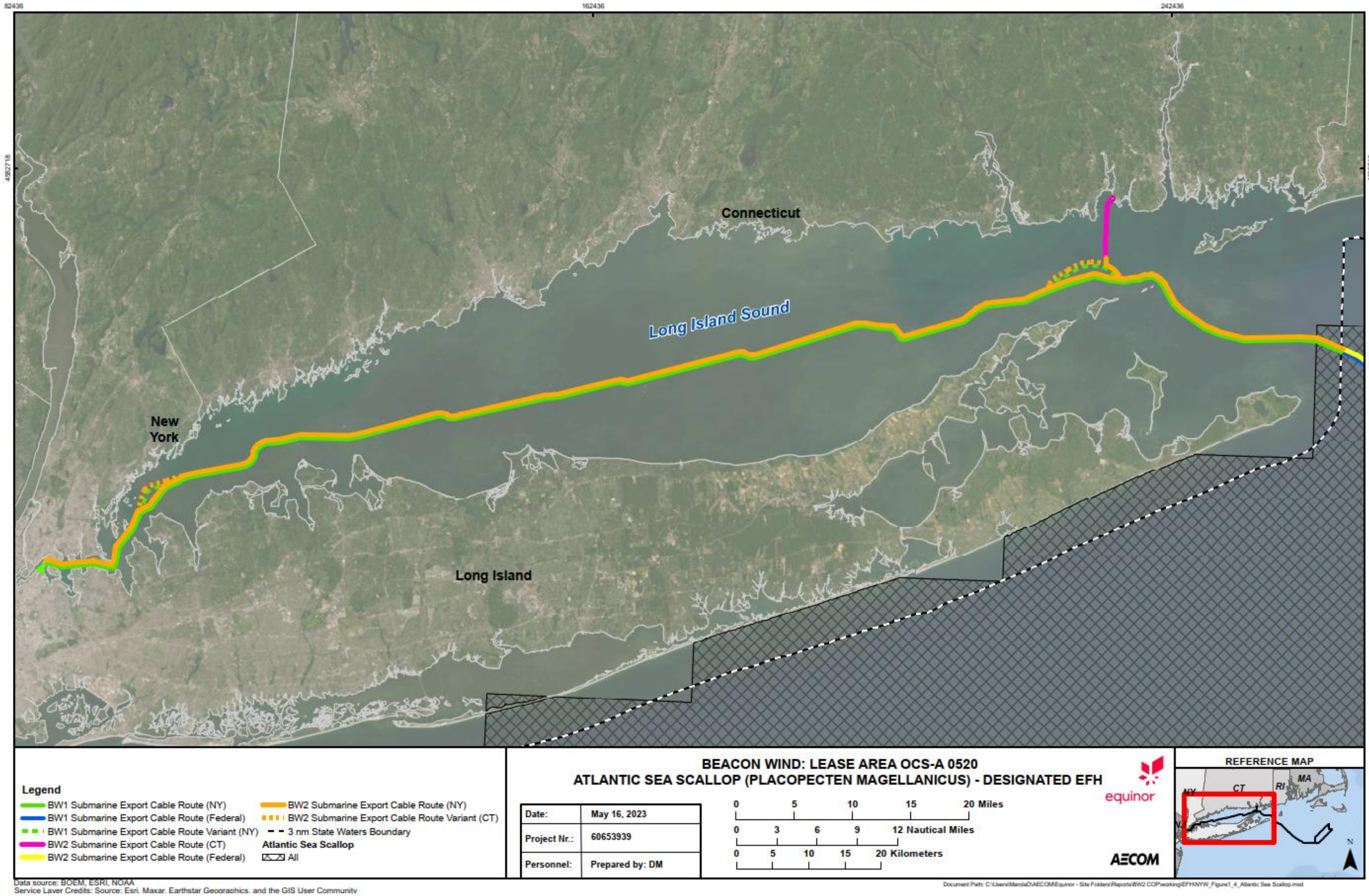


FIGURE 5.5-74. ATLANTIC SURFCLAM (*SPISULA SOLIDISSIMA*) DESIGNATED EFH IN NEW YORK AND CONNECTICUT PROJECT AREA

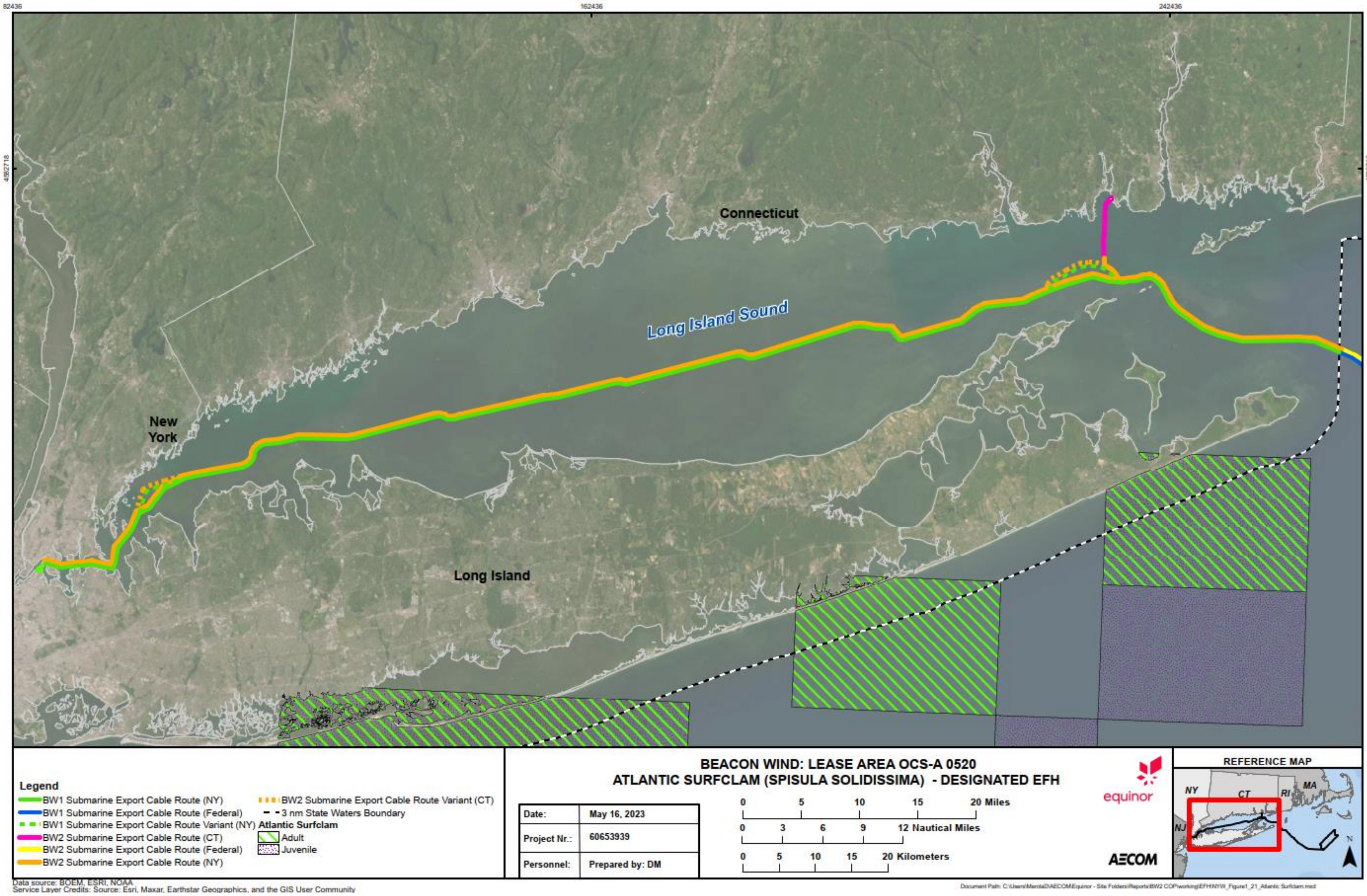


FIGURE 5.5-75. OCEAN QUAHOG (*ARCTICA ISLANDICA*) DESIGNATED EFH IN NEW YORK AND CONNECTICUT PROJECT AREA

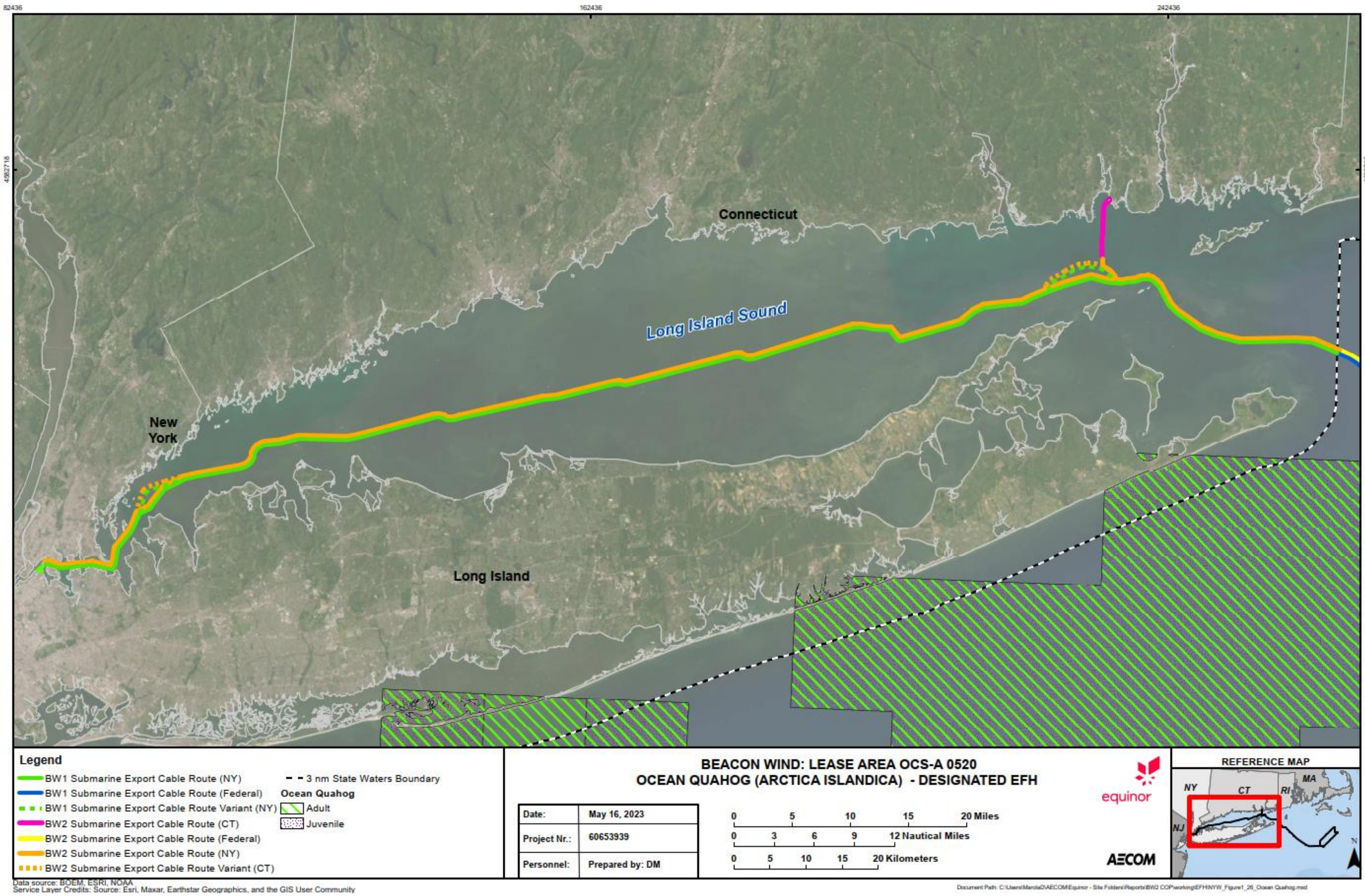
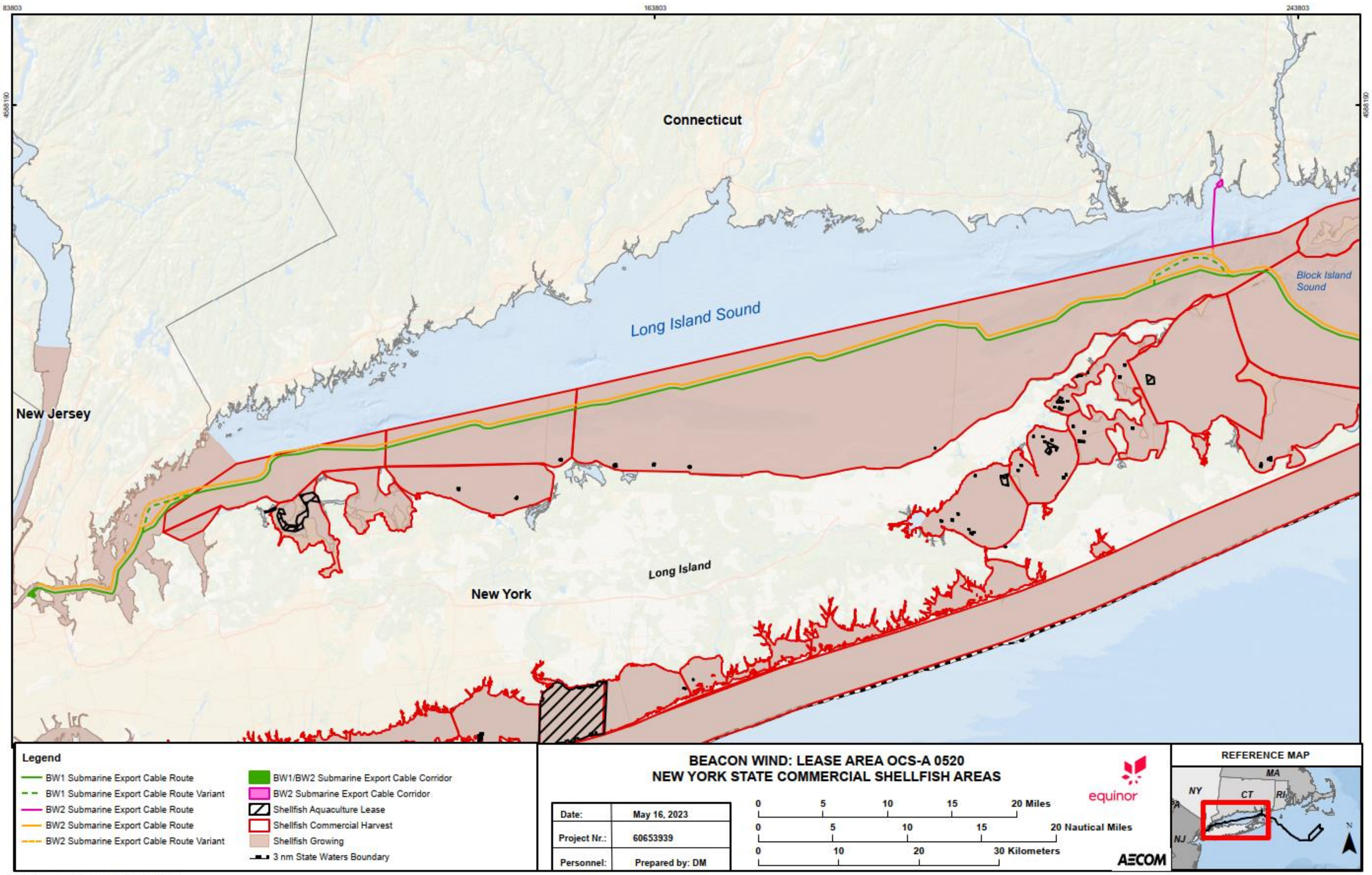
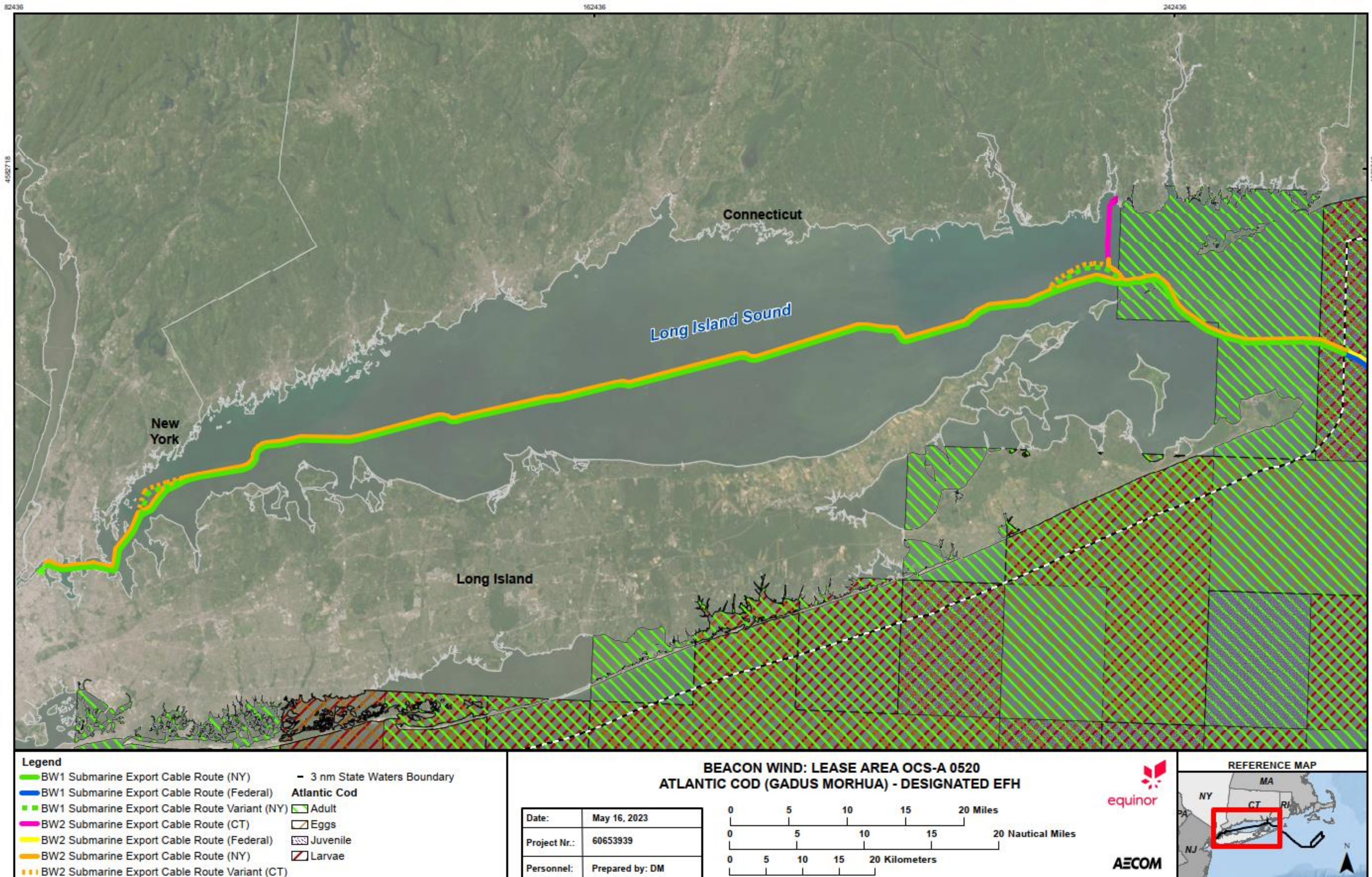


FIGURE 5.5-5.5-76. SHELLFISH GROWING, HARVEST, AND AQUACULTURE LEASE AREAS IN NEW YORK STATE



Data Sources: BOEM, ESRI, NOAA, DECNY
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

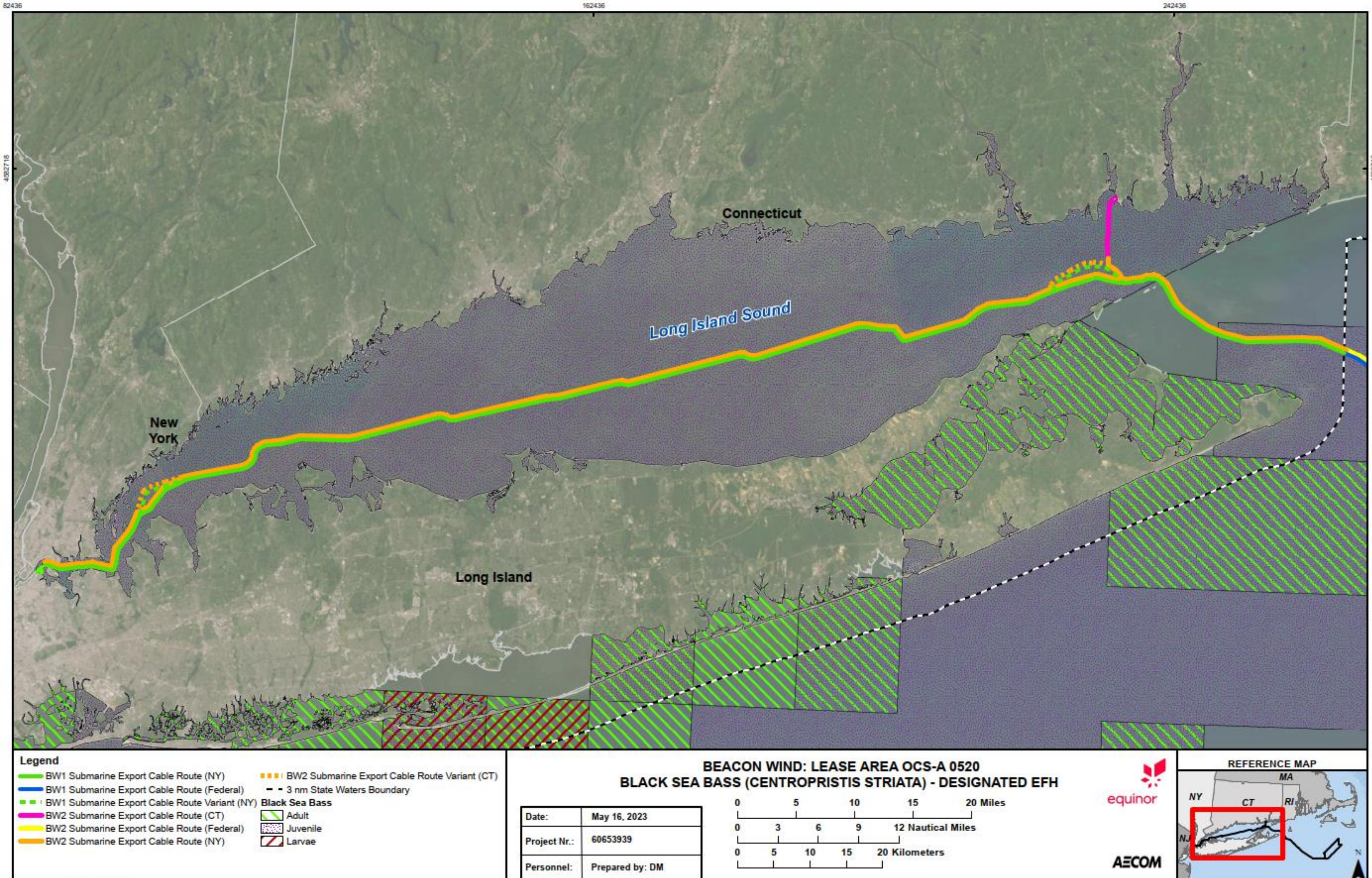
FIGURE 5.5-77. ATLANTIC COD (*GADUS MORHUA*) DESIGNATED EFH IN NEW YORK AND CONNECTICUT PROJECT AREA



Data source: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Document Path: C:\Users\MarolaD\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\EFH\NYW_Figure1_2_Atlantic Cod.mxd

FIGURE 5.5-78. BLACK SEA BASS (*CENTROPRISTIS STRIATA*) DESIGNATED EFH IN NEW YORK AND CONNECTICUT PROJECT AREA



Data source: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

TABLE 5.5-16. EFH OVERLAP BY SPECIES WITH THE NEW YORK AND CONNECTICUT STATE WATERS OF THE OFFSHORE SUBMARINE EXPORT CABLE CORRIDORS

Species	Life Stage	New York Submarine Export Cable Corridors			Connecticut Submarine Export Cable Corridors		
		Acres of EFH	Hectares of EFH	Percent of Total EFH	Acres of EFH	Hectares of EFH	Percent of Total EFH
Atlantic cod	Adult	3,915.7	1,584.7	15.8	0	0	0
	Eggs	466.3	188.7	1.9	0	0	0
	Juvenile	466.3	188.7	1.9	0	0	0
	Larvae	466.3	188.7	1.9	0	0	0
Atlantic herring	Adult	24,669.1	9,983.3	99.4	1073.5	434.4	98.8
	Juvenile	24,669.1	9,983.3	99.4	1073.5	434.4318	98.8
	Larvae	18.1	7.3	0.1	0	0	0
	All	466.2	188.7	1.9	0	0	0
Atlantic sea scallop	Adult	992.0	401.5	4.0	0	0	0
Atlantic clearnose skate	Juvenile	16.1	6.5	0.1	0	0	0
	Adult	0.0	0.0	0.0	0	0	0
Haddock	Juvenile	0.0	0.0	0.0	0	0	0
	Larvae	466.5	188.8	1.9	0	0	0
	Adult	23,267.7	9,416.1	93.8	1073.5	434.4	98.8
Little skate	Juvenile	24,669.1	9,983.3	99.4	1073.5	434.4	98.8
	Adult	466.5	188.8	1.9	0	0	0
Monkfish	Eggs-Larvae	466.5	188.8	1.9	0	0	0
	Juvenile	1,797.1	727.3	7.2	0	0	0
	Adult	271.5	109.9	1.1	0	0	0

Species	Life Stage	New York Submarine Export Cable Corridors			Connecticut Submarine Export Cable Corridors		
		Acres of EFH	Hectares of EFH	Percent of Total EFH	Acres of EFH	Hectares of EFH	Percent of Total EFH
Ocean pout	Eggs	466.5	188.8	1.9	0	0	0
	Juvenile	466.4	188.8	1.9	0	0	0
	Adult	21,038.7	8,514.1	84.8	1073.5	434.4	98.8
Pollock	Eggs	466.5	188.8	1.9	0	0	0
	Juvenile	21,505.1	8,702.8	86.7	1073.5	434.4	98.8
	Larvae	0.0	0.0	0.0	0	0	0
	Adult	22,801.3	9,227.4	91.9	1073.5	434.4	98.8
Red hake	Eggs-Larvae-Juvenile-Adult	21,519.8	8,708.8	86.7	1073.5	434.4	98.8
	Adult	7,197.2	2,912.6	29.0	0	0	0
Silver hake	Eggs-Larvae	9,470.4	3,832.6	38.2	0	0	0
White hake	Juvenile	466.5	188.8	1.9	0	0	0
	Adult	24,669.1	9,983.3	99.4	1,073.5	434.4	98.8
Windowpane flounder	Eggs	21,521.3	8,709.4	86.7	1,073.5	434.4	98.8
	Juvenile	24,669.1	9,983.3	99.4	1,073.5	434.4	98.8
	Larvae	21,521.3	8,709.4	86.7	1,073.5	434.4	98.8
	Eggs	21,422.7	8,669.5	86.3	1,073.5	434.4	98.8
Winter flounder	Juvenile	24,668.9	9,983.2	99.4	1,073.5	434.4	98.8
	Larvae-Adult	24,669.1	9,983.3	99.4	1,073.5	434.4	98.8
	Adult	23,722.5	9,600.2	95.6	1,073.5	434.4	98.8
Winter skate	Juvenile	23,722.5	9,600.2	95.6	1,073.5	434.4	98.8
Witch flounder	Eggs	466.5	188.8	1.9	0	0	0
	Juvenile	0.0	0.0	0.0	0	0	0

Species	Life Stage	New York Submarine Export Cable Corridors			Connecticut Submarine Export Cable Corridors		
		Acres of EFH	Hectares of EFH	Percent of Total EFH	Acres of EFH	Hectares of EFH	Percent of Total EFH
	Larvae	466.5	188.8	1.9	0	0	0
	Adult	4,033.2	1,632.2	16.3	0	0	0
Yellowtail flounder	Eggs	466.5	188.8	1.9	0	0	0
	Juvenile	4,939.5	1,998.9	19.9	0	0	0
	Larvae	466.5	188.8	1.9	0	0	0
	Adult	21,985.4	8,897.2	88.6	1073.5	434.4	98.8
Atlantic butterfish	Eggs	21,037.3	8,513.5	84.8	1073.5	434.4	98.8
	Juvenile	24,164.1	9,778.9	97.4	1071.2	433.5	98.6
	Larvae	21,053.5	8,520.1	84.9	1073.5	434.4	98.8
	Adult	21,037.3	8,513.5	84.8	1073.5	434.4	98.8
Atlantic mackerel	Eggs	21,503.7	8,702.3	86.7	1073.5	434.4	98.8
	Juvenile	22,451.7	9,085.9	90.5	1073.5	434.4	98.8
	Larvae	21,503.7	8,702.3	86.7	1073.5	434.4	98.8
	Adult	0.0	0.0	0.0	0	0	0
Black sea bass	Juvenile	23,250.3	9,409.1	93.7	1073.5	434.4	98.8
	Adult	23,266.3	9,415.6	93.8	1073.5	434.4	98.8
Bluefish	Eggs	466.5	188.8	1.9	0	0	0
	Juvenile	23,266.3	9,415.6	93.8	1073.5	434.4	98.8
	Larvae	0.0	0.0	0.0	0	0	0
	Adult	21,985.0	8897.0	88.6	1073.5	434.4	98.8
Longfin inshore squid	Eggs	24,669.1	9,983.3	99.4	1073.5	434.4	98.8
	Juvenile	24,197.7	9,792.5	97.5	1073.5	434.4	98.8

Species	Life Stage	New York Submarine Export Cable Corridors			Connecticut Submarine Export Cable Corridors		
		Acres of EFH	Hectares of EFH	Percent of Total EFH	Acres of EFH	Hectares of EFH	Percent of Total EFH
	Juvenile	0.0	0.0	0.0	0	0	0
Ocean quahog	Juvenile	0.0	0.0	0.0	0	0	0
	Adult	23,250.3	9,409.1	93.7	1073.5	434.4	98.8
Scup	Eggs	21,037.4	8,513.6	84.8	1073.5	434.4	98.8
	Juvenile	23,250.3	9,409.1	93.7	1073.5	434.4	98.8
	Larvae	21,037.4	8,513.6	84.8	1073.5	434.4	98.8
	Sub-Adult Male	0.0	0.0	0.0	0	0	0
Spiny dogfish	Sub-Adult Female	1,746.5	706.8	7.0	0	0	0
	Adult Male	1,746.5	706.8	7.0	0	0	0
	Adult Female	2,901.4	1,174.2	11.7	1073.5	434.4	98.8
	Adult	23,266.4	9,415.6	93.8	1073.5	434.4	98.8
Summer flounder	Eggs	466.5	188.8	1.9	0	0	0
	Juvenile	23,266.4	9,415.6	93.8	1073.5	434.4	98.8
	Larvae	486.6	196.9	2.0	0	0	0
	Adult	0.0	0.0	0.0	0	0	0
Atlantic albacore tuna	Juvenile	6,221.9	2,517.9	25.1	157.2	63.6	14.5
	Adult	1,308.9	529.7	5.3	0	0	0
Atlantic bluefin tuna	Juvenile	883.6	357.6	3.6	0	0	0
	Adult	4,350.0	1,760.4	17.5	0	0	0
Atlantic yellowfin tuna	Juvenile	1,308.9	529.7	5.3	0	0	0
	Juvenile-Adult	0.0	0.0	0.0	0	0	0

Species	Life Stage	New York Submarine Export Cable Corridors			Connecticut Submarine Export Cable Corridors		
		Acres of EFH	Hectares of EFH	Percent of Total EFH	Acres of EFH	Hectares of EFH	Percent of Total EFH
	Neonate	0.0	0.0	0.0	0	0	0
	All	374.4	151.5	1.5	0	0	0
Common thresher shark	Neonate	0.0	0.0	0.0	0	0	0
	Adult-Juvenile	0.0	0.0	0.0	0	0	0
	Neonate-Juvenile	23,581.3	9,543.1	95.0	1071	433.4	98.6
Sand tiger shark	Adult	663.8	268.6	2.7	0	0	0
Sandbar shark	Juvenile	618.9	250.5	2.5	0	0	0
	All	0.0	0.0	0.0	0	0	0
	All	19,718.9	7,980.0	79.5	1071	433.4	98.6
Smoothhound shark/Smooth dogfish	Juvenile-Adult	0.0	0.0	0.0	0	0	0
	Juvenile-Adult	0.0	0.0	0.0	0	0	0
	Neonate	1,184.1	479.2	4.8	0	0	0

Overview of the Fish Identified in the Benthic Resource Characterization for the Submarine Export Cable Corridor

During the Benthic Surveys for the Submarine Export Cable Corridor (July – November, 2021), numerous fish and commercially important macroinvertebrates were observed using the drop/towed video system. These observations are geographically grouped by areas within Long Island Sound and areas outside of Long Island Sound. For the commercially important species observed within Long Island Sound, some appeared to have areas of concentration (and/or were more readily observed on video camera), some were more widely distributed within the study area, and some were considered present based on a very low observational frequency (MMT Beacon Wind Export Cable Survey, 2022). Observational frequency of commercially important and managed species within Long Island Sound are as follows:

- Scup (*Stenotomus chrysops*) were most common, widely distributed and observed at 71 of 199 video stations within Long Island Sound;
- Hakes, including silver hake (*Merluccius bilinearis*), red hake (*Urophycis chuss*), and spotted hake (*Urophycis regia*), were uncommon and observed at five stations, primarily in the western portion of the Sound;
- Butterfish (Stromateidae*, Peprilus triacanthus*) were widely distributed and observed at 12 stations;
- Black Sea Bass (*Centropristis striata*) were widely distributed and observed at 18 stations;
- Anchovy (*Anchoa spp.*) were observed at 22 stations and appeared to be more concentrated in the western portion of the Sound;
- Bluefish (*Pomatomus saltatrix*) were observed at seven stations, primarily in the western half of the Sound;
- Flounder including sand flounder (Paralichthyidae), fourspot flounder (*Paralichthys oblongus*), and summer flounder (*Paralichthys dentatus*) were observed at 13 stations (concentrated in the eastern half of the Sound;
- Herring (Clupeidae) were widely distributed and observed at 12 stations;
- Skates (Rajidae) were only observed at one station; and
- Blue crab (*Callinectes sapidus*) were observed at four stations concentrated in the western end of the Sound.

The commercially important fish and invertebrate species observed outside of Long Island Sound and their general distribution are as follows:

- Scup (*Stenotomus chrysops*) were observed at 9 of 85 video stations collected outside of Long Island Sound, primarily concentrated in the western portion of the offshore submarine export cable corridor;
- Hakes, including silver hake (*Merluccius bilinearis*), red hake (*Urophycis chuss*), and spotted hake (*Urophycis regia*), were widely distributed and observed at 26 stations outside of Long Island Sound;
- Butterfish (Stromateidae*, Peprilus triacanthus*) were widely distributed and observed at seven stations outside of Long Island Sound;
- Black sea bass (*Centropristis striata*) was observed at one station;

- Flounder including sand flounder (Paralichthyidae), fourspot flounder (*Paralichthys oblongus*), and summer flounder (*Paralichthys dentatus*) were widely distributed and observed at 22 stations outside of Long Island Sound;
- Skates (Rajidae), including winter skate, (*Leucoraja ocellata*), and the little skate, (*Leucoraja erinacea*) were observed at 32 stations, the majority of which were located in the western half of the offshore submarine export cable corridor outside of Long Island Sound;
- Monkfish (*Lophius americanus*) was observed at a single station outside of Long Island Sound;
- Jonah crab (*Cancer borealis*) were widely distributed and observed at 40 stations, with a higher concentration of observations in the eastern half of the offshore submarine export cable corridor;
- Atlantic sea scallops (*Placopecten magellanicus*) were widely distributed and observed at 38 stations outside of Long Island Sound; and
- American lobster (*Homarus americanus*) were located at two stations in the offshore segments.

5.5.1.3 Threatened and Endangered Species

The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), which is protected under state and federal statutes, is expected to occur in the Lease Area and submarine export cable siting corridors (see **Table 5.5-17**).

TABLE 5.5-17. PROTECTED FISH SPECIES POTENTIALLY OCCURRING IN THE PROJECT AREA

Common Name	Scientific Name	Federal Status	New York Status	Connecticut Status	Massachusetts Status	Rhode Island	Likelihood of Occurrence
Atlantic sturgeon	*Acipenser oxyrinchus*	E	CI	T	E	E	High
Shortnose sturgeon	*Acipenser brevirostrum*	E	E	E	E	E	Low
Giant manta ray	*Manta birostris*	T	NC	NC	NC	NC	Low
Oceanic whitetip shark	*Carcharhinus longimanus*	T	NC	NC	NC	NC	Low

Note: CI – Critically Imperiled; E – Endangered; T –Threatened; NC – Not Considered
Sources: NOAA Fisheries 2021a; NYSDEC 2019b; MDFW 2013; CTDEEP 2009

Atlantic Sturgeon (*Acipenser oxyrinchus*)

The Atlantic sturgeon is listed as endangered under the ESA, critically imperiled in New York (NY Natural Heritage Program 2019), threatened in Connecticut (CT DEEP, 2009), and endangered in Massachusetts and Rhode Island (MDFW 2013, RIDEM 2021). The Atlantic sturgeon is a large, bottom-dwelling, long-lived anadromous fish. Although several distinct population segments (DPS) of the Atlantic sturgeon are listed under the ESA, the DPS are not entirely separate, and the individual sturgeon are protected.

Adult Atlantic sturgeon migrate to freshwater spawning habitats, including the Hudson River, the Connecticut River, and the Housatonic River which are all in close proximity to the Project area and are considered critical habitat for Atlantic sturgeon (82 FR 39160). Critical habitat is defined as: specific areas within the geographical area occupied by the species at the time of listing that contain physical or biological features essential to conservation of the species and that may require special management considerations or protection; and specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation (NOAA Fisheries 2022b). Eggs hatch in the rivers and the young migrate to marine waters where they feed on benthic invertebrates such as isopods, crustaceans, worms, and mollusks (NOAA Fisheries 2017b, 2014; NOAA Fisheries 1998; Stein et al. 2004). During non-spawning years, adults may remain in marine waters year-round (Bain 1997). Spawning adults migrate upriver in spring to spawn, then back into estuarine and marine waters in summer or fall (Dadswell 2006). Immature Atlantic sturgeon disperse widely once they move into coastal waters (Secor et al. 2000) and are often observed over mud-sand bottoms (Dadswell 2006). Subadults and adults forage in coastal waters and estuaries, generally in shallow (35 to 165 ft [10 to 50 m]) inshore areas of the continental shelf (Dunton et al. 2015). The Atlantic sturgeon is strongly associated with specific coastal areas, including the Hudson River and estuary (Ingram et al. 2019; Stein et al. 2004). Declines of sturgeon populations are attributed to overfishing, habitat loss, and degradation of spawning grounds. The most recent stock assessment for Atlantic sturgeon reports that DPSs are still depleted relative to historical abundances, but some recovery has been observed (ASMFC 2017b). Specific threats on the East Coast include damming of major rivers that prevents upstream spawning, dredged material disposal, channel maintenance, oil and gas exploration, trawling, and water quality degradation by pesticides, heavy metals, and other agricultural and industrial contaminants (USFWS and NOAA Fisheries 2009; Collins et al. 2000; Smith and Clugston 1997). Vessel strikes have also been noted as threats to this species (Brown and Murphy 2010; Balazik et al. 2012).

In a Biological Opinion on the leasing program for offshore wind projects in the Mid-Atlantic and Southern New England, NOAA Fisheries suggested that the Atlantic sturgeon was not likely to occur in dense aggregations in any of the WEAs, including the MA WEA (NOAA Fisheries 2013). The New York Bight DPS includes anadromous Atlantic sturgeon spawned in the watersheds that drain into coastal waters from Chatham, Massachusetts, to the Delaware-Maryland border on Fenwick Island. Within this range, Atlantic sturgeon historically spawned in the Connecticut, Delaware, Hudson, and Taunton Rivers (BOEM 2019b). Spawning still occurs in the Delaware and Hudson Rivers (BOEM, 2019b).

The Atlantic sturgeon was once numerous enough in the Connecticut River to support a significant fishery. As of 2009, it was thought that Atlantic sturgeon no longer breed anywhere in Connecticut. Overfishing, dam building, and pollution may have contributed to their demise in the state (CT DEEP, 2022). Individuals occasionally observed in Connecticut estuaries were thought to be strays from the nearby Hudson River, where their population is more robust. In June 2014, several age-0 Atlantic sturgeons captured in the Connecticut River were subjected to mitochondrial DNA control region sequence and microsatellite analysis indicating successful spawning within the Connecticut River in 2013 (BOEM 2019b).

Analysis also indicated that the offspring were primarily from South Atlantic DPS and Chesapeake Bay DPS origins (BOEM 2019b). The results of Savoy et al. (2017) along with previous genetic and tagging studies provide ample evidence of large-scale coastal movements and mixing of DPS stocks along the Atlantic Coast (Savoy 2017). Sturgeon that are spawned elsewhere continue to use habitats within the Connecticut River as part of their overall marine range (BOEM 2019b).

Little is known about the foraging behavior of sturgeon in offshore waters, including the Lease Area, but it is reasonable to assume that they feed on benthic invertebrates. Although the foraging habits of Atlantic sturgeon are not well described, a study of stomach contents of more than 200 sturgeon caught by commercial fishing vessels off the coast of New Jersey reported that polychaetes and isopods dominated the prey; sand and organic debris took up a substantial portion of the stomachs, and both fish and mollusks were rare. Prey composition was seasonally variable, and more sturgeon stomachs were empty in the spring than in the fall (Johnson et al. 1997).

Shortnose Sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon (*Acipenser brevirostrum*) is listed as endangered under the ESA, in New York under 182.2(g) of 6 NYCRR Part 182 (NYSDEC 2019a) and in Connecticut under CTDEEP's Division of Fisheries (CT DEEP 2022). The shortnose sturgeon primarily occurs in the Hudson River, the Connecticut River, and several other Atlantic coastal rivers. Strays from Hudson or Connecticut River stocks have occasionally been found in the Housatonic and Thames River estuaries (CT DEEP 2009). The Hudson River population of shortnose sturgeon is almost exclusively confined to the river, unlike other populations that use coastal marine waters to move between rivers (Pendleton et al. 2018; Kynard et al. 2016). In New York, this species ranges from River Mile 0 at the southern tip of Manhattan to 150 miles upriver (NYSDEC 2019a). This species may transit through Long Island Sound where the submarine export cable siting corridors are planned and CTDEEP has designated the eastern portion of Long Island Sound and small areas on Stratford Shoals in the central portion in Long Island Sound as designated shortnose sturgeon habitat (CTDEEP 2019). The shortnose sturgeon is not expected to occur in the Lease Area (NOAA Fisheries 2013).

Giant Manta Ray (*Manta birostris*)

The giant manta ray (*Manta birostris*) is a large migratory species typically occurring offshore of productive coastlines (NOAA Fisheries 2018b). It ranges throughout tropical, subtropical, and temperate oceans filter-feeding on zooplankton; it is largely threatened by commercial fishing, especially industrial purse seine and artisanal gillnet fisheries (Miller and Klimovich 2017; NOAA Fisheries 2018b). This species may transit through the offshore portions of the Project Area and be temporarily exposed to Project-related activities. Giant manta rays are typically found in water temperatures off the U.S. east coast ranging between 66 °F to 71 °F (19 °C to 22 °C) (NOAA Fisheries 2018b). This species is unlikely to be found within the New York and Connecticut State waters of Long Island Sound and is unlikely in the Project Area during colder seasons.

Oceanic Whitetip Shark (*Carcharhinus longimanus*)

The oceanic whitetip shark (*Carcharhinus longimanus*) was listed as threatened throughout its range under the ESA in 2018 (NOAA Fisheries 2018c). This pelagic shark ranges throughout tropical and subtropical oceans, generally on the outer continental shelf or around oceanic islands in water depths greater than 600 ft (183 m) (NOAA Fisheries 2018c). It is most typically reported in the warm (more than 68°F [20°C]) surface layers of deep open waters. The oceanic whitetip shark is threatened by pelagic longline, purse seine, and gillnet fisheries, as well as shark finning (NOAA Fisheries 2018c; Young et al. 2017). This species may transit through the offshore Project Area and be temporarily exposed to Project-related activities. Changes in physiochemical oceanic conditions have been implicated in largescale shifts in species assemblages across the United States Atlantic coast, including Southern New England and the Mid-Atlantic Bight. In conjunction with fishing pressure, increasing ocean temperatures are reported to have caused managed fishery species to shift northward over the past several decades (Lucey and Nye 2010). Global climate change manifests as increases in ocean temperatures, seasonal shifts in thermal stratification of nearshore waters, and decreases in pH (acidification of seawater). These physical and chemical changes affect marine communities as species become redistributed based on their physiological preferences or tolerances (Morley et al. 2018).

5.5.1.4 *Regional Effects of Climate Change on Distributions of Fish and Invertebrates*

Changes in physiochemical oceanic conditions have been implicated in largescale shifts in species assemblages across the United States Atlantic coast, including Southern New England. In conjunction with fishing pressure, increasing ocean temperatures are reported to have caused managed fishery species to shift northward over the past several decades (Lucey and Nye 2010). Global climate change manifests as increases in ocean temperatures, seasonal shifts in thermal stratification of nearshore waters, and decreases in pH (acidification of seawater). These physical and chemical changes affect marine communities as species become redistributed based on their physiological preferences or tolerances (Morley et al. 2018).

5.5.1.4.1 Temperature

Recent increases in water temperatures in Southern New England are expected to continue (Kavanaugh et al. 2017; NOAA Fisheries 2017a; Forsyth et al. 2015), causing several groundfish species to move northward and farther offshore (Pinsky et al. 2013; Nye et al. 2009; Selden et al. 2018; Rheuban et al. 2017; Kleisner et al. 2017). Increases in estuarine water temperatures in spring are associated with poor recruitment of winter flounder in Long Island Sound (Able et al. 2014). Changes in locations or timing of spawning in response to temperature may lead to shifts in both demersal and pelagic species assemblages (Bethoney et al. 2017; Walsh et al. 2015). Several pelagic forage species have been increasing in Southern New England, including butterfish, scup, squid (Collie et al. 2008), and Atlantic mackerel (McManus et al. 2018). Likewise, the black sea bass has been expending northward and becoming more abundant in the Project Area (Slesinger et al. 2019). Conversely, spiny dogfish, little skate, and silver hake have moved southward (Walsh et al. 2015). The influx of spiny dogfish in Southern New England suggests that this species may fill the feeding niche historically held by the Atlantic cod (Selden et al. 2018). NEFSC seasonal trawls did not catch a single Atlantic cod in the Lease Area between 2003 and 2016 (Guida et al. 2017)

Bottom temperatures in the Project Area have increased more than surface temperatures in the past 30+ years, disproportionately affecting demersal organisms such as lobster (Wahle et al. 2015) and Atlantic cod (Kavanaugh et al. 2017). Secondary effects of increased temperatures may be mediated by interspecific interactions such as competition and foraging. For example, in Long Island Sound, the winter flounder now competes for food with smallmouth flounder (*Etropus microstomus*) and scup, which are more tolerant of warm water. At the same time, the winter flounder is under increasing predatory pressure from temperature-tolerant summer flounder, striped bass, and bluefish (Howell et al. 2016; Frisk et al. 2018).

The surfclam population has shifted north and offshore in the past 20 years; New York populations are now farther offshore, and nearshore populations have shifted northward to Long Island and beyond (Hofmann et al. 2018). The surfclam is considered highly vulnerable to climate change through direct physiological stress (Hornstein et al. 2018) and indirect decreases in its food supply (Hofmann et al. 2018; Hare et al. 2016). About two-thirds of its diet is provided by the fall-winter bloom of phytoplankton that normally responds to ocean mixing when the surface waters cool and sink in the fall. However, when high fall temperatures delay the turnover of ocean waters, the phytoplankton bloom is either small or delayed, reducing the availability of food for the surfclam. The surfclam population off the New York coast benefits from phytoplankton fed by natural upwelling in the area, but larval recruitment has been declining overall (Hofmann et al. 2018). Many surfclam larvae are transported southward to areas that are no longer able to support adult surfclam because of inadequate food and physiological stresses of warm water temperatures. These stressors make it difficult for the population to expand into better habitats offshore and farther north, which restricts the surfclam's ability to adapt to climate changes throughout its current range (Hofmann et al. 2018). Conversely, ocean quahog growth rates around Long Island Sound have responded favorably to increased bottom temperatures (Pace et al. 2018).

Anadromous fish such as American shad, alewife, blueback herring, striped bass, Atlantic sturgeon, and American eel migrate through the Long Island Sound as they come and go from the rivers and tributaries that feed into it. These species are particularly vulnerable to climate change, as they are sensitive to physiological stress of water temperature and acidification as well as increased habitat degradation during river flooding (Hare et al. 2016). The food supply of planktivores and other filter feeders is also threatened by climate change. Copepods and other zooplankton mature more quickly, produce fewer offspring, and carry smaller fat reserves when water temperatures increase (Kavanaugh et al. 2017).

5.5.1.4.2 Acidification

As more carbon dioxide is released to the atmosphere, the pH of ocean waters will continue to decrease (Saba et al. 2016). Acidification of seawater makes it more energetically costly for an animal to produce a calcareous shell (Przeslawski et al. 2015). Bivalves such as Atlantic sea scallop, surfclam, and ocean quahog are expected to be adversely affected, as larval recruits tend to have thinner or deformed shells and weak predator-avoidance maneuvers when reared under low pH conditions (Stevens and Gobler 2018; Cooley et al. 2015).

Quantitative predictive models of increasing acidification indicate that the landings and economic value of Atlantic sea scallop are likely to decline in the next few decades (Rheuban et al. 2018). Larval longfin inshore squid were also reported to exhibit physical and behavioral abnormalities when reared under low pH conditions in the laboratory (Kaplan et al. 2013). Arthropods such as crabs and lobster are considerably less sensitive to the negative effects of acidification (Styf et al. 2013). Direct effects of acidification on cartilaginous and bony fishes are more subtle; early results indicate that low pH causes physiological stress and potential interference with chemosensory processes in some species (Heuer and Grosell 2014; Fabry et al. 2008).

5.5.1.4.3 Other Managed Species (Lease Area and Submarine Export Cable Siting Corridors)

The ASMFC manages several fish and invertebrate species separately from the MSA and ESA. Such species potentially affected by the Project include the horseshoe crab, blue crab, Jonah crab, river herring, and striped bass. These species are described briefly here and in more detail throughout this section.

The horseshoe crab stock is in neutral condition in the Northeast, but in poor condition in New York, where the State allows a harvest of just 150,000 crabs per year (ASMFC 2019a). Commercial harvest (for bait) and collection for biomedical research are the largest intentional sources of horseshoe crab mortality but discards by commercial harvesters are considered substantial. Adults typically spawn on sandy beaches in protected bays and coves, and juveniles rear in shallow inshore waters. Although some spawning coincides with the Project Area in Long Island Sound, the center of the spawning area is south of the Project Area in the Delaware and Chesapeake Bays. Non-spawning adults are subtidal, most commonly at depths of less than 98 ft (30 m) (ASMFC 2019a).

The blue crab (*Callinectes sapidus*), which is managed by NYSDEC, shares shallow coastal bay habitat with the horseshoe crab, but also ventures into the tidal Hudson River and other less saline habitats (NYSDEC 2016, 2020). Adults are associated with structures and submerged aquatic vegetation (SAV), but also occur over unvegetated sandy, clay, and mud substrates (NJ SeaGrant 2014).

The Jonah crab is one of the top three species commercially and recreationally harvested in the Project Area (AECOM, 2021). The Jonah crab is reported to be attracted to rocky habitats with crevices as well as softbottom habitats in the Long Island Sound, where it feeds on polychaetes and mollusks (ASMFC 2019b; NOAA Fisheries 2018a). Although their life cycle is poorly known, adult Jonah crabs are reported to move seasonally between nearshore and offshore waters (ASMFC 2018e). Its population status and trends are unknown (ASMFC 2018d).

In New York, river herring are currently harvested only from the Hudson River Estuary and tributaries, as historical fisheries in Long Island streams have become unsustainable (ASMFC 2017a). River herring stocks are considered depleted with declining trends coastwide (ASMFC 2018d), but were determined to not warrant protection under the ESA (NOAA Fisheries 2019a, 2019b). Spawning occurs upriver of the Project Area, typically from March (alewives) through June (blueback herring). Adults return to offshore marine waters after spawning and offspring rear in fresh riverine waters (ASMFC 2017a).

The anadromous striped bass spawns in the rivers that are tributaries to Long Island Sound. Juveniles were collected in mid-water trawls in the New York Upper Bay at the mouth of the Hudson River in spring, fall, and early winter; adults appeared in bottom trawls from January through May (USACE New York District [NYD] 2015a). Additionally, striped bass are a popular recreational fish species throughout the shallow estuaries and bays of Long Island Sound including Little Neck Bay, Hempstead Bay, around Center Island, Cold Spring Harbor, lloy Neck, Mattituck Inlet, and around Montauk (North of the Point, The Elbow, The Point, South of the Point) (Clark 1968). Although the striped bass was identified by NOAA Fisheries and NYSDEC as a migratory species of particular concern (USACE NYD 2015a), ASMFC determined that the Atlantic population is overfished and declines in female striped bass have been noted since the mid-2000s (ASMFC 2018d, ASMFC 2021). The striped bass is predicted to expand its northern range in response to rising sea temperatures (Kleisner et al. 2017). As a large predatory species, it has been implicated in the decline of winter flounder (Frisk et al. 2018).

5.5.2 Impacts Analysis for Construction, Operations, and Decommissioning

The potential impacts resulting from the construction, operations, and decommissioning of the Project are based on the maximum design scenario from the PDE (see **Section 3 Project Description**). For benthic and pelagic habitat and species, the maximum design scenario is the full build-out of the Project, which incorporates a total of up to 157 structures within the Lease Area (up to 155 wind turbines and two offshore substation facilities) with one submarine export cable route for BW1 to

Queens, New York and one submarine export cable corridor route for BW2 to Queens, New York or to Waterford, Connecticut (see **Table 5.5-18**). Three foundation types were considered for benthic impacts: monopiles; piled jackets, and suction bucket jackets (see **Section 3 Project Description**). Calculations supporting the maximum design scenario are shown in **Table 5.5-19** through **Table 5.5-22**.

TABLE 5.5-18. SUMMARY OF MAXIMUM DESIGN SCENARIO PARAMETERS FOR OFFSHORE BENTHIC AND PELAGIC HABITATS AND RESOURCES

Parameter	Maximum Design Scenario	Rationale
Construction		
Offshore structures	Based on full build-out of the Project (BW1 and BW2) (155 turbines and two offshore substation facilities).	Representative of the maximum number of structures.
Interarray cables	Based on full build-out of the Project (155 wind turbines and two offshore substation facilities): BW1: 162 nm (300 km). BW2: 162 nm (300 km).	Representative of the maximum number and length of interarray cables to be installed.
Submarine export cables	Based on full build-out of the Project (BW1 and BW2): • BW1 to Queens, New York (202 nm [375 km]). • BW2: o To Queens, New York (202 nm [375 km]) or o To Waterford, Connecticut (113 nm [209 km]).	Representative of the maximum length of new submarine export cables to be installed.
Submarine export cable landfalls offshore	Based on full build-out of the Project (BW1 and BW2): • BW1 to Queens, New York (HDD casing pipe and goalpost in a 60 ft x 7 ft [18 m x 2 m] area offshore). • BW2: o To Queens, New York (HDD casing pipe and goalpost in a 60 ft x 7 ft [18 m x 2 m] area offshore) or o To Waterford, Connecticut (HDD casing pipe and goalpost in a 60 ft x 7 ft [18 m x 2 m] area offshore	Representative of the maximum area of new HDD to be installed.
Wind turbine softbottom habitat loss	Suction bucket jacket	Representative of the maximum amount of softbottom benthic habitat lost to foundation and scour protection installation, which would result in the greatest surface area of hard substrate introduced to the Project Area.

Parameter	Maximum Design Scenario	Rationale
Wind turbine foundation	Monopile, piled jacket	Representative of foundation options that have installation methods that would result in the maximum introduction of underwater noise.
Wind turbine foundation installation method underwater noise	Pile driving	Representative of the installation method that would result in the loudest underwater noise generated.
Wind turbine foundation installation method physical disturbance	Suction bucket jacket	Representative of the installation method that would result in the maximum volume of sediment disturbance during installation.
Duration offshore installation	Based on full build-out of the Project (BW1 and BW2) which corresponds to the maximum number of structures (155 wind turbines and two offshore substation facilities), submarine export and interarray cables, and maximum period of cumulative duration for installation.	Representative of the maximum period required to install the offshore components, which has the potential to impact resources in, access to the Project Area.
Underwater noise pile driving – single monopile	Pile diameter: 43 ft (13 m) Max penetration: 180 ft (55 m) Max hammer energy: 6,600 kJ[5] Total max pile driving duration per foundation: 4.8 hours Total duration for 155 wind turbines: BW1 and BW2: 744 hours	The longest temporal duration of impact for monopiles, which equates to the maximum number of pile driving events.
Underwater noise pile driving – piled jacket	Pile diameter: 14.7 ft (4.5 m) Max penetration: 229.6 ft (70 m) Number of piles per foundation: 4 Max hammer energy: 2,300 kJ[6] Total max pile driving duration per foundation: 24 hours (6.1 hours per pile) Total duration for 155 wind turbines: BW1 and BW2: 3,100 hours	The longest temporal duration of impact for piled jackets, which equates to the maximum number of pile-driving events.

[5] Total rated energy shown; actual effective energy level will not exceed 6,208 kJ.
[6] Total rated energy shown; actual effective energy level will not exceed 2,168 kJ.

Parameter	Maximum Design Scenario	Rationale
Underwater noise pile driving – piled offshore substation facilities (BW1 and BW2)	Pile diameter: 9.8 ft (3 m) Max penetration: 328 ft (100 m) Max number of corner legs piled: 4 Max hammer energy: 2,850 kJ[7] Total max pile driving duration per pile: 8.3 hours Total number of piles for: BW1: 3 BW2: 6 Total number of piles per leg: BW1: 12 BW2: 24 Total duration for two offshore substation facilities: BW1 and BW2: 299 hours	The longest temporal duration of impact for piled jackets for offshore substation facilities, which would result in the maximum of two offshore substation facilities. 299 hours is considered the maximum amount of time required to drive pile driven jackets for two offshore substation facilities (active pile driving).
Casing pipe and goalposts	Impact Pile Driving	Representative of the installation method that would generate underwater noise in the nearshore environment.
Project-related vessels underwater noise	Based on full build-out of the Project (BW1 and BW2) which corresponds to the maximum number of structures (155 wind turbines and two offshore substation facilities), submarine export and interarray cables, and maximum number of associated vessels.	Representative of the maximum number of Project-related vessels for underwater vessel noise.
Operations and Maintenance		
Wind turbines underwater noise	Based on full build-out of the Project (BW1 and BW2) which corresponds to the maximum number of structures (155 wind turbines).	Representative of the maximum underwater noise generated by operational wind turbines.
Project-related vessels underwater noise	Based on full build-out of the Project (BW1 and BW2) which corresponds to the maximum number of structures (155 wind turbines and two offshore substation facilities), submarine export and interarray cables, and maximum number of associated vessels. Based on maximum number of vessels and movements for servicing and inspections.	Representative of the maximum number of Project-related vessels for underwater noise.
Wind turbine and offshore substation facilities foundation and scour protection Habitat loss	<u>Wind Turbine</u> Based on suction bucket jacket, which represents the maximum overall footprint (155 x 3.0 ac [1.2 ha] with scour protection). Total 465 ac (188 ha) including scour protection.	Representative of the maximum area of foundation and scour protection installed which would result in the maximum long-term loss of seabed habitat.

[7] Total rated energy shown; actual effective energy level will not exceed 1,959 kJ.

Parameter	Maximum Design Scenario	Rationale
	Offshore Substation Facilities Based on suction bucket jacket, which represents the maximum overall footprint (2 x 5.2 ac [2.1 ha] with scour protection). Total 10.4 ac (4.2 ha) including scour protection.	
EMF interarray cables	Based on full build-out of the Project (BW1 and BW2) (155 wind turbines and two offshore substation facilities) Total interarray length: BW1: 162 nm (300 km) BW2: 162 nm (300 km).	Representative of the maximum length of interarray cables, which would result in the maximum exposure to EMF within the Lease Area.
EMF submarine export cables	Based on full build-out of the Project (BW1 and BW2): • BW1 to Queens, New York (202 nm [375 km]). • BW2: o To Queens, New York (202 nm [375 km]) or o To Waterford, Connecticut (113 nm [209 km]).	Representative of the maximum number and length of submarine export cables, which would result in the maximum exposure to EMF on the cable corridors.

Table 5.5-19. Supporting Calculations: Maximum Design Scenario for Benthic Substrate Burial

Type and Size	Number of Structures	Foundation Diameter at Substrate	Total Foundation Footprint	Total Foundation-Buried Substrate	Rank by Total Foundation-Buried Substrate (max. first)
Wind Turbines					
Suction Bucket Jacket	155	66 ft (20 m) a/	0.31 ac (0.13 ha)	48.05 ac (19.45 ha)	1
Monopile	155	43 ft (13 m)	0.033 ac (0.013 ha)	5.12 ac (2.07 ha)	2
Piled Jacket	155	14.7 ft (4.5 m) b/	0.016 ac (0.0064 ha)	2.48 ac (1.0 ha)	3
Offshore Substation Facilities					
Suction Bucket Jacket	2	65 ft (20 m) a/	0.30 ac (0.12 ha)	0.61 ac (0.25 ha)	1
Piled Jacket	2	9.8 ft (3.0 m) b/	0.03 ac (0.01 ha)	0.06 ac (0.02 ha)	2

Note: Additional information about foundations and scour protection is provided in **Section 3.3.1 Offshore Infrastructure**.
a/ Maximum diameter of individual bucket; represents up to four buckets per wind turbine or offshore substation foundation.
b/ Maximum diameter of individual piles; represents up to four piles per wind turbine foundation and up to 16 piles per offshore substation foundation.

Table 5.5-20. Supporting Calculations: Required Scour Protection by Foundation Type and Size

Type and Size	Number of Foundations	Total Foundation Footprint	Scour Protection Around Each Foundation a/	Total Scour Protection	Rank by Total Scour Protection (max. first)
Wind Turbines					
Suction Bucket Jacket	155	0.31 ac (0.13 ha)	3.0 ac (1.20 ha)	465 ac (188 ha)	1
Piled Jacket	155	0.016 (0.0064 ha)	1.9 ac (0.77 ha)	295 ac (119 ha)	2
Monopile	155	0.033 ac (0.013 ha)	1.24 ac (0.50 ha)	192 a (78 ha)	3
Offshore Substation Facilities					
Suction Bucket Jacket	2	0.30 ac (0.10 ha)	5.2 ac (2.1 ha)	10.4 ac (4.2 ha)	1
Piled Jacket	2	0.30 ac (0.10 ha)	4.0 ac (1.60 ha)	8.0 ac (3.2 ha)	2

Note: Additional information about foundations and scour protection is provided in **Section 3.3.1 Offshore Infrastructure.**
a/ Value represents the footprint of the scour protection armor layer around each foundation and does not consider the footprint of any pre-installed filter layer under individual piles.

Table 5.5-21. Supporting Calculations: Total Habitat Conversion to Hardbottom

Type and Size	Number of Structures	Foundation Diameter at Substrate	Total Foundation Footprint with Scour Protection	Total Benthic Habitat Conversion	Rank by Total Habitat Conversion (max. first)
Wind Turbines					
Suction Bucket jacket	155	66 ft (20 m) a/	3.0 ac (1.2 ha)	465 ac (188 ha)	1
Piled Jacket	155	14.7 ft (4.5 m) b/	1.9 ac (0.77 ha)	295 ac (119 ha)	2
Monopile	155	43 ft (13 m)	1.24 ac (0.50 ha)	192 ac (78 ha)	3
Offshore Substation Facilities					
Suction Bucket Jacket	2	65 ft (20 m) a/	5.2 ac (2.1 ha)	10.4 ac (4.2 ha)	1
Piled Jacket	2	9.8 ft (3.0 m) b/	4.0 ac (1.6 ha)	8.0 ac (3.2 ha)	2

Note: Additional information about foundations and scour protection is provided in **Section 3.3.1 Offshore Infrastructure**.
a/ Maximum diameter of individual bucket; represents up to four buckets per wind turbine or offshore substation foundation.
b/ Maximum diameter of individual piles; represents up to four piles per wind turbine foundation and up to 16 piles per offshore substation foundation.

TABLE 5.5-22. SUPPORTING CALCULATIONS: TOTAL TEMPORARY BENTHIC IMPACT FROM OTHER PROJECT COMPONENTS

Component	Distance	Width of Impact	Total Benthic Temporary Habitat Impact
Submarine Export Cables a/			
BW1 to Queens, New York	202 nm (375 km)	33 ft (10m)	929 ac (376 ha)
BW2 to Queens, New York	202 nm (375 km)	33 ft (10m)	929 ac (376 ha)
BW2 to Waterford, Connecticut	113 nm (209 km)	33 ft (10m)	520ac (210 ha)
Interarray Cables a/			
BW1	162 nm (300 km)	33 ft (10m)	746 ac (302 ha)
BW2	162 nm (300 km)	33 ft (10m)	746 ac (302 ha)
Other Construction Components b/ c/			
Anchoring	TBD	3,000 ft (914 m)	TBD

Note:
TBD – To be determined
a/ Footprint is a conservative estimate based on the widest trench generating tool (e.g., jet plow) and its outer width of disturbance.
b/ Mats are installed within the same footprint as proposed scour measures and therefore do not incur a separate temporary impact outside of what has already been accounted with permanent scour measures.
c/ Project is not proposing chain sweep during vessel installation activities.

5.5.2.1 *Construction*

Construction may include the following potential impact-producing factor to benthic and pelagic habitats and species:

- Installation of offshore components, including foundations, wind turbines, offshore substations, submarine export and interarray cables, and the associated scour and cable protection.

The following impacts may occur as a consequence of factor identified above:

- Direct disturbance, injury, and/or mortality of benthic species;
- Short-term (<2 year) change in water quality, including turbidity, sediment deposition, suspended sediment and chemical contamination;
- Short-term (<2 year) entrainment of plankton and ichthyoplankton species;
- Short-term (<2 year) disturbance of common softbottom sandy habitat; and
- Short-term (<2 year) increase in Project-related noise, including vibrations.

Disturbance, injury, or mortality of benthic species. Immobile or slow-moving demersal life stages of fish and invertebrates (including eggs and larvae) could be injured or killed during pre-construction grapnel runs, pre-sweeping and pre-trenching activities, pile driving for piled jackets, seabed preparation activities, suction bucket placement, anchoring, cable burial and installation, dredging, and armoring activities. These activities would disturb the seabed directly and crush or bury small sessile benthic organisms.

Pre-lay grapnel runs, pre-sweeping and pre-trenching activities, and dredging, which would be completed throughout the Project Area prior to foundation and cable installation, would disturb the bottom much as bottom dredges and trawls do. Similarly, placement and the potential dragging of anchors on construction vessels would injure or kill organisms by direct contact. However, most construction vessels will maintain position using DP or jack-up features, limiting the use of anchors. Any anchors would be placed within the previously cleared and disturbed area around the foundations. Based on analysis of a similar project (Block Island Wind Farm), NOAA Fisheries (2015) estimated that each anchor would temporarily disturb an area of 0.12 acres (0.05 ha). Assuming the Project would require anchors, some areas of the bottom would be disturbed; most of the affected area would be within habitats with prior and ongoing impacts from non-Project-related anchoring, trawling, and dredging.

After grapnel clearing and leveling, the wind turbine foundations would be placed on the sea floor. The area and depth of bottom disturbance would differ among foundation types. The monopile and piled jacket foundations would cover the smallest area but would penetrate deepest into the seabed. The suction bucket foundations and associated scour protection would cover the largest total area (see

Table 5.5-20).

Following the pre-lay grapnel run and pre-sweeping and pre-trenching activities within the submarine export cable corridors, cable-laying equipment would disturb the bottom within a narrower band where the cable would be buried. Burrowing surfclam and other invertebrates that were not previously disturbed by the grapnel would be displaced by the jet plow (or other installation equipment) as the cables were installed. The jet plow would move slowly, which would allow most mobile fish and invertebrates time to move away from the equipment and likely escape injury; soft-bodied sessile invertebrates within the trenched area would be crushed or buried. Shelled mollusks would fare better; the mortality of surfclam left behind in the path of a commercial clam dredge is generally assumed to be 12 percent (Kuykendall et al. 2019), although mortality could be considerably lower. Only 1 percent of the surfclam in an experimentally trawled area in Portugal died from trawl injury (Sabatini 2007). Injury and death of surfclam following commercial dredging are attributed to the direct impact of the dredge teeth. In contrast, the jet plow has no metal teeth, so it would not cause physical breakage of surfclam shells. The jet plow would remain in a given area for only a few hours, representing a transient impact on fish and invertebrates. Surf clams, ocean quahogs, and other burrowing bivalves would use their muscular foot to reposition themselves at the desired depth in the sediment after the cable installation was complete. The submarine export cable corridors were selected to minimize overlap with sensitive benthic habitats and cable installation will be further micro-sited within the route to avoid boulders and other fine-scale hardbottom to the extent feasible. Given these avoidance and conservation measures, the probability of adverse interactions of construction with sensitive benthic resources is low.

Change in water quality, including turbidity, suspended sediment, and sediment deposition and chemical contamination. Existing information indicates the subsurface currents within the Lease Area and adjacent waters are expected to be typically less than 0.65 ft per second (0.20 m per second). To better understand the physical environment, Beacon Wind installed current meters in the Lease Area to collect measurements to support sediment transport modeling for the COP assessments (**Section 4.2 Water Quality** and **Appendix I Sediment Transport Analysis**). Based on the existing information, the relatively low near-bed current speeds are not expected to generate significant quantities of suspended sediments during construction. Armoring around the foundations, where appropriate, would further reduce the potential for scour to generate suspended sediment plumes.

Beacon Wind is conducting studies to identify where scour protection could be applied to reduce the suspension of sediments around the foundations and cables. This is a balance between reducing scour through placement of hard material versus loss of existing habitat. For this analysis, using the maximum design scenario as defined in **Table 5.5-18**, it was assumed that the seafloor around each foundation would be armored with rock or other material to prevent bottom scour; it was also conservatively assumed that 10 percent of the interarray cables would require armoring (surface protection), mostly in areas where sufficient burial cannot be achieved (i.e., at cable and pipeline crossings). Areas assumed to require scour protection or armoring are listed in **Table 5.5-23.**

TABLE 5.5-23. MAXIMUM SCOUR PROTECTION/ARMORING PER PROJECT COMPONENT

Project Component	Maximum Design Scenario	Total Armored Area
Suction Bucket Foundations	155 wind turbine foundations plus two offshore substation facilities	661 ac (268 ha)
Interarray Cables	10 percent of 189 nm (350 km); 15 ft (4.5 m) wide	40 ac (16 ha)
Submarine Export Cables		
BW1 Queens, New York	10 percent of 202 nm (375 km]; 15 ft (4.5 m wide)	42 ac (17 ha)
BW2 Queens, New York	10 percent of 202 nm (375 km]; 15 ft (4.5 m wide)	42 ac (17 ha)
BW2 Waterford, Connecticut	10 percent of 113 nm (209 km); 15 ft (4.5 m wide)	23 ac (9.4 ha)

Armoring material would be lowered into place from a construction vessel, which would be stabilized by dynamic positioning, spuds, or anchors. Mobile fish and invertebrates would likely leave the area to avoid the noise and physical disturbance during armoring (**Section 3.4.2.7 Cable Protection Installation**). Sessile organisms within the armored area that were injured or buried by the armoring material would likely be scavenged by fish, crabs, and other mobile predators following construction activity in the area (Vallejo et al. 2017). The armored areas would be colonized by organisms that attach to hard substrate (sessile anthozoans, sponges, bryozoans), mobile macroinvertebrates such as crabs, and small demersal fish (NOAA Fisheries 2015). Organisms would emigrate from adjacent habitats or recruit from the plankton and reestablish the infaunal and epifaunal communities in adjacent softbottom habitats.

5.5.2.1.1 Turbidity

Softbottom sediment would be suspended, and turbidity would increase temporarily within and immediately adjacent to submarine export cable corridors. Long-term chronic increases in suspended sediment can cause physiological stress to sessile organisms; however, most fish and invertebrate organisms are capable of mediating short-term turbidity plumes by expelling filtered sediments or reducing filtration rates (NYSERDA 2017; Bergstrom et al. 2013; Clarke and Wilbur 2000). Some bivalves temporarily close their shells to avoid contact with unsuitable water, which temporarily interrupts their ability to feed and excrete wastes (Roberts and Elliott 2017; Roberts et al. 2016).

During the brief disturbance of the bottom as the cables are installed, turbidity would temporarily increase, temporarily reducing visibility and altering the behavior of some fish and invertebrates in the immediate vicinity. Pelagic fishes such as river herring and striped bass in the Long Island Sound may encounter areas of increased turbidity, especially in the relatively confined areas. However, fish and invertebrates inhabiting estuarine and coastal habitats are generally adapted to temporary turbidity events caused by storms and may even use the visual cover provided by suspended sediment to forage opportunistically. Conversely, the suspended sediment plume raised by the jet plow may directly increase the density of food particles in the immediate area, indirectly benefitting the surfclam and other suspension feeders in the submarine export cable corridors. The high metabolic demands of large surfclam may not be met solely by planktonic food sources. The nutritional value of suspended sediment near the sea floor can be two orders of magnitude greater than in the water column 3 ft (1 m) above the sea floor (Munroe et al. 2013). Surfclam and other demersal filter feeders may benefit from the benthic algae and detritus mobilized by bottom disturbance during construction. Blue crab and horseshoe crab typically occur in dynamic nearshore waters where turbidity is naturally high; effects on these species would be transient and similar to those described for other large mobile demersal crustaceans such as lobster and swimming crabs.

Studies of turbidity raised by hydraulic dredges, which are considerably larger than the jet plows proposed for the Project, indicate that suspended sediments behind the dredge fall rapidly back to the bottom within a short distance from the dredge, posing no obstacle to fish migration or transit through the area (USACE NYD 2015b). Suspended sediment concentrations during jet plowing and cable installation at the Block Island Wind Farm were well below predictions of the project-specific turbidity model (Elliot et al. 2017). Sediment modeling for this Project indicates that suspended sediment would increase in the immediate area around bottom-disturbing construction, then decrease to ambient concentrations (see **Section 4.2 Water Quality** and **Appendix I Sediment Transport Analysis**).

5.5.2.1.2 Sediment Deposition

Following cable installation and armoring, suspended sediments would settle in and adjacent to the submarine export cable corridors. The duration and height of the suspended sediment above the bottom would be influenced by grain size and bottom currents (see **Section 4.2 Water Quality** and **Appendix I Sediment Transport Analysis**). Along the submarine export cable corridors, pre-sweeping activities will result in the side-casting of material along sand waves and megaripples; at submarine cable and pipeline asset crossings, material has the potential to be side-cast or removed. While side-casting is provided as the base case, the Project design is still maturing and considering and identifying other potential disposal methods such as disposal at an approved location such as a federal or state managed historic area remediation site.

Some demersal eggs and larvae (e.g., longfin squid, winter flounder, ocean pout) and solitary star coral larvae could be buried by deposited sediments during construction. However, measurable sediment deposition would be limited to the installation trench and areas directly adjacent. Currents, storms, and other oceanographic processes frequently disturb softbottom habitats in the Project Area and native fish and invertebrates are adapted to respond to such disturbances. For example, the surfclam is considered to be tolerant of smothering and burial by sediment because it is a fast burrower that can move both vertically in the sediment and laterally across the surface of the sediment; its recovery following sedimentation events is very high. Under experimental trawl conditions, the surf clam reburied in the sediment within a few minutes of the trawl disturbance (Sabatini 2007). Mobile scavengers such as hermit crabs, whelks, sea stars, and some fish would likely move into the area to eat the dead and injured invertebrates (Sciberras et al. 2018; Vallejo et al. 2017; Kaiser and Hiddink 2007; Ramsay et al. 1997; NYSERDA 2017). Some species may even benefit from disturbances as new substrate becomes available for colonization (NOAA Fisheries 2018a).

Indirect impacts on fish and invertebrate resources from sediment suspension and deposition would be short-term and minimal. This one-time disturbance would not prevent natural recovery of benthic communities. Estimates of recovery time following construction vary by region, species, and type of disturbance. Case studies from cable installations on the continental shelf at depths comparable to the Project Area indicate that recovery begins immediately after construction and is complete within two years after jet plowing; the duration depends on the availability of mobile sediment (Brooks et al. 2006). Softbottom habitat recovers more quickly after cable installation by plowing than by jetting (Kraus and Carter 2018). Evidence of recovery following sand mining in the Atlantic and Gulf of Mexico OCS indicates that softbottom benthic habitat in the Project Area would fully recover within 3 months to 2.5 years (Kraus and Carter 2018; BOEM 2015; Normandeau 2014; Brooks et al. 2006). NOAA Fisheries estimated recovery of the softbottom benthic community at Block Island Wind Farm within three years (NOAA Fisheries 2015).

5.5.2.1.3 Suspended Sediment and Chemical Contamination

Sources of non-routine chemical releases during construction include suspension of contaminated sediments within the submarine export cable corridors, fuel spills from vessels, and releases of bentonite drilling muds associated with the base case HDD installation method at the cable landfall sites (**Section 3.3.2 Onshore Infrastructure**).

Sediment in the Lease Area is not known or expected to be contaminated, since no industry or other source of chemical releases exist at that distance from shore (Merck and Wasserthal 2009, cited in Taormina et al. 2018). The Project avoids known dump sites. Subsurface sediment disturbed by cable installation in the submarine export cable corridors, particularly in the western portion of Long Island Sound, is likely to contain elevated concentrations of contaminants, as discussed in **Section 4.2 Water Quality**.

In addition to chemical contaminants, fecal coliform colonies have affected water and sediment in coastal portions of the submarine export cable corridors. Shellfish in nearshore and inshore portions of the offshore installation corridors may be designated unsuitable for harvest based on water quality monitoring for nutrients, fecal coliform, and harmful algae. Differences in state management practices for shellfish resources are depicted in **Figure 5.5-79**, Typical offshore construction support vessels burn diesel fuel and have the potential to accidentally release small amounts of fuel to the waterway. Diesel fuel floats on the water’s surface briefly before volatilizing; it does not sink to the bottom and would not affect benthic habitat or species. Beacon Wind would require the construction vessels to minimize the risk of fuel spills and leaks, as detailed in **Appendix E Oil Spill Response Plan**; vessels would not refuel at sea. Construction vessels would comply with USGS regulations and with discharge limits in the Vessel Incidental Discharge Act of 2018 as appropriate for the vessel size and type. Chemical releases from vessels are considered unlikely; impacts would be short-term and localized.

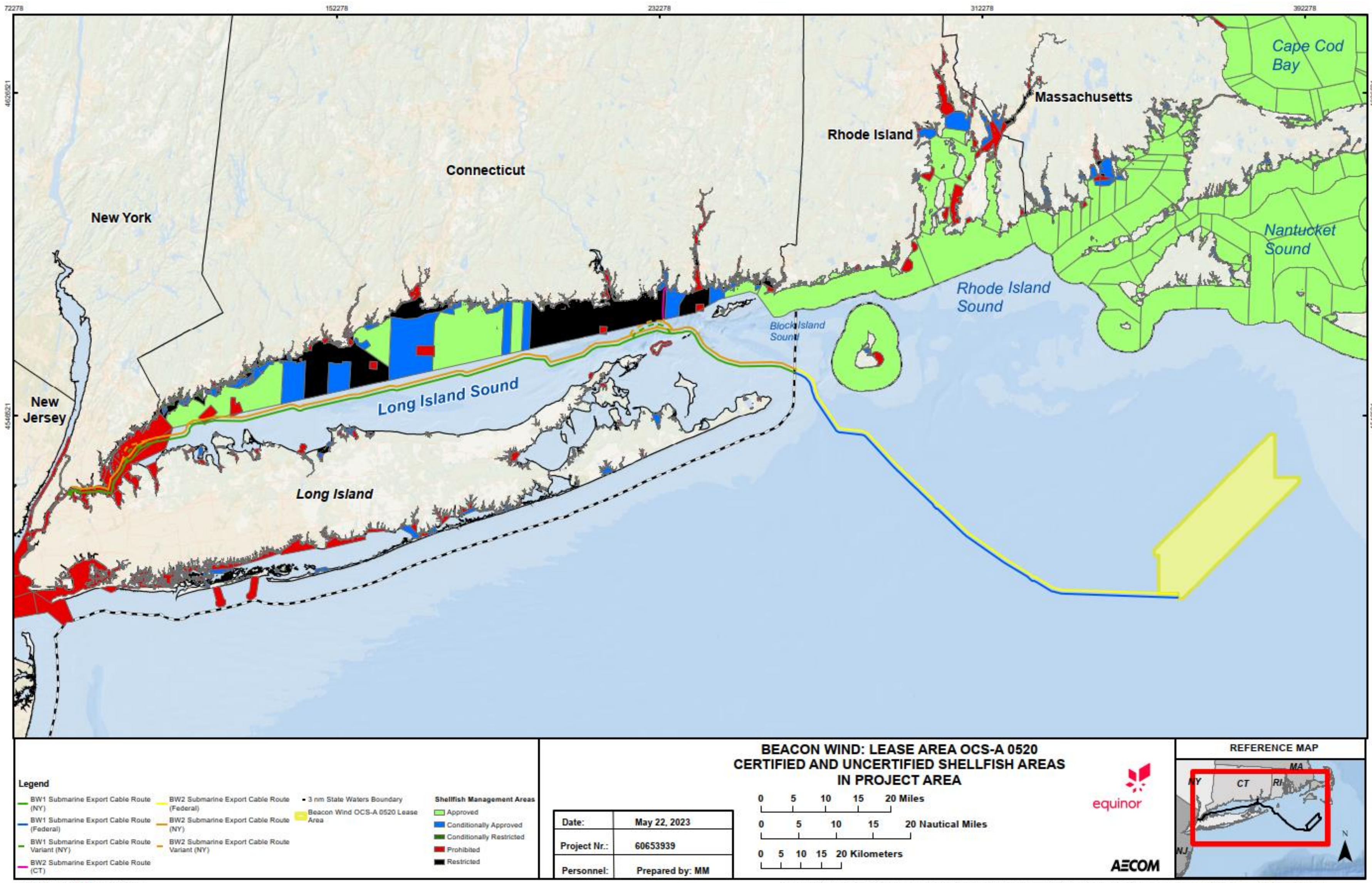
During HDD at the landfall sites for the submarine export cables, the release of non-toxic drilling mud would be unlikely, but possible. Beacon Wind’s HDD Contingency Plan, which would be submitted for review prior to the start of HDD, would specify response actions to be implemented if an accidental release occurred. Given the unlikely occurrence of a release and the precautions outlined in the Contingency Plan, impacts of drilling muds on benthic habitat would be indirect and temporary, consistent with BOEM’s analysis of the HDD installation at the Virginia Offshore Wind Technology Advancement Project (BOEM 2015.)

Project-related marine debris would have an indirect short-term effect on fish and invertebrate resources. However, Beacon Wind would continue practices established during the site assessment surveys that require offshore personnel to comply with USCG regulations concerning the proper disposal of marine debris.

Disturbance of the wind turbine and offshore substation foundations would support an extensive artificial reef habitat in the Lease Area, and likely act as fish aggregation devices. The presence of foundations would alter the surrounding habitat by temporarily disturbing sand ripples and mega-ripples, introducing artificial habitat, changing bottom scour patterns, and increasing shade. Effects of these habitat modifications on fish and invertebrates are discussed in **Section 5.5.2.3**.

Short-term entrainment of plankton and ichthyoplankton species. Ichthyoplankton may be entrained by the jet plow during cable installation. The jet plow would move continuously, affecting a given area for a brief time. The area of impact would be small relative to the available habitat for ichthyoplankton, consistent with entrainment analyses for other offshore wind farms in Southern New England (BOEM 2019c). Species entrained would vary by location, water depth, and season. Although entrained organisms would likely be killed, the loss would not be detectable against the background of existing vessels, including hydraulic scallop and clam dredges, in the Project Area.

FIGURE 5.5-79. CERTIFIED AND UNCERTIFIED SHELLFISH AREAS IN PROJECT AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Source: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributions

Short-term disturbance of common softbottom sandy habitat. As described in **Section 5.5.1**, much of the Lease Area is characterized as muddy sand. The pre-lay grapnel runs and installation of interarray cables would disturb the soft sediment temporarily, but tidal and wind-forced bottom currents would reform the area. Areas that are more strongly influenced by extreme weather events would reform in response to Nor'easters and tropical systems. The natural environment would return to pre-construction conditions within a few months. The only permanent loss of habitat would be up to 661 ac (268 ha) of soft-bottom in the Lease Area converted to hardbottom by foundations and scour protection (**Table 5.5-21**) and supplemental cable armoring (**Table 5.5-23**). The remainder of the Lease Area and the submarine export cable corridors would remain softbottom habitat.

Larger sand waves are maintained by current flow into and out of Block Island Sound and Long Island Sound in the nearshore portion of the submarine export cable offshore installation corridors along the eastern tip of Long Island; this high-flow area of sand waves is designated EFH for silver hake. Sand waves increase habitat value for demersal species by providing topographic relief where fish can shelter from high current flow and hide from predators and prey (Auster et al. 2003; Lock and Packer 2004; Hallenbeck et al. 2012). Sand waves in the export cable corridors would reform by natural processes following cable installation (McMullen et al. 2012).

No anticipated disturbance to seagrass. Seagrass beds in the Project Area are located at the shoreline of the Waterford, Connecticut landfall, on the southwestern coast of Fisher's Island, located 3 nm (5.4 km) to the northeast of the offshore submarine export cable route, as well as on the southwestern coast of Plum Island, 3.5 nm (6.6 km) to the southwest of the offshore submarine export cable routes. The Waterford, Connecticut landfall seagrass beds will not be disturbed due to the planned use of HDD to accommodate the landfall. All other seagrass beds are far enough away from construction that no disturbance is anticipated either from direct or indirect impacts.

Short-term increase in Project-related noise, including vibrations. The Project will generate noise during construction, which could directly and indirectly affect marine fish and invertebrates. Sudden loud noises can cause behavioral changes, permanent or temporary threshold shifts, injury, or death (Popper and Hastings 2009; Popper et al. 2014; Popper and Hawkins 2016; Andersson et al. 2017). Extended exposure to mid-level noise or brief exposure to extremely loud sound can cause a permanent threshold shift, which leads to long-term loss of hearing sensitivity. Less-intense noise may cause a temporary threshold shift, resulting in short-term, reversible loss of hearing acuity (Buehler et al. 2015).

Underwater noise associated with pile driving is a function of the type and size of piling, as well as the method of driving. The greatest source of injurious noise in the Lease Area would be pile driving using an impact hammer and the corresponding vibration of the seabed as the pile is driven into the substrate.

To facilitate the HDD installation, the Project will utilize a goal post pipe which marks and keeps the borehole in place during HDD activities. Casing pipe will also be utilized and installed to provide for improved boring conditions at the beginning of the HDD alignment. The installation of these supporting HDD appurtenances and the resulting underwater noise are modeled and discussed within **Appendix L Underwater Acoustic Assessment.**

The potential impact of underwater noise is influenced by the physiology of the receiver, the magnitude of the sound, and the distance of the receiver from the sound. Fish and invertebrates may be sensitive to both sound pressure and particle motion (oscillation of water molecules set in motion by sound) generated by underwater construction. While marine fish and invertebrates can detect particle motion, fish with swim bladders connected to the ear are the most sensitive to sound pressure (Popper and Hawkins 2018; Hawkins and Popper 2018; Popper et al. 2014) (see **Table 5.5-24**).

TABLE 5.5-24. RELATIVE SENSITIVITY OF FISH AND INVERTEBRATES TO SOUND

Morphological Type	Vulnerability to Barotrauma	Vulnerability to Sound Pressure	Typical Species in Project Area
No swim bladder or other gas-filled organ linked to hearing	Low	No	**Fish**: flatfish, sharks, rays, some tunas, some eggs, and larvae **Invertebrates**: squid, clams, whelk, crabs, lobster
Swim bladder not related to hearing	Medium	No	Sturgeons, striped bass, yellowfin and bluefin tuna, some eggs, and larvae
Swim bladder or gas-filled organ related to hearing	High	Yes	Atlantic cod, haddock, herring.

Interim threshold criteria established by a Working Group on Effects of Sound on Fish and Turtles initiated by NOAA Fisheries were finalized under the ANSI (Popper et al. 2014). Although data were not adequate to derive acoustic criteria for fish or invertebrates, the Working Group did develop general guidelines for predicting acoustic sensitivity from basic morphological traits of fish and invertebrates. Consensus was reached on numeric thresholds for mortality, recoverable injury, and temporary threshold shifts, as well as qualitative risk of masking effects and behavioral responses for fish and invertebrates at three relative distances from the sound source (near, intermediate, and far). Injury thresholds for fish with swim bladders not linked to hearing were applied to eggs and larvae based on morphological similarities because information on these early life stages was not available (Popper et al. 2014). Consensus guidance is summarized in **Table 5.5-25**).

TABLE 5.5-25. CONSENSUS GUIDANCE ON ACOUSTIC THRESHOLDS FROM IMPULSIVE SIGNALS FOR FISH AND INVERTEBRATES

Morphological Type	Potential or Actual Mortality	Recoverable Injury	Temporary Threshold Shift	Masking	Behavioral Responses
No swim bladder	>219 dB SEL_{cum} or >213 dB peak a/	>216 dB SEL_{cum} or >213 dB peak b/	>>186 dB SEL_{cum} (unweighted) a/	(N) Moderate (I) Low (F) Low a/	(N) High (I) Moderate (F) Low a/
Swim bladder (no hearing)	210 dB SEL_{cum} or >207 dB peak a/	203 dB SEL_{cum} or >207 dB peak a/	>186 dB SEL_{cum} (unweighted) a/	(N) Moderate (I) Low (F) Low a/	(N) High (I) Moderate (F) Low a/
Swim bladder(hearing)	207 dB SEL_{cum} or >207 dB peak a/	203 dB SEL_{cum} or >207 dB peak a/	186 dB SEL_{cum} (unweighted) a/	(N) High (I) High (F) Moderate a/	(N) High (I) High (F) Moderate a/
All size of fish		206 dB peak c/			
All fish mass ≥ 2g		187 dB SEL_{CUM} or 206 dB peak (unweighted) c/	--		
All fish mass < 2g		183 dB SEL_{CUM} or 206 dB peak (unweighted) c/	--		
Eggs and larvae	>210 dB SEL_{cum} or >207 dB peak a/	(N) Moderate (I) Low (F) Low a/	(N) Moderate (I) Low (F) Low a/	(N) Moderate (I) Low (F) Low a/	(N) Moderate (I) Low (F) Low a/

Notes:
Peak and rms sound pressure levels are shown as decibels (dB) re 1 micropascal (µPa); SEL as dB re 1 µPa2·s. No data are available to support thresholds for particle motion, so values are given in terms of sound pressure for the fish and invertebrates.
N = Near (tens of meters from the source), I = Intermediate (hundreds of meters), F = Far (thousands of meters).
Source: a/ Popper et al. 2014, b/ BOEM 2021, and c/ FHWG 2008

As more data on the effects of noise on fish and invertebrates become available, the interim noise thresholds may be updated. More recent empirical studies suggest that the thresholds may be as much as 20 decibels (dB) re 1 µPa too low for most species (see review by Casper et al. 2016). Guidance from Swiss researchers points to uncertainties in the injury thresholds in Popper et al. (2014) resulting from the confined test chambers where test fish were exposed to noise for 24 minutes with no choice of leaving (Andersson et al. 2017). For example, a cod or herring can swim more than 3,281 ft (1,000 m) in 24 minutes, thus reducing its exposure to injurious noise through avoidance behavior.

Even in open water, uncertainties related to interspecific variability suggest that the interim guidelines may be overprotective. Fishes in the field exhibit various reactions to pile driving noise; in south Florida, the sheepshead (*Archosargus probatocephalus*) remained for 10 days in a pile driving area while the grey snapper (*Lutjanus griseus*) left the area after only three days (Iafrate et al. 2016). NOAA Fisheries concluded in a Biological Opinion for a proposed offshore wind project that acoustic stressors were unlikely to adversely affect Atlantic sturgeon or their prey (NOAA Fisheries 2015).

An individual fish would be injured by pile driving noise only if it remained near the pile during installation (NOAA Fisheries 2015). Because the ESA requires protection of individual fish, it is reasonable to conclude that the lack of adverse effect on the Atlantic sturgeon applies equally to species managed for commercial harvest under the MSA. Fish and adult squid in the open waters of the Lease Area could readily avoid harmful noise levels by temporarily leaving the area as soon as soft-start pile driving began, if not before. Schools of pelagic fish moved horizontally and vertically when an air gun was shot, but no overall effect of the noise on their diurnal movements was observed (Carroll et al. 2017).

The 2014 interim criteria for predicting acoustic impacts to fish and invertebrates are not reflective of the effect on these taxa of particle motion (Hawkins and Popper 2016) or sediment vibration (Roberts et al. 2016). Fish and invertebrates have been shown to detect and respond to particle motion in small hard-surfaced experimental chambers in the laboratory. However, the environmental field conditions that determine the probability of detection and response of particle motion by organisms in the field cannot be replicated in the laboratory (Hawkins and Popper 2016). The study of noise effects on marine invertebrates has lagged behind fish and other vertebrates (de Soto 2016). A marine mussel and hermit crab were reported to detect and respond to sound-generated vibrations of the sediment itself, suggesting acoustic pathways not typically measured or modelled (Popper and Hawkins 2018 and references within). These logistical limitations have stalled the development of consensus guidelines on predictive impacts of particle motion and vibrations on fish and invertebrates (Andersson et al. 2017).

The effects of noise on squid behavior vary by species, life stage, and individual. Most species of squid can detect particle motion with statocysts (Mooney et al. 2010) and a lateral line (Solé et al. 2018), similar to some fish. An Australian squid (*Sepioteuthis australis*) exposed to air gun sounds similar to the proposed pile driving squirted ink and then quickly jetted away from the sound. Other individuals of the same species reacted by freezing (Fewtrell and McCauley 2012). In a separate laboratory experiment on *Loligo vulgaris* and *Illex coindetii*, the squid dropped to the bottom of the tank and did not move for several days (Solé et al. 2013). The reaction of squid in the Project Area to pile driving noise cannot necessarily be predicted from observations of fish or other species of squid in the laboratory; the behavior of individual squid in experimental chambers may or may not represent the reaction of schools of free-swimming squid in the Project Area to pile driving noise.

Sessile demersal species such as squid egg mops, demersal fish eggs and larvae, surfclam, scallop, and ocean quahog would be exposed to sound pressure, particle motion, and substrate vibrations throughout the period of pile driving. Surfclam, ocean quahog, and scallops would likely respond to the vibration and sound of the impact hammer by closing their valves or “flinching,” which prevents feeding (Charifi et al. 2017; Day et al. 2017). The loss of foraging opportunity resulting from closed valves would be a short-term reversible adverse impact on these species; once the disturbance ended, the bivalves would resume feeding. A brachyuran crab, two species of lobster (Edmonds et al. 2016), and a hermit crab (Roberts et al. 2016) also detected and responded to particle motion in the laboratory. These crustaceans may be temporarily disturbed during pile driving.

As discussed in **Section 8.8 Commercial and Recreational Fishing**, substantial commercial harvest of squid occurs in the Lease Area in some years. Despite the limited acreage of EFH for squid eggs in the Lease Area (14,902 acres [6,031 ha] or 18.8 percent; **Appendix T Essential Fish Habitat Technical Report (EFHTR)**), the Lease Area is reported to support extensive squid spawning (Guida et al. 2017). Effects of acoustic stress on squid reproductive behavior or demersal eggs is unknown. One squid laid eggs on the camera during the air gun test, but the authors could not determine whether the spawning was a reaction to the acoustic stress or simply a response to an available substrate for placing eggs (Fewtrell and McCauley 2012). As discussed above, laboratory data suggest that some cephalopods may be susceptible to injury by loud noises, particularly during early life stages (Solé et al. 2018; Solé et al. 2013). Some adult and hatchling squid could be exposed to and injured by acoustic stressors during pile driving.

Ichthyoplankton have limited ability to avoid unfavorable conditions, although more developmentally mature individuals of some species may be capable of directional swimming (Pineda et al. 2007). The sensory cells of newly hatched squid were shown to be susceptible to injury by anthropogenic sound in controlled laboratory studies. When squid hatchlings were exposed to 50-400 hertz (Hz) sinusoidal wave sweeps for 2 hours at a measured sound pressure level of 157±5 dB re 1 micropascal (μPa) with peak levels up to 175 dB re 1 μPa, statocysts and lateral line cells were damaged (Solé et al. 2018). In some larval fish, sensory hair cells were able to regenerate within a few weeks, but the permanence of the damage to squid sensory cells is not known (Solé et al. 2018). Underwater noise will be generated by several construction operations including: pile driving, jet-plowing, dredging, and Project-related vessel. The results of Beacon Wind's underwater acoustic modeling of maximum Project design elements are presented in **Appendix L Underwater Acoustic Assessment**. Beacon Wind is committed to using a soft start procedure as part of avoidance, minimization, and mitigation measures for marine mammals and sea turtles that will also allow fish and other mobile organisms to leave the immediate area to avoid injurious cumulative exposure (see **Section 5.6 Marine Mammals** and **Section 5.7 Sea Turtles** for additional information). Given the extent of suitable habitat outside the construction area, it is reasonable to expect adult fish and squid to relocate temporarily during pile driving (BOEM 2015). Given the naturally high mortality of fish and invertebrate eggs and larvae in the field, injury caused by acoustic pulses during pile driving would not cause significant population-level effects on any species.

The number of individual fish or invertebrates potentially affected by pile driving noise would be negligible relative to overall abundance of these managed species. Impacts to fish and invertebrates (including ichthyoplankton), would be direct and short-term. Overall, noise associated with pile driving would be temporary and localized.

Fish Acoustic Range Estimates

As detailed within **Appendix L Underwater Acoustic Assessment**, although some fish may move during pile driving, they were considered static receivers and acoustic distances where sound levels could exceed fish regulatory thresholds were determined using a maximum-over-depth approach and finding the distance that encompasses at least 95 percent of the horizontal area that would be exposed to sound at or above the specified level. The calculated acoustic distances for fish with 10 dB of broadband attenuation are presented in **Appendix L Underwater Acoustic Assessment.**

<u>Goal Posts and Casing Pipe Modeling</u>

Submarine export cable landfall construction activities will include the installation of temporary casing pipe and goalposts which would require impact pile driving, and/or pneumatic pipe ramming to install a casing pipe in support of horizontal directional drilling which would require the temporary installation of cylindrical steel “goal post” piles via impact pile driving. Pneumatic pipe ramming and impact pile driving produce underwater sounds that have the potential to exceed regulatory thresholds for auditory injury and behavioral disruption in fishes. The isopleth distances to thresholds corresponding to potential injury and behavioral disruption of fish were computed by propagating measured source levels at potential cable landfall construction areas and then comparing the resulting sound fields to regulatory thresholds. Fish exposure estimates were then calculated based on expected construction scenarios forcasing pipe installation and goal post pile driving, incorporating marine mammal density estimates in the Project area. **Appendix L Underwater Acoustic Assessment** details the results of acoustic and exposure modeling forgoal posts and casing pipe.

Vessels used for construction would introduce routine noise into the Project Area. Construction vessel noise does not differ substantively from noise generated by other commercial vessels moving slowly while trawling or idling in an area. Noise generated during cable laying (using jet plow or similar equipment) would be similar to other diesel-powered vessels. The noise of maintenance dredging was determined not to differ from vessel background sounds and to pose no barrier to migratory behavior of fishes in New York (USACE NYD 2015b). The acoustic impact of vessels on fish and invertebrates would be temporary and localized.

5.5.2.2 *Operations and Maintenance*

During operations, the potential impact-producing factors to benthic and pelagic habitats and species may include:

- The presence of new permanent structures and infrastructure (i.e., foundations, wind turbines, and offshore substation facilities); and
- The presence of new buried submarine export and interarray cables.

The following impacts may occur as a consequence of the factors identified above:

- Long-term disturbance, displacement, and/or modification of habitat and the introduction of artificial habitat;
- Introduction of nonindigenous species;
- Increase in shading and Project-related artificial lights;
- Underwater noise/vibration;
- Changes in water quality (turbidity, incidental spills, and marine debris);
- Long-term increase in Project-related EMF; and
- Thermal effects.

Long-term disturbance, displacement, and/or modification of habitat and the introduction of artificial habitat. Underwater portions of foundations would be colonized by encrusting and attaching organisms, creating an array of biogenic reefs in the Lease Area wind turbine foundations (Degraer et al. 2018; Hooper et al. 2017a, 2017b; Griffin et al. 2016; Fayram and de Risi 2007). Algae, sponges, tubeworms, bryozoans, hydroids, anemones, blue mussels, barnacles, amphipods, and tunicates would begin recruiting from the plankton shortly after the structures were installed (Causon and Gill 2018; BOEM 2015, 2014; Langhamer 2012; Langhamer et al. 2009; Steimle et al. 2002; Steimle and Zetlin 2000). Attached organisms would create secondary habitat, increase biodiversity, and attract mobile fish and invertebrates that feed on them (Causon and Gill 2018). Jacket foundations would support a greater variety of attaching and encrusting organisms than monopile and would also provide more complex shelter for large demersal and pelagic fish and invertebrates.

Studies of colonization of wind turbine foundations in the North Sea reported no difference in the types of epifauna accumulated on these structures and other marine infrastructure (Kerckhof et al. 2010). Each studied wind turbine foundations (with its 197-ft [60-m] diameter scour collar) provided about 7,000 ft^3 (650 m^2) of new hard surface for colonization. Foundations on a flat sandy shelf, where the only available hard structures were shipwrecks, were colonized by more than 60 species within a few months of installation. After four years, 84 species of epifauna were reported (Coates et al. 2014). Early colonizing bivalve species often disappeared as succession progressed; after one year, the wind turbine foundations were dominated by crustaceans (especially juvenile crabs), mollusks, and annelids. The calcareous tubes constructed by polychaetes and amphipods on the foundations provided additional rugosity and microhabitats for smaller organisms, leading to a rich and complex reef community. Seasonal variability was noted, as species richness increased during summer (Kerckhof et al. 2010).

The assemblage of species that colonizes each foundation in the Lease Area would be influenced not only by the surface area to be colonized but also by the availability of larval recruits immediately following installation because planktonic larval assemblages vary throughout the year. Therefore, the pattern of colonization and succession would vary throughout the Lease Area, especially during the early years (Krone et al. 2013, 2017). The dominant northward current in the continental shelf is the Gulf Stream, which carries ichthyoplankton and pelagic fish into Southern New England from the south (NOAA Fisheries 2017a). Planktonic larvae and cool water from the Gulf of Maine are delivered to the Project Area by a cold countercurrent. The quasi-decadal shift in the latitude of the Gulf Stream is reported to cause a subsequent northward shift in some species, such as the silver hake, in response to increases in bottom temperature (Davis et al. 2017). The wind turbines are not expected to interfere with these oceanic currents or to disrupt the typical dispersion of eggs and larvae in the region.

Within the vast waters of the Project Area, the vertical foundations provide a relatively small surface area for settlement. Recruitment is influenced by numerous environmental signals in addition to the presence of physical structure, including stage of larval development, temperature, prey availability, and chemical odor of conspecifics (McManus et al. 2018; Pineda et al. 2007). Foundations predicted to serve as attachment sites for squid and herring eggs in the North Sea have not yet been demonstrated as such (Vandendriessche et al. 2016). Planktonic life stages of fish would not be directly affected by the introduction of foundations and scour protection.

Colonization of wind turbine foundations in the North Sea varied on the vertical axis, with more species reported nearer the seafloor (possibly because tube-building species use suspended sediment to construct tubes) (Kerckhof et al. 2010). Overall abundance of mobile demersal megafauna was highest at the bottom of the foundation, perhaps because the bottom anchorage offered shade, shelter, and access to surrounding soft-bottom areas for foraging (Krone et al. 2013). Assemblages of mobile demersal megafauna (large crustaceans and fish) associated with the lower levels of steel jacket foundations and shipwrecks in the German Bight (North Sea) were dominated by Cancer crabs (Krone et al. 2013). The upper portions of steel jacket and monopile foundations were colonized by larval edible crab (*Cancer pagurus*), possibly increasing overall production of this species in the offshore subtidal wind farm area (Krone et al. 2017). Related crabs in the Project Area (e.g., Jonah crab may use the jacket foundations in similar ways.

The area surrounding each foundation would accumulate remains of the attached organisms, such as empty mollusk shells and a rain of enriched fecal particles, known as littoral fall or foundation effect (Causon and Gill 2018; Coates et al. 2014; Goddard and Love 2008). Accumulations of empty shells provide essential habitat for juvenile lobster, crabs, scup, and other benthic fishes. In particular, discarded bivalve shells are known to provide valuable habitat for juvenile ocean pout, little skate, American lobster, red hake, and black sea bass, and other species, and to support more species per unit area than habitat with no shells (Coen and Grizzle 2007). Squid egg masses were observed attached to empty ocean quahog shells in the Lease Area (Guida et al. 2017). The organic detritus around the wind turbines would then be colonized by benthic organisms attracted by the nutrients or physical shelter near the foundations. Based on studies of well-established oil and gas platforms, enrichment of the benthic community would be detectable only within 3 to 16 ft (1 to 5 m) of the foundation (Bergstrom et al. 2014; Wilhelmsson et al. 2006). In general, the benthic species assemblage is reported to be affected only within a 49 ft (15 m) radius of a wind turbine foundation (Schröder et al. 2006, cited in Coates et al. 2014).

A study of small-scale effects of wind farm construction documented variability in grain size, TOC, and benthic species assemblages along 656-ft (200-m) horizontal transects out from the wind turbine foundations. Organic carbon enrichment was highest in samples near the foundations and decreased with distance along the 656-ft (200-m) transects. Mean grain size was smaller immediately adjacent to the wind turbine foundations, possibly due to construction activities and the slight slowing of bottom currents as they moved around the wind turbine foundations. The low-flow pocket immediately down-current from the wind turbine foundations provides a sheltered area where both larval recruits and organic matter may accumulate and enrich the seafloor (Coates et al. 2014). The speed and direction of bottom currents were reported to be unaffected by piled jacket foundations, likely because the water moves through rather than around the foundation (Coates et al. 2014; Reubens et al. 2016).

The biodiversity and productivity of the foundations could influence the distribution and abundance of predatory fish and invertebrate species (Rein et al. 2013; Reubens et al. 2013). Benthic fish collected within and outside a wind farm in the North Sea had stomachs full of hardbottom prey, suggesting that fish associated with softbottom adjacent to the wind farm responded to the prey associated with the foundations (Degraer et al. 2016). The muddy sand substrate typical of the Lease Area provides little habitat for fish and invertebrates that prefer structure, including black sea bass, ocean pout, red hake, monkfish, and squid (eggs) (NEFMC 2017 and references within).

Because hardbottom and three-dimensional structures in the Lease Area are currently limited to shipwrecks, some structure-oriented species are expected to respond favorably to the habitat created by wind turbine foundations (Guida et al. 2017). Black sea bass, tautog, scup, and lobster are reported at artificial reefs in coastal New York waters, as are summer flounder, cod, and several species of edible crab. Adult black sea bass do not move far from where they settle as adults; they are currently most abundant in the northern portion of the Lease Area (Guida et al. 2017). The addition of complex structural habitat would expand the area of settlement habitat to deeper waters and potentially support greater abundance of this species in the area (Guida et al. 2017 and references within). Likewise, adult and subadult tautog prefer structured habitats, particularly in winter, and are expected to take advantage of the foundations in the Lease Area after construction (ASMFC 2019c). The Jonah crab is reported to be attracted to rocky habitats with crevices as well as softbottom habitats (ASMFC 2019b; NOAA Fisheries 2018a).

An offshore wind farm in the United Kingdom reported initial aggregations of European lobster within a newly constructed wind farm; studies on long-term effects on lobster densities are ongoing (Roach et al. 2018). The same reaction of American lobster to the Project cannot be assumed; however, because the Southern New England lobster stock has collapsed, and recruitment is exceedingly low (ASMFC 2018a, 2018b; Le Bris et al. 2018). After several years of steadily declining catches and record low recruitment, only about 2 percent of Atlantic coast landings in 2017 came from the Southern New England stock (ASMFC 2018c). Recruitment and growth of young lobsters is most successful in cobble habitats (Collie and King 2016), although recent research has demonstrated that larval lobster may recruit to firm mud bottoms (Dinning and Rochette 2019). Primary causes of the poor condition of the Southern New England and Mid-Atlantic lobster stock include increasing water temperature and fishing pressure, making recovery in the Project Area unlikely (ASMFC 2018a). Despite the overall decline of the lobster stock in the Project Area, recreational and limited commercial harvest is supported in the Long Island Sound and Block Island Sound. Lobster pots were so dense in the Long Island Sound during 2021 geophysical surveys that Beacon Wind's vessels delayed surveying that area due to the risk of snagging tow survey equipment on them. Beacon Wind subsequently completed the survey during a period of harvest closure. Commercial harvest of lobster and Jonah crab are discussed in more detail in **Section 8.8 Commercial and Recreational Fishing**.

Evidence for the effect of well-established offshore wind farms on distributions of fish and macroinvertebrates in Europe is equivocal. Increases in Atlantic cod and pouting to wind turbine foundations in the Belgian part of the North Sea were reported to reflect better quality forage on the foundations relative to nearby sources, leading to greater reproductive output (Reubens et al. 2014). Demersal fish abundances were higher near wind turbine foundations than in surrounding softbottom habitats (Wilhelmsson et al. 2006; Bergstrom et al. 2013, 2014). At a wind farm in the Netherlands, an increase in sand eels within the wind farm area was attributed to the attraction of this semipelagic species to the hardbottom scour protection around the foundations (Rein et al. 2013). Benthic epifauna growing on wind turbines in the North Sea were reported to provide increased feeding opportunities for other fish, which redistributed fish in patchy assemblages throughout the wind farm impact area (Stenberg et al. 2015). Likewise, pagurid crab abundance increased on wind turbine foundations and the surrounding rock armoring, which provided crab nursery habitat (Krone et al. 2017). An artificial reef intentionally placed near Sydney Harbor created an "ecological halo" 15 times larger than the reef footprint within which abundance of demersal fishes increased (Reeds et al. 2018). Oil platforms on the California coast, which have similar underwater structure to the jacket foundations used for wind turbines, supported demersal and pelagic juvenile fish that, in turn, attracted predatory rockfishes (Claisse et al. 2014, 2015). NOAA Fisheries concluded that any individual Atlantic sturgeon that migrated through an operational wind farm in this region would likely benefit from the increased prey associated with the rock armoring around the wind turbine foundations and submarine export cables (NOAA Fisheries 2015).

A recent meta-analysis of the effect of wind farms on fish abundance concluded that effects are positive, meaning that more fish occur within wind farms than at nearby reference locations (Methratta and Dardick 2019). However, not all studies report strong correlations of fish abundance with offshore wind farms. In the North Sea, an increase in structure-associated fish near a wind farm was reported, but the increase was not clearly attributable to productivity or immigration from surrounding areas (Rein et al. 2013). A review of operating wind farms in the Belgian part of the North Sea reported no difference in abundances of fish eggs, fish larvae, or squid larvae within and outside of the wind farm (Degraer et al. 2016; Vandendriessche et al. 2016). Distribution, abundance, and reproductive success of the benthic, resident eelpout (*Zoarces viviparous*) were not affected by a wind farm in the Baltic Sea (Langhamer et al. 2018).

Whether artificial reefs increase or simply redistribute overall productivity is an open question (Shipp and Bortone 2009; Love et al. 2006; Girard et al. 2004). The expansion of structure-associated species into the Lease Area is not guaranteed. Demersal fish and the American lobster did not respond as expected to the increase in hard structure at the Block Island Wind Farm; no effect on the distribution, abundance, or condition of fish was demonstrated (Carey 2017; Wilber et al. 2018). Catch per unit effort increased for structure-oriented species such as black sea bass and Atlantic cod in the years following Block Island Wind Farm turbine installation, but not for forage fish such as Atlantic herring, scup, or butterfish (Wilber, et. al. 2022, Carey, et. al. 2020). Offshore structures attract most highly migratory fishes (NOAA Fisheries 2017a). Mahi-mahi and some tuna (e.g., yellowfin [*Thunnus albacares*], bigeye [*Thunnus obesus*]) and sharks (e.g., dusky, whitetip, shortfin mako, common thresher [*Alopias volpinus*]) may be drawn by the abundant prey (Itano and Holland 2000; Wilhelmsson and Langhamer 2014) or use the structures as navigational landmarks (Taormina et al. 2018). Schooling forage fish (Brown et al. 2010), sea turtles (Blasi et al. 2016) and marine mammals (Rein et al. 2013) also congregate around offshore structures (Raoux et al. 2017). Effects on fish and invertebrate populations may be adverse, beneficial, or mixed, depending on the species and location (van der Stap et al. 2016; NOAA Fisheries 2015).

Under current conditions, benthic species assemblages are not well-correlated with substrate type in the Lease Area, largely because of the relative uniformity of substrate type in the area. Although the Project would introduce habitat variability to the area, the extent of artificial reef and the acreage subject to reef effect represents a small fraction of the total softbottom on the Southern New England continental shelf. A maximum of 651 ac (264 ha) of benthic substrate would be directly covered by the 155 wind turbine foundations and associated scour protection and up to 10.4 ac (4.2 ha) of benthic substrate would be directly covered by the two offshore substation facilities foundations and associated scour protection, creating a maximum direct reef effect of 661 ac (268 ha) under the maximum design scenario (see **Table 5.5-21**).

Potential impacts of the monopile, suction bucket jacket, and piled jacket foundation types would differ slightly for various demersal species. The suction bucket and monopile foundations would provide largely smooth vertical walls for attachment. Conversely, the piled jacket foundation would provide greater surface area for encrusting and attaching organisms and more sheltering area, enhancing the reef effect and increasing potential habitat complexity. The piled jacket would also provide hard surfaces of diverse orientations relative to the largely vertical orientation of the monopiles. Because some species prefer to settle on surfaces with a particular orientation, the piled jacket foundation is expected to support a greater diversity of organisms (Causon and Gill 2018). However, the species assemblage that would colonize each foundation type is expected to vary and cannot be known in advance. Given the highly localized extent of the converted habitat, population-level effects on fish or invertebrate resources would not be measurable.

In summary, the habitat value of operating suction buckets, monopiles, and piled jackets would be similar but not identical. The complex structure of a piled jacket foundation would support a more complex reef community than a smooth monopile (Wilhelmsson and Langhamer 2014). As a consequence of the structural complexity, jacket foundations would support a greater diversity of organisms. The jacket foundations would allow water to flow through the structure; monopiles would have an intermediate effect on bottom current deflection. Placement of scour protection, described above, would mediate effects on bottom currents.

On balance, the Project's impact on benthic and pelagic habitat would be either neutral or beneficial to most fish and invertebrates (Hooper et al. 2017b). While the presence of foundations may influence local distributions of demersal fish and invertebrates on a small spatial scale, no population-level effects are expected. Structure-associated species such as black sea bass, Jonah crab, and others may benefit from the expanded habitat. The new infrastructure would neither harm nor benefit demersal species that prefer open sandy bottoms, such as surfclam, ocean quahog, and some flatfish, because muddy sand is not a limiting feature in the Project Area.

The offshore converter stations, located within the offshore substation facilities, will each include a CWIS that will utilize up to 10.6 million gallons per day (mgd) of once-through non-contact cooling water that may result in the entrainment of egg and larval stages of ichthyoplankton species, as discussed in **Appendix T Essential Fish Habitat Technical Report (EFHTR)**. Ocean water will be drawn in from the water column, approximately 49-131 ft (15-40 m) below the water surface. The flow required by the converter station is several orders of magnitude lower than the flow (500 to 2,900 mgd) required for similar cooling water intake structures for many coastal power plants throughout the northeast (USEPA 2010). While individual eggs and larvae of commercially or recreationally-managed species in the immediate vicinity of the intake may be subject to entrainment through the cooling water system, this discrete intake location is not expected to result in measurable impacts to fish or shellfish populations or managed fisheries stocks on a local or regional scale. After the water passes through the CWIS, water will be discharged back into the water column approximately 66-112 ft (20-34 m) below the water surface. Discharged water temperature will be approximately 87.8°F (31°C) when the seawater inlet temperature is 68°F (20°C), though for much of the year the seawater will be cooler and the discharge temperature will accordingly be lower. Discharged water will not exceed 96.8°F (36°C), and this maximum temperature would correlate to a CWIS operating at a much smaller discharge volume than the maximum. The heated water is expected to dissipate rapidly within the ambient source-water and is not expected to result in measurable impacts to fish or shellfish populations or managed fisheries stocks. Within a short distance from the CWIS, the temperature difference from surrounding seawater will drop to undetectable levels. No impingement of juvenile or adult fish is anticipated from operation of the CWIS.

The design, configuration, and operation of the offshore substation facilities' cooling systems will be permitted as part of an individual NPDES permit and additional details will be included in the permit application submitted to the EPA. Beacon Wind will actively work with EPA to understand additional modelling and assessment that may be required for this system.

Introduction of nonindigenous species. Offshore wind farms have been reported to host nonindigenous invasive species, especially in nearshore intertidal areas (Adams et al. 2014; Mineur et al. 2012; Kerckhof et al. 2010). At the Block Island Wind Farm, the regionally common invasive tunicate *Didemnum vexillum* was observed colonizing foundation structures within four calendar years of foundation installation (Hutchison, et. al. 2020). Wind farms in intertidal habitats in the Belgian part of the North Sea may provide stepping-stones for invasive species (Degraer et al. 2010). In contrast, subtidal wind turbine foundations were found to have little effect on the spread of nonindigenous invasive species (Degraer et al. 2016). The nearest wind turbine foundation for the Project would be at least 19 nm (35 km) from shore. Because hard substrate is already available within the Project Area in the form of shipwrecks, artificial reefs, and derelict fishing gear, the introduction of wind turbine foundations is not expected to have a measurable impact on invasive species.

Shading and Project-related artificial lights. The Project would introduce shade and artificial lighting to the Project Area. The impacts of shading on primary productivity would be discountable because the above-water portion of the wind turbines is narrow and vertical, the two offshore substation facilities are relatively small in context of the overall Lease Area and located individually within the Lease Area, and the phytoplankton in the surface waters around the structures would remain in the shade only briefly as they are transported by waves and currents.

Artificial lights would be installed on the wind turbines and offshore substation facilities as required for navigational safety. The lights are designed to penetrate only the top few centimeters of the water column, leaving the vast majority of the water column unilluminated. Most demersal fish and invertebrates in the Lease Area would be unlikely to detect the additional light at the water surface.

Some zooplankton and ichthyoplankton may aggregate around spots of light in the water (Hernandez et al. 2003; Hernandez and Shaw 2003) and pelagic predators (e.g., mackerels and herrings) may opportunistically feed there. Although the risk of predation on individual larvae may increase in the immediate vicinity of a lighted structure, the risk is fleeting because planktonic organisms are not expected to remain in one location for long periods of time. The response to artificial lights varies among fishes. Mackerels forage well in very low light; in contrast, Atlantic herring and other clupeids feed best in very bright light (Keenan et al. 2007). Many of the fish observed in the water column near offshore infrastructure during daylight migrate vertically at night, thus avoiding the nighttime effects of artificial light (Barker and Cowan 2018).

Artificial lights on the wind turbines and offshore substation would disrupt daily or seasonal migrations of fish or invertebrates in the Project Area. Nighttime light pollution does not substantially decrease primary productivity (Gaston et al. 2013) and it was determined that the lighting on offshore wind turbines does not affect fish to a meaningful extent (Orr et al. 2013). Unlike the intense lights that support 24-hour work on fully staffed oil platforms, the lights on wind turbines and offshore substation facilities are designed strictly for navigational safety. The limited area of low-wattage lighting on the wind turbines and offshore substation facilities would affect a minimal fraction of the available sea surface and would be unlikely to affect fish or invertebrate resources.

Underwater noise: noise and vibration. The Project will generate noise during operations that could directly and indirectly affect marine fish and invertebrates. Sudden loud noises can cause behavioral changes, permanent or temporary threshold shifts, injury, or death (Popper and Hastings 2009; Popper et al. 2014; Popper and Hawkins 2016; Andersson et al. 2017). Extended exposure to mid-level noise or brief exposure to extremely loud sound can cause a permanent threshold shift, which leads to long-term loss of hearing sensitivity. Less-intense noise may cause a temporary threshold shift, resulting in short-term reversible loss of hearing acuity (Buehler et al. 2015).

Vessels used for operations and maintenance would introduce routine noise into the Project Area. Project-related vessel noise does not differ substantively from noise generated by other commercial vessels moving slowly while trawling or idling in an area. The acoustic impact of vessels on fish and invertebrates would be temporary and localized.

During operations, the wind turbine gears, generators, and blades would generate above-water noise that could be transmitted as sound pressure or vibrations through the foundation to the water. Field data from operating wind farms indicate that both turbine noise and natural background underwater noise generated by wave action and entrained bubbles are influenced by wind speed. Under stronger wind conditions, the increase in background ocean noise masks the increase in turbine noise, creating a steady state (Nedwell et al. 2004).

Change in water quality including oil spills and use of cooling water for offshore converter stations. During operations, routine maintenance activities have the potential to result in temporary increases in turbidity and sedimentation in the Project Area. Potential impacts to water quality resulting from turbidity are further discussed in **Section 4.2 Water Quality** and **Appendix I Sediment Transport Analysis**. As shown, the increase in turbidity and or release of contaminants from re-suspended sediments is not expected to exceed background levels during natural events and will be short-term and temporary in nature.

In addition to turbidity, water quality has the potential to be impacted through the introduction of contaminants, including oil and fuel spills. Beacon Wind has provided an OSRP (**Appendix E Oil Spill Response Plan**), which details the measures proposed to avoid inadvertent releases and spills and a protocol to be implemented should a spill event occur. Additional information can be found in **Section**

8.12 Public Health and Safety. Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts on the benthic environment and species from impacts to water quality and spills:

- The Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste; and
- An OSRP will be developed and enforced.

Project-related EMF. The submarine export cable would generate EMF in the Project Area, as described in **Appendix CC Offshore Electric and Magnetic Field Assessment**. Some fish and invertebrates are known to detect and respond to EMF from buried cables, but no clear trend of avoidance, attraction, or adverse effects has been established. A recent review of potential effects of the weak EMF generated by alternating current undersea power cables associated with offshore wind energy projects would not negatively affect any fishery species in Southern New England because the frequencies are not within the range of detection for these species (Snyder et al. 2019). Nevertheless, Beacon Wind has committed to sufficiently burying electrical cables wherever feasible, which will minimize detectable EMF. The findings, as further detailed within the assessment, determined maximum magnetic field strengths and induced electric fields calculated for the BW1 and BW2 submarine export cables have a de minimis risk to demersal marine species for the majority of the submarine export cable routes where the cable will be buried and either bundled or separated. In areas where the submarine export cable is surface laid, the maximum magnetic fields and induced electric fields are elevated though the effect reference values are based on behavioral changes, and is considered a conservative estimate of potential population level effects. In summary, population level risks to demersal invertebrates from the submarine export cables are de minimis, even under the maximum magnetic field strengths. Regarding the interarray cables, the findings determined risks associated with potential exposures to magnetic fields and induced electric fields are de minimis.

In addition, numerous studies of EMF emitted by subsea alternating current cables reported no interference with the movement or migration of fish or invertebrates (Hutchison et al. 2018; Love et al. 2017; Rein et al. 2013); no adverse or beneficial effect on any species was attributable to EMF (Snyder et al. 2019; Copping et al. 2016). A review of effects of EMF on marine species in established European offshore wind farms suggested that heat generated by electrified cables should be further investigated (Rein et al. 2013). Follow-up analysis of thermal effects of subsea cables on benthic species concluded that the effects were negligible because cables are relatively narrow, and the expected heat is expected to dissipate within the overlying sediment and armoring (Taormina et al. 2018; Emeana et al. 2016). Thermal gradients do not form above the buried cables because the overlying water is in constant motion. At the Block Island Wind Farm off the Rhode Island coast, buried subsea cables were determined to have no effect on Atlantic sturgeon or on any prey eaten by sturgeon, sea turtles, or whales (NOAA Fisheries 2015), which includes most fish and macroinvertebrates.

Given the data from operational wind projects, field experiments in Europe and the United States (Snyder et al. 2019; Kilfoyle et al. 2018; Taormina et al. 2018; Wyman et al. 2018; Love et al. 2017; Dunlop et al. 2016; Gill et al. 2014), modeling results of potential effects of EMF on fish and invertebrates in the Project Area, and Beacon Wind's commitment to cable burial. Studies performed on other submarine energized cables have been shown to not disturb populations of fish or invertebrates in offshore environments (Snyder et al. 2019). No adverse effect of existing subsea cables offshore or in state waters of New York has been demonstrated for any marine resource (Copping et al. 2016; NYSERDA 2017). Electric and magnetic fields generated by the buried export cables would be detectable by some benthic fish and invertebrates but would not adversely impact individuals or populations (Snyder et al. 2019).

Thermal Effects. Potential thermal effects associated with the Project HVAC and HVDC buried cables were evaluated to assess potential risks to the benthic community. The depth of the cables relative to the where benthic organisms reside and the estimated changes in surrounding sediment temperatures associated with the cables were considered.

The target burial depth of the HVAC interarray cables and the HVDC submarine export cables is 3 to 6 ft (0.9 to 1.8 m). Burial may not be feasible in a small number of instances (estimated to occur for 10% of the areas where the cables may be placed), in which case the cables will be surface laid and have rocks, rock bags, or concrete mattresses placed over them as cover protection. The depth of the cover protection material will be 5 ft (1.5 m). At the base of the wind turbines and the offshore substation facilities, the cables will be covered by 6.6 to 13 ft (2 to 4 m) of cover material used for scour protection prior to the cables being buried at their target depth.

Benthic organisms residing in the sediment bed (i.e., infaunal species) and at the sediment surface (i.e., epifaunal species) are not expected to be present at depth immediately adjacent to the buried cables where elevated temperatures may occur. While temperature is one environmental determinant of benthic community distribution (Hiscock et al. 2004; Emeana et al. 2016), others include availability of oxygen, levels of organic material (i.e., "organic carbon") and grain size (Thrush et al. 2003; Pratt et al. 2014; Soto et al. 2016; Hubler et al. 2016). Because oxygen and available organic carbon are typically limited to only the top inches of sediment, these factors are the primary determinants of the depth at which benthic organisms may reside. With respect to benthic organisms and the Project, comprehensive benthic community surveys have been performed for the Lease Area (MMT 2022a) and the HVDC submarine export cable corridors for both the Queens, New York and Waterford, Connecticut routes (MMT 2022b). Data from over 500 sample locations collected during this survey are comparable to other data for the continental shelf in showing that depth of biological activity is generally limited to the top 4 to 8 in (10 to 20 cm) (MMT 2022a, 2022b, USEPA 2015). With respect to grain size, the sediment of the Lease Area and cable corridors consist of a range of geological sediment types from clay and silt to coarser sand and pebbles, as well as biogenic sediment types (i.e., shell deposits). Overall, the predominant sediment types were sand (i.e., coarse unconsolidated substrate) and muddy sands (fine unconsolidated substrate) (MMT 2022a, 2022b).

Thermal tolerances of benthic organisms varies by species, but is generally assumed to span the range of seasonal temperature changes in the lower water column that occurs on the continental shelf of southern New England waters. Mountain (2020) found that seasonal range water temperatures across the Mid-Atlantic Bight shelf off the southeast coast of Long Island can vary by as much as 16.2 degrees Fahrenheit (°F) (9 degrees Celsius [°C]).

Heat emissions from buried cables can warm surrounding sediments, creating a thermal gradient that may extend up to tens of inches away from the cable (Taormina et al. 2018). The factors that determine the thermal gradient include the cable characteristics and transmission rate, as well as the characteristics of the surrounding sediments (e.g., ambient temperatures, permeability of sediments) (OSPAR Commission 2012; Emeana 2016). Temperatures at the surface of high voltage cables may reach approximately 160°F (70°C)[8] (Swaffield et al. 2008; Hughes et al. 2015). The use of high

[8]Based on an assumed conductor temperature of 194 degrees Fahrenheit (90 degrees Celsius).

voltages minimizes heat loss and HVDC cables generally exhibit lower heat emissions than do HVAC cables at equal transmission rates (Viking Link 2017; Taormina et al. 2018)

In open water, unburied cables have negligible effect, because water is a relatively poor conductor of heat and because water currents quickly dissipate heat (Viking Link 2017; Tetra Tech 2021). For buried cables, heat transfer can occur both by conduction (transfer of thermal energy through direct contact) and convection (transfer of thermal energy through the movement of a liquid) (Emeana et al. 2016). In continental shelf settings, finer-grained sediments associated with sand and mud are expected to exhibit both conductive heat transport and convective heat transport. In a laboratory experiment, Emeana et al. (2016) found that cable surface temperatures of 140°F (60°C) could result in an 18°F (10°C) change approximately 2.3ft (0.7 m) away from the cable in fine sands with medium permeability. Changes in temperature of 3.6°F (2°C)[9] occurred within 3.3 ft (1 m) within the same sediment.

In conclusion, the Project HVAC and HVDC buried cables at the target burial depth of 3 to 6 ft (0.9 to 1.8 m) are anticipated to result in *de minimis* risk to the benthic community that resides in the top 8 inches (20 cm) of sediment. Thermal gradients associated with the buried cables are expected to diminish to ambient conditions within 3.3 ft (1 m) or less. While this distance is larger than the shallowest proposed burial depth, when accounting for the thermal tolerance of benthic organisms and the cited range of bottom water temperatures in New England waters, the risk is anticipated to be de minimis. Risk is also anticipated to be *de minimis* in the relatively few instances where cables will be present at the surface and covered with rocks, rock bags or concrete mattresses as heat will rapidly dissipate in the water column.

5.5.2.3 *Summary of Potential Impacts to Benthic and Pelagic Habitats and Fish and Invertebrates from Operations and Maintenance*

The assemblages of demersal and pelagic fishes and invertebrate species in the Project Area may be minimally altered by the introduction and long-term presence of the wind turbine and offshore substation facilities foundations, although the alteration would not necessarily represent an adverse impact. Marine species assemblages are presently undergoing large regional shifts in response to changing ocean temperatures and fishing pressures, and predictions about future stable ecological states are highly uncertain.

The southern portion of the Project Area was observed to be fished by commercial fishermen for lobsters and based upon evidence of trawl scars in the Lease Area, the area is fished for groundfish and/or sea scallops and exhibited characteristics of a seafloor repeatedly disturbed by bottom fishing gear. The typical New Bedford scallop dredge homogenizes softbottom habitats as it stirs up and redistributes particles in the top layer of sediment. Overall, the dredges directly injure or kill nearly as many scallops as they harvest; crabs, gastropods, and soft-bodies invertebrates are also crushed or maimed, which leads to an increase in mobile scavenging species such as hermit crabs. Repeated dredging reduces biodiversity and degrades the area for future scallop recruitment (Stewart and Howarth 2016). Scallop dredging also results in injuries and mortality of non-target fish (bycatch), especially skates (Knotek et al. 2018). In a recent study, up to 63 percent of little skate discarded by scallop dredges died following release; winter skate fared only slightly better (45 percent mortality)

[9]The German Federal Agency of Nature Conservation has developed thermal guidelines for buried cables by recommending no more than a 2°C temperature elevation in seafloor sediments located 8 in (20 cm) below the surface to protect benthic organisms (Worzyk 2009).

(Knotek et al. 2018). Overall, commercial fisheries discarded about six times as many skates as their total landings, amounting to almost 73 million pounds (33 million kilograms) of skate discards in 2010 (NMFS 2013, as cited in Knotek et al. 2018). The one-time bottom disturbance associated with construction of the Project would be comparable to the scallop dredging and bottom trawling that has occurred repeatedly in the Project Area but would not represent a substantial incremental impact within the current disturbance regime.

Despite the bottom disturbance caused by other existing anthropogenic activities (e.g. anchoring, fishing trawls, and other gear), effects on populations or stocks of managed species are not generally considered substantial because the effects are limited to localized areas and a small number of individual organisms at any one time. For example, the MAFMC found no evidence that squid egg mops attached to benthic substrates were harmed by fishing activities (MAFMC 2011). NOAA Fisheries determined that intensive trawling (up to 81 vessels per month) in a single area had no adverse effect on squid (BOEM 2018). Within this context, the single disturbance of cable installation within narrow corridors would cause little harm to squid egg mops or other benthic resources. The long-lasting physical effects of bottom disturbance on benthic habitats and species assemblages is generally attributed to repeated disturbances that reinjure surviving individuals and interfere with settlement of colonizers (Hiddink et al. 2017; Kaiser et al. 2006). The one-time disturbance associated with the installation of foundations and cables would not harm populations of fish or invertebrates or prevent natural recovery of benthic habitat.

Benthic communities on the outer continental shelf in waters less than 262 ft (80 m) generally recover within a few weeks to two years after cable installation, depending on the available supply of sediment (Brooks et al. 2006). Recovery time varies somewhat with the method of installation, with more rapid recovery after plowing than jetting (Kraus and Carter 2018). Modeling of jet plow impacts for the Cape Wind project indicated that effects would be temporary, as benthic organisms would recolonize the jet-plowed trench within 38 days (BOEM 2018).

The analysis of impacts supports the overall determination that the Project would not result in substantial adverse impacts on demersal or pelagic life stages of fish or invertebrates; the impacts would be short-term and would not affect stocks or populations. The introduction of hard structures may benefit some species/life stages that require or prefer rugosity, including squid eggs, black sea bass, lobster, and edible crabs. Extensive acreage of the sand and gravelly sand softbottom habitat favored by surfclam, scallop, and ocean quahog would remain available for recruitment and development. Both adverse and beneficial effects would be largely reversible following decommissioning.

5.5.2.4 *Decommissioning*

Impacts during decommissioning are expected to be similar or less than those experienced during construction, as described in **Section 5.5.2.1**. It is important to note that advances in decommissioning methods/technologies are expected to occur throughout the operations of the Project. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities and potential impacts will be re-evaluated at that time.

Under 30 CFR 585.910, BOEM requires that infrastructure be fully removed or severed 15 ft (4.6 m) below the sediment surface; predictive ecosystem modeling indicates that the novel, benthic-pelagic coupling relationships established when the foundations were installed would be decoupled, returning regional connectivity parameters to pre-construction conditions (van der Molen et al. 2018). For additional information on the decommissioning activities that Beacon Wind anticipates will be needed for the Project, please see **Section 3 Project Description**.

5.5.3 Summary of Avoidance, Minimization, and Mitigation Measures

In order to mitigate the potential impact-producing factors described in **Section 5.5.2**, Beacon Wind is proposing to implement the following avoidance, minimization, and mitigation measures.

5.5.3.1 *Construction*

During construction, Beacon Wind will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in **Section 5.5.2.1**:

- Avoiding, to the extent possible, siting structures (wind turbines, offshore substation facilities, and submarine export cables) in areas of sensitive habitat, where feasible;
- Mitigation and avoidance measures to protect water quality, such as spill prevention;
- Sensitive lighting schemes to minimize exposure of marine organisms to artificial light;
- Soft-start, pre-clearance, and shut-down procedures implemented to minimize potential impacts associated with noise generating activities, where feasible, for an agreed upon duration;
- Where pile-driven foundations are selected, Beacon Wind will consider the potential use of commercially available noise reducing technologies, when technically feasible;
- Project-related vessels will operate in accordance with the laws regulating the at-sea discharges of vessel generated waste;
- Using appropriate measures for vessel operation and implementing an OSRP, which includes measures to prevent, detect, and contain accidental release of oil and other hazardous materials. Project personnel would be trained in accordance with relevant laws, regulations, and Project policies, as described in the OSRP; and
- Most construction vessels will maintain position using dynamic positioning, limiting the use of anchors and jack-up features, where feasible. Any anchors or jack-up features would be placed within the previously cleared and/or disturbed area around the foundations.

In addition, during construction, Beacon Wind will consider the following avoidance, minimization, and mitigation measures to mitigate the impacts described in **Section 5.5.2.1**:

- Using HDD at landfalls in Queens, New York at the Astoria power complex and in Waterford, Connecticut at the Waterford power complex to minimize physical disturbance of coastal habitats; Beacon Wind would implement appropriate measures during HDD activities at the landfalls to minimize potential release of HDD fluid. To minimize an inadvertent fluid return, an HDD Contingency Plan would be developed and implemented;
- Using appropriate measures and timing during cable installation activities to minimize sediment resuspension and dispersal in areas of known historically contaminated sediments; and
- Consideration the timing of construction activities; working with the fishing industry and fisheries agencies on sensitive spawning and fishing periods to actively avoid or reduce interaction with receptors, where feasible.

5.5.3.2 Operations and Maintenance

During operations, Beacon Wind will commit to the following avoidance, minimization, and mitigation, measures to mitigate the impacts described in **Section 5.5.2.2**:

- Sensitive lighting schemes on wind turbines and offshore substation facilities to minimize exposure of marine organisms to artificial light;

- A commitment to sufficiently bury electrical cables where feasible, minimizing seabed habitat loss and reducing the effects of EMF; where deep burial is not technically feasible, rock armoring will shield the cable from the overlying water;
- Implementation of an agency-reviewed OSRP;
- Installation of scour protection, as needed; and
- Development of appropriate monitoring program(s) in close coordination with regulatory agencies and stakeholders, for example.

As indicated in the list of measures above, Beacon Wind proposes to monitor select benthic, finfish, and/or invertebrate resources to clarify baseline conditions and reduce uncertainty in assessing changes in distribution or abundance of resources within the context of climate change and other large-scale regional variables. During the COP review process, Beacon Wind will work with regulatory agencies and stakeholders in developing appropriate program(s).

5.5.3.3 *Decommissioning*

Avoidance, minimization, and mitigation measures proposed to be implemented during decommissioning are expected to be similar to those implemented during construction and operations, as described in **Section 5.5.3.1** and **Section 5.5.3.2**. A full decommissioning plan will be submitted for approval to BOEM prior to any decommissioning activities, and avoidance, minimization, and mitigation measures for decommissioning activities will be proposed at that time.

5.5.4 References

TABLE 5.5-26. SUMMARY OF DATA SOURCES

Source	Includes	Available at	Metadata Link
BOEM	Lease Area	https://www.boem.gov/BOEM-Renewable-Energy-Geodatabase.zip	N/A
BOEM	State Territorial Waters Boundary	https://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/ATL_SLA(3).aspx	http://metadata.boem.gov/geospatial/OCS_SubmergedLandsActBoundary_Atlantic_NAD83.xml
CTDEEP	Connecticut Blue Plan Data	https://storymaps.arcgis.com/stories/3bfc4facab2047db8ed794d6dcd264cc	N/A
NOAA NCEI	Sand and Gravel Borrow Area	http://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/Federal-Sand-n-Gravel-Lease-Borrow-Areas_gdb.aspx	https://mmis.doi.gov/boemmmis/metadata/PlanningAndAdministration/LeaseAreas.xml
NOAA NCEI	Aliquots with Sand Resources	https://www.boem.gov/Sand-Aliquots-Shapfile/	https://mmis.doi.gov/boemmmis/metadata/PlanningAndAdministration/ATLSandAliquots.xml
NOAA Fisheries	Recreational Diving Reef	ftp://ftp.coast.noaa.gov/pub/MSP/ArtificialReefs.zip	https://inport.nmfs.noaa.gov/inport/item/54191

Source	Includes	Available at	Metadata Link
NOAA Fisheries	Dredged Material Disposal Site	ftp://ftp.coast.noaa.gov/pub/MSP/OceanDisposalSites.zip	https://inport.nmfs.noaa.gov/inport/item/54193
NOAA Fisheries	Atlantic Sturgeon Critical Habitat	https://www.fisheries.noaa.gov/webdam/download/91216948	https://www.fisheries.noaa.gov/webdam/download/92900513
NOAA Fisheries	Surfclam/ Quahog Totals	https://www.nefsc.noaa.gov/femad/ecosurvey/mainpage/rsr/clam-rsr-2018.pdf	N/A
NOAA NCEI	Bathymetry	https://www.ngdc.noaa.gov/mgg/coastal/crm.html	N/A
Northeast Ocean Data	Shellfish Management Area	http://www.northeastoceandata.org/files/metadata/Themes/Aquaculture.zip	http://www.northeastoceandata.org/files/metadata/Themes/Aquaculture/ShellfishManagementAreas.pdf
NY OPDGIG	Recreational Diving Wreck	https://opdgig.dos.ny.gov/	http://opdgig.dos.ny.gov/geoportal/catalog/search/resource/detailsnoheader.page?uuid={4990846B-A419-486B-AA9F-A7D770382832}
NYSDEC	Statewide Seagrass Map	https://www.arcgis.com/home/webmap/viewer.html?webmap=12ba9d56b75d497a84a36f94180bb5efextent=-74.6987,39.852,-71.315,41.7603	N/A
USACE	USACE Benthic Samples	https://www.nan.usace.army.mil/Portals/37/docs/harbor/Biological%20&%20Physical%20Monitoring/Benthic/2006%20Harborwide%20Benthos%20Report.pdf	N/A
USGS	Stellwagen Bank Seafloor Imagery	https://cmgds.marine.usgs.gov/data/field-activity-data/2017-043-FA/data/imagery/2017-043-FA_SeabedImages.zip	https://cmgds.marine.usgs.gov/data/field-activity-data/2017-043-FA/data/logs/2017-043-FA_log.zip

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5.6 Marine Mammals

This section describes the marine mammal (whales, dolphins, porpoise, and seals) species known to be present, traverse, and/or incidentally occur in the waters within and surrounding the Project Area. The Project Area includes the offshore Lease Area, as well as waters adjacent to the submarine export cable routes (**Figure 5.6-1)**. Potential impacts to marine mammals resulting from construction, operations, and decommissioning of the Project are discussed in **Section 5.6.2**. Proposed Project-specific measures adopted by Beacon Wind as a result of engagement and following recommended best management practices are also described, which are intended to avoid, minimize, and/or mitigate potential impacts to marine mammals are also described, see **Section 5.6.3**.

Other assessments within this COP that provide information relevant to marine mammals include the following:

- Underwater Acoustic Environment (**Section 4.4.2**);
- Water Quality (**Section 4.2**);
- Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat (**Section 5.5**);
- Sea Turtles (**Section 5.7**);
- Underwater Acoustic Assessment (**Appendix L**).
- Ornithological and Marine Fauna Aerial Survey – APEM Studies (**Appendix O**)
- Benthic Resources Characterization Reports and Mapbooks (**Appendix S**); and
- Essential Fish Habitat Technical Report (**Appendix T**).

Data Relied Upon and Studies Completed

For the purposes of this section, the Study Area includes the offshore waters and coastlines within the vicinity of the Lease Area, as well as the submarine export cable routes, and vessel routes where Project vessels are expected to traverse in the vicinity of the Lease Area (**Figure 5.6-1**).

In accordance with BOEM’s site characterization requirements in 30 CFR § 585.626(3) and BOEM’s *Guidelines for Providing Information on Marine Mammals and Sea Turtles for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 Subpart F* (Marine Mammal and Sea Turtle Guidelines; BOEM 2019), this section relies on several sources of data and information in the assessment of marine mammals that may be present in the Project Area. These include regionally specific and Beacon Wind–led focused studies including the following (with additional details following):

- Avian site-specific aerial surveys by Beacon Wind that included marine mammal data (Appendix O Ornithological and Marine Fauna Aerial Survey – APEM Studies);
- Protected Species Observers (PSO) marine wildlife data collected during Beacon Wind 2020 and 2021 High-Resolution Geophysical Surveys;
- Cetacean and Turtle Assessment Program (CeTAP) Surveys from 1979 to 1982 (CeTAP 1981, 1982);
- New England Aquarium aerial and acoustic surveys of whales and turtles in the Massachusetts WEA conducted since 2011 for the Massachusetts Clean Energy Center (MassCEC) and BOEM (Kraus et al. 2013, 2014, 2016; Quintana et al. 2019; O’Brien et al. 2020, 2021a, b);
- NOAA Fisheries surveys:

  - North Atlantic Right Whale Sighting Surveys (NARWSS) aerial surveys since 2002 from New Jersey to Canada (Cole et al. 2007; Gatzke et al. 2017; Khan et al. 2018).
  - National Marine Fisheries Service-Southeast Fisheries Science Center (NOAA-SEFSC) conducted the Mid-Atlantic Tursiops Surveys (MATS) for bottlenose dolphins (*Tursiops truncatus*) in nearshore waters of the U.S. east coast. During the summer of 1994, NOAA-SEFSC conducted a pilot study which consisted of an aerial survey to count the bottlenose dolphins along the shoreline and a line transect aerial survey from Long Island, New York, to Vero Beach, Florida (Blaylock 1995). During the following summer, a line-transect aerial survey from Sandy Hook, New Jersey, to Cape Hatteras, North Carolina from the shoreline to the 82-foot [ft] (25-meter [m]) isobath (around 0 to 81 km [0 to 44 nm] was conducted from shore; (Garrison and Yeung 2001). The MATS surveys flown during the summer (June through July) of 2002 covered coastal waters between Sandy Hook, New Jersey, and Ft. Pierce, Florida (Waring et al. 2009). Additional surveys were flown in the summer of 2004 between Atlantic City, New Jersey, and Fort Myers, Florida (Fertl and Fulling 2007).
  - Atlantic Marine Assessment Program for Protected Species (AMAPPS) surveys conducted seasonally from Massachusetts to the Florida Keys since 2010 (NEFSC and Southeast Fisheries Science Center [SEFSC] 2013, 2014, 2015, 2016, 2018, 2019, 2020, 2021; Palka et al. 2017).
- Northeast Large Pelagic Survey Collaborative (NPLSC) surveys from 2011 to 2015 (Kraus et al. 2016; Leiter et al. 2017; Stone et al. 2017), a partnership between the New England Aquarium, the Center for Coastal Studies, the University of Rhode Island, and Cornell University;
- New York State Department of Environmental Conservation (NYSDEC) Division of Marine Resources surveys:
  - Aerial surveys conducted by Tetra Tech and LGL from March 2017 through February 2020 (Tetra Tech and LGL 2019, 2020; Tetra Tech and SES 2018);
  - Center for Conservation Bioacoustics at Cornell University's Cornell Lab of Ornithology’s passive acoustic survey for large whales in the New York Bight (Eastbrook et al. 2019, 2020).
- New York State Energy Research and Development Authority (NYSERDA):
  - Aerial Baseline Surveys of Marine Wildlife in Support of Offshore Wind Energy (Normandeau Associates Inc. and APEM Ltd. 2020).
  - Marine Mammals and Sea Turtle Study (NYSERDA 2017).
- New York State Department of State (NYSDOS) Offshore Atlantic Ocean Study (NYDOS 2013);
- Rhode Island Ocean Special Area Management Plan marine mammal study, which includes Narragansett Bay, Rhode Island Sound, Block Island Sound, and adjacent continental shelf waters out to about the 50-m isobath (Kenney and Vigness-Raposa 2010);
- Bureau of Ocean Energy Managements (BOEM) Risk Assessment to Model Encounter Rates Between Large Whales and Vessel Traffic from Offshore Wind Energy on the Atlantic OCS (Barkaszi et al. 2021; Malhorta et al. 2021);
- Vineyard Wind, LLC (Vineyard Wind 1) 2020 offshore geophysical survey campaign offshore of Massachusetts (Vineyard Wind 2021);

- Woods Hole Oceanographic Institution (WHOI) and Wildlife Conservation Society (WCS) Autonomous Real-time Marine Mammal Detections Moored Buoys and Gliders (WHOI 2021); and Ecosystem and Passive Acoustic Monitoring (ECO-PAM):
  - New York Bight Buoy Southeast and New York Bight Buoy Northwest deployed outside of New York Harbor in June 2016 (WHOI 2021).
  - Martha's Vineyard Buoy deployed 20 mi southwest of Martha's Vineyard, Massachusetts in July 2020 (Baumgartner and Lin 2019; Baumgartner et al. 2019; WHOI 2021).
  - Cox Ledge - Slocum G3 glider was deployed March 2021 near Cox Ledge just south of the Rhode Island/Massachusetts WEA (WHOI 2021).

Beacon Wind supported the collection of Project-specific digital camera aerial survey sightings data and vessel-based visual sighting data that encompassed the Lease Area plus an approximate 1-nm (2.0-km) buffer around the Lease Area. Images were captured using a grid-based survey design with a 0.59-in (1.5-cm) ground sampling distance (GSD). Images were analyzed by APEM, Inc. and quality assurances (QA) were undertaken by Normandeau Associates, Inc. (**Appendix O Ornithological and Marine Fauna Aerial Survey – APEM Studies**). The aerial surveys were conducted monthly over the course of a year, from October 2019 to October 2020, and recorded sightings of avian, marine mammal, sea turtle, and other species, including sharks, rays, and large fish assemblages were logged. The digital camera aerial data collected by Beacon Wind is intended to supplement the data collected by other entities, including the aerial survey data collected from the above-mentioned references. Sighting data from these aerial surveys were organized by general categorical regions, defined as follows:

- Lease Area (sightings occurring in the Lease Area);
- Lease Area 1.2 mi (2 km) buffer (sightings around the Lease Area in this buffer zone);
- Submarine export cable siting corridor (sighting occurred along the submarine export cable routes, within a corridor 1,640 ft [500 m] wide in state waters or 3,280 ft [1,000 m] wide in federal waters);
- Nearshore (sightings fell outside of the Project Area and within state waters [within the 3-nm [5.6-km] limit from the coast]); and
- Offshore (sightings fell outside of the Project Area in federal waters [outside the 3 nm {5.6 km} limit from the coast]).

As part of Beacon Wind’s marine site characterization surveys, including HRG and geotechnical surveys, in the area of Commercial Leases of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS)-A 0520 and OCS-A 0512 (Lease Areas) and along potential submarine export cable routes offshore New York, Rhode Island, Massachusetts, and New Jersey in 2020 and 2021, vessel-based monitoring for marine mammals was conducted in conjunction with survey activities as specified in the Incidental Harassment Authorization (IHA) issued to Equinor Wind by NOAA Fisheries in September 2020 (85 FR 60424; RPS 2020).

The PSO visual sightings data (and some Passive Acoustic Monitoring [PAM] acoustic detection data) specific to the Project Area were also collected during these Project-related vessel-based surveys conducted in 2020 and 2021. The sightings data are summarized in **Table 5.6-1** (aerial survey digital imagery data) and **Table 5.6-2** (PSO visual sighting data). While a low total of baleen whales were observed during the APEM survey effort, the survey spanned an entire year with some months (April, May, August, September) having more than one survey undertaken. Therefore, the survey ensured completion in all seasons to allow for the coverage of those time periods when certain species are predicted to be present in the Lease Area.

TABLE 5.6-1. AERIAL SURVEY SIGHTINGS DATA SUMMARY

Species (Common Name)	Lease Area	Lease Area 1 nm (2 km) Buffer
Atlantic white-sided dolphin	0	1
Beaked whale (unid.)	0	1
Bottlenose dolphin	4	0
Common dolphin	74	47
Dolphin species (unid.)	37	11
Fin whale	1	0
Gray seal	6	3
Harbor porpoise	30	36
Harbor seal	1	0
Humpback whale	1	0
Marine mammal (unid.)	13	5
Minke whale	3	5
Seal species (unid.)	31	11

Note:
The digital camera aerial data collected by Beacon Wind (Appendix O) are limited to 1 nm (2 km) around the Lease Area.
Sources: APEM and Normandeau Associates 2019 and 2020; **Appendix O Ornithological and Marine Fauna Aerial Survey – APEM Studies.**

TABLE 5.6-2. PSO REPORT SIGHTING DATA SUMMARY

Species (Common Name)	Lease Area	Lease Area 1 nm (2 km) buffer	Submarine Export Cable Siting Corridor	Nearshore	Offshore
Atlantic white-sided dolphin	20	0	0	0	0
Bottlenose dolphin	122	0	0	0	0
Common dolphin	4,489	504	246	50	65
Dolphin species (unid.)	977	80	36	0	142
Fin whale	16	6	0	0	2
Gray seal	8	2	5	4	2
Harbor seal	1	0	4	5	3
Humpback whale	72	4	7	1	29
Marine mammal (unid.)	1	0	0	0	0
Minke whale	28	3	2	0	10
North Atlantic right whale	140	14	0	0	0
Seal species (unid.)	5	0	0	4	1
Sei whale	7	3	0	0	0
Whale (unid.)	37	17	7	0	16
White-beaked dolphin	35	0	0	0	0

Sources: Geoquip 2020, Marine Ventures 2020a-e and 2021a-m-

Additional data sources come from the 2022 Duke University Marine Geospatial Ecology Lab (MGEL) developed habitat-based cetacean density models for the U.S. EEZ of the U.S. East Coast and Gulf of Mexico (Roberts and Halpin 2022). MGEL updated these models in 2022 to include additional survey data utilizing over 2.8 million linear kilometers of survey effort collected between 1992-2020, yielding new absolute density maps for 31 taxa and includes the version 12 model for North Atlantic right whale, serving as a complete replacement for the Roberts et al. 2016 models and subsequent updates The 2022 updated North Atlantic right whale model (v12) provides model predictions for three eras, 2003–2020, 2003–2009, and 2010–2020, to reflect the apparent shift in NARW distribution around 2010. Additional details on the base-layer models and summary products can be found in the MDAT Technical Report (Curtice et al. 2019) and until the new journal manuscript in support of the 2022 MGEL data is available, the Roberts et. al. 2016 paper provides a general overview of the effort and methods used.

In 2014, BOEM prepared a revised environmental assessment, Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts, Revised Environmental Assessment, which included an assessment of marine mammal occurrence within potential lease areas (BOEM 2014).

From 2019–2020, a regional stakeholder engagement process was sponsored by NYSERDA, MassCEC, and the U.S. Department of the Interior's BOEM, which resulted in the establishment of the Regional Wildlife Science Collaborative Entity (RWSC). The mission of RWSC is to coordinate regional wildlife monitoring and research that "supports the advancement of environmentally responsible and cost-efficient offshore wind power development activities in U.S. Atlantic waters" (Cadmus and CBI Catalyzing Collaboration 2020). Regional data sharing and collaboration is further facilitated by the Northeast and Mid-Atlantic Ocean Data Portals (run by the Northeast Regional Ocean Council, NROC, and the Mid-Atlantic Regional Council on the Ocean, MARCO). Ocean planning data including habitat-based marine mammal density models for the Atlantic OCS can be found at these portals (MARCO 2021; NROC 2021). The portals include data from state and federal agencies, scientists, ocean industries, non-government organizations, and other entities in the Northeast and Mid-Atlantic regions. Collectively, the data derived from these portals are, as determined by NOAA Fisheries, to be the best information currently available for marine mammal densities in U.S. Atlantic waters.

Other data sources include the NOAA Fisheries aerial and vessel-based surveys (AMAPPS I and II), and its associated PAM studies for marine mammals and/or sea turtles along the East Coast of the U.S. For several decades, NOAA Fisheries have been conducting systematic aerial or vessel-based surveys and passive acoustic monitoring studies known as the AMAPPS surveys (NOAA Fisheries 2017a and 2019a). Older published reports such as the Cetacean and Turtles Assessment Program (CETAP 1982) are also included. on these species-specific details are described in the **Section 5.6.1 Affected Environment**. In addition, average densities for common marine mammals that may occur in the Study Area are provided in **Table 5.6-3**. Seasonal densities are included where these data are available.

Numerous papers cited include general regional overviews (e.g., Davis et al. 2017; Stone et al. 2017) and sources specific to the more precise Project Area waters of New York were evaluated, such as DiGiovanni and DePerte 2013, Whitt et al. 2013 and 2015, Ecology and Environment Engineering 2017, and Muirhead et al. 2018. Findings from multiple surveys in the Study Area indicate marine mammals may occur in the Project Area during all seasons; this includes data from the multiple-entity aerial surveys, which found that some species of large whales occur in the Lease Area during all seasons. Multiple studies or published findings show other marine mammals, such as dolphins or pinnipeds, have been documented to occur in and around the Lease Area and submarine export cable routes, generally with seasonal rather that year-round presence. More information on these species-specific details is described in the **Section 5.6.1 Affected Environment**.

In the Study Area site-specific aerial surveys conducted by Beacon Wind found minke whale sightings accounted for 80 percent of the whale observations (**Appendix O Ornithological and Marine Fauna Aerial Survey – APEM Studies**). From PSO reporting, Beacon Wind found North Atlantic right whale sightings accounted for 44 percent followed by humpback whales accounting for 32 percent of the whale observations in the Study Area. Though rates varied seasonally, both of these species occurred year-round. A digital acoustic monitoring (DMON) moored buoy deployed in 2021 off Martha's Vineyard, Massachusetts detected the acoustic presence of four whale species (right, fin, sei, and humpback whales), but no minke or blue whales (WHOI 2021). Fin whales were the only species detected in every month of the year. By contrast, corresponding PAM in the Mid-Atlantic region indicated the presence of six focal study species (right, fin, sei, blue, humpback, and minke whales). Right whales, fin whales, and humpback whales were detected every month of the year (Eastbrook et al. 2019, 2020).

In addition, this section relies on publicly available information (including existing literature and reporting on sightings, such as from newspaper or other historical accounts), NOAA Fisheries Stock Assessment Reports (Hayes et al. 2018, 2019, 2020), scientific publications or technical reports, and geospatial sighting information retrieved from the Ocean Biodiversity Information System (OBIS) datasets (**Figure 5.6-2**) (Roberts et al. 2016a, 2016b, 2017, 2018, 2020, 2021, Roberts and Halpin 2022). The compendium of data sources utilized included both general North Atlantic sources (to account for marine mammal mobility and distribution and abundance trends) as well as reports highly specific to the MA/RI WEA for marine mammal data collection efforts. Average densities for common marine mammals that may occur in the Study Area are provided in **Table 5.6-3**. Seasonal densities are included where these data are available.

TABLE 5.6-3. AVERAGE SEASONAL DENSITY SUMMARY FOR MARINE MAMMAL SPECIES CONSIDERED COMMON IN THE STUDY AREA (2010-2019 [2020])

Species	Annual	Winter	Spring	Summer	Fall
Atlantic spotted dolphin	0.0118	0.0009	0.0011	0.0048	0.0403
Atlantic white-sided dolphin	0.229	0.2417	0.2392	0.2015	0.2336
Bottlenose dolphin	0.1386	0.0801	0.0512	0.2211	0.2021
Common dolphin	1.3289	1.0064	0.5251	1.4473	2.3369
Harbor porpoise	0.6705	1.2611	1.1412	0.1431	0.1364
Pilot whales b/	0.0261	0.0261	0.0261	0.0261	0.0261
Risso's dolphin	0.0107	0.0109	0.0048	0.0105	0.0165
Minke whale	0.0761	0.0164	0.1341	0.1133	0.0407
North Atlantic right whale	0.0323	0.0607	0.0563	0.0046	0.0077
Humpback whale	0.0201	0.0086	0.0226	0.0234	0.0257
Fin whale	0.0274	0.0245	0.027	0.0426	0.0155
Seals c/	2.8954	3.9999	3.5178	2.1378	1.9259
Sei Whale	0.0082	0.0071	0.016	0.0031	0.0065
Sperm Whale	0.004	0.0027	0.0014	0.0068	0.0049

Notes: Density summary per season are provided in number of individuals per 9.7 mi^2 (25 km^2).

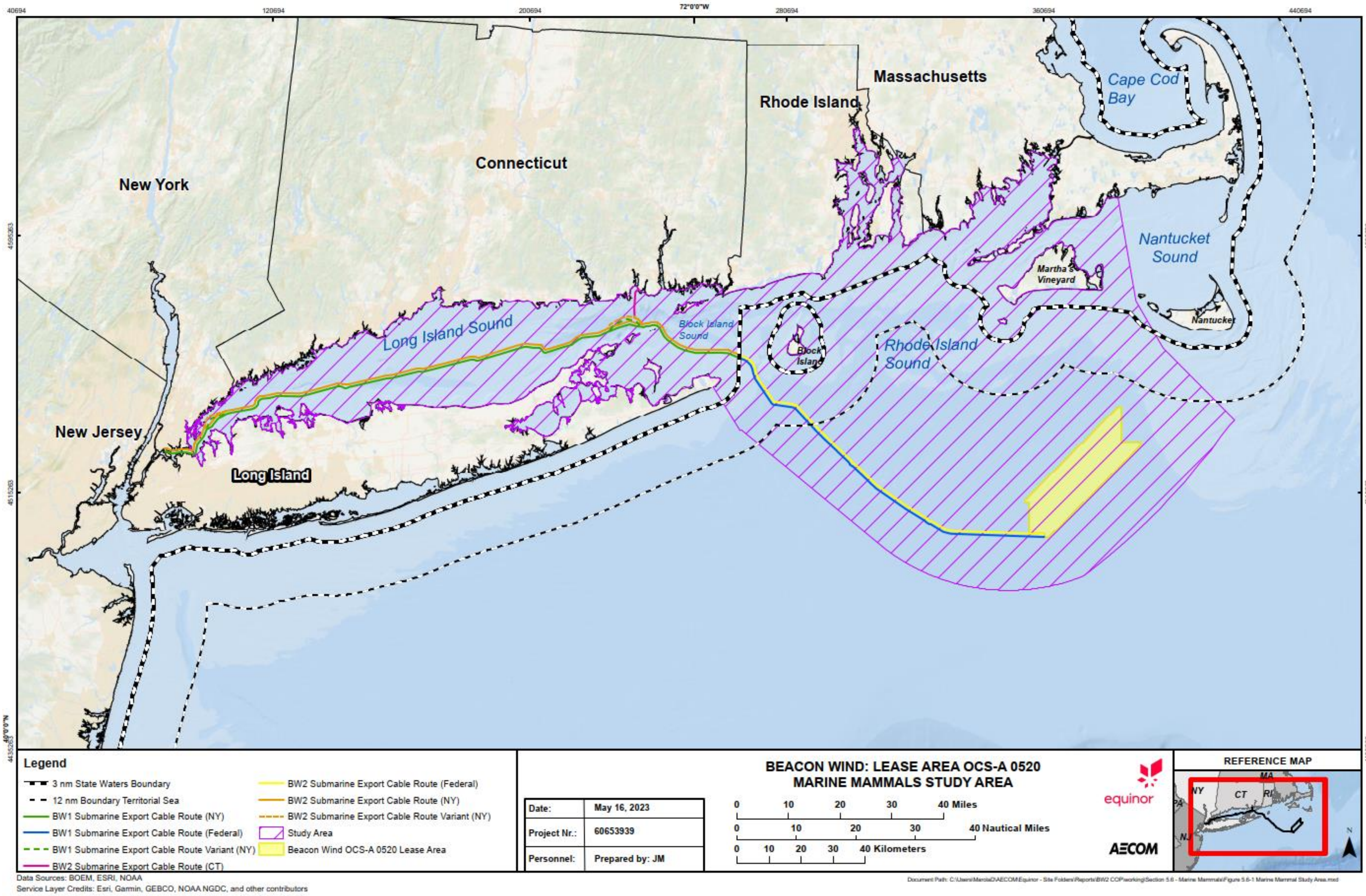
a/ Study Area entails the smaller Project Area and includes the entirety of Long Island Sound and the northern coastline extending east to Mashpee, Massachusetts and a buffer around the Lease Area that accounts for Project activities and vessel traffic in the vicinity of the submarine export cable routes and Lease Area.

b/ Density determined on annual data as seasonal density not available for pilot whales.

c/ Seals: This category reflects pooled data from sightings of both harbor seals and gray seals. A minimum number of detections are necessary in order to derive the detection function uses in the density formula that informs these values. Since sighting data of seals in the Study Area per species was limited data were pooled. This is standard line transect practice for similar species with limited sightings.

Source: Roberts and Halpin. 2022.

FIGURE 5.6-1. PROJECT AND STUDY AREA



5.6.1 Affected Environment

The affected environment is defined as the coastal and offshore areas where marine mammals are known to be present, traverse, or incidentally occur and have the potential to be directly or indirectly affected by the construction, operations, and decommissioning of the Project. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Beacon Wind expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Beacon Wind will comply with in using the facilities.

Regulatory Context

Marine mammal species are protected under the MMPA (50 CFR § 216) as amended in 1994. Within the framework of the MMPA, marine mammal populations are further defined into a "stock", which is defined as "a group of marine mammals of the same species or smaller taxa in a common spatial arrangement that interbreed when mature" (16 U.S.C. § 1362). The MMPA prohibits the "take" of marine mammals, which is defined under the MMPA as the harassment, hunting, or capturing of marine mammals, or the attempt thereof. "Harassment" is further defined as any act of pursuit, annoyance, or torment, and is classified as Level A (potentially injurious to a marine mammal stock in the wild) and Level B (potentially disturbing a marine mammal or marine mammal stock in the wild by causing disruption to behavioral patterns). Some marine mammal stocks may be designated as strategic under the MMPA, which may require the jurisdictional agency (NOAA Fisheries for marine mammal species under consideration in this COP) to impose additional protective measures.

In addition, some marine mammal species found in U.S. waters are listed and protected under the ESA (16 U.S.C. § 1361). The ESA protects endangered and threatened species and their habitats by prohibiting the take of listed animals. Under the ESA, to "take" a listed endangered or threatened species is to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The regulations also define harm as an act that kills or injures wildlife.

5.6.1.1 *Occurrence in the Study Area*

In 2014, BOEM prepared a revised environmental assessment, which included an assessment of marine mammal occurrence within potential lease areas (BOEM 2014). The Environmental Assessment (BOEM 2014) reports 39 species of marine mammals (whales, dolphins, porpoise, seals, and manatee) in the Northwest Atlantic OCS region of the mid-Atlantic that are protected by the MMPA, five of which are listed under the ESA and are known to be present, at least seasonally, in the Lease Area and along the submarine export cable routes (see **Table 5.6-4**, **Figure 5.6-2**). There is no critical habitat for any marine mammal species in the Study Area.

The five whale species listed as endangered under the ESA and meeting one or more criteria for listing of Strategic under the MMPA that may occur or are expected or likely to occur in or transit near the Lease Area and submarine export cable routes include:

- Fin whale (Balaenoptera physalus);
- Sei whale (Balaenoptera borealis);
- Blue whale (Balaenoptera musculus);
- North Atlantic right whale (Eubalaena glacialis); and
- Sperm whale (Physeter macrocephalus).

Thirty-nine species of marine mammals occur in Atlantic OCS waters. Those that have been documented in or near the Lease Area and submarine export cable routes are shown in **Table 5.6-4**. The likelihood of occurrence of each species/species group in the Study Area is defined as follows:

- Common – occurring consistently in moderate to large numbers;
- Regular – occurring regularly, inhabitants at least seasonally and have been documented within the Lease Area and submarine export cable routes;
- Uncommon – occurring in low numbers or on an irregular basis;
- Rare – records for some years but limited; and
- Not expected – range includes the Lease Area and submarine export cable routes but due to habitat preferences and distribution information, species are not expected to occur in the Lease Area and submarine export cable routes although records may exist for adjacent waters.

Status, stock identification, abundance, and seasonal or annual occurrence of these species are listed in **Table 5.6-4** and each species and stock are discussed in detail in **Section 5.6.1.2 Species Overview**. Seasonal occurrence is broken up by seasons: winter (December - February), spring (March - May), summer (June - August), and fall (September - November) (**Figure 5.6-2**).

TABLE 5.6-4. MARINE MAMMALS KNOWN TO OCCUR IN OR NEAR THE STUDY AREA FOR THE LEASE AREA AND SUBMARINE EXPORT CABLE ROUTES

Common Name (Species Name)	Stock	Regulatory/ Federal Status; Strategic (Y = Yes)	CT Status	MA Status	NY Status	RI Status	Stock Abundance	Known Study Area Distribution	Likelihood of Occurrence in Study Area	Seasonal Occurrence in Study Area
Mysticetes										
North Atlantic right whale (*Eubalaena glacialis*)	W. North Atlantic	MMPA, ESA; E; Y	N/A	E	E	SGCN	368	Coastal to continental shelf	Common	Winter and spring
Humpback whale (*Megaptera novaeangliae*)	Gulf of Maine	MMPA; N	N/A	E	E	SGCN	1,396	Coastal to continental shelf	Common	Year-round
Fin whale (*Balaenoptera physalus physalus*)	W. North Atlantic	MMPA, ESA; E; Y	N/A	E	E	SGCN	6,802	Coastal to continental shelf	Common	Year-round
Sei whale (*Balaenoptera borealis borealis*)	Nova Scotia	MMPA, ESA; E; Y	N/A	E	E	N/A	6,292	Continental shelf	Common	Spring and summer
Minke whale (*Balaenoptera acutorostrata acutorostrata*)	Canadian East Coast	MMPA	N/A	N/A	N/A	N/A	21,968	Continental shelf	Common	Spring, summer, and fall
Blue whale (*Balaenoptera musculus musculus*)	W. North Atlantic	MMPA, ESA; E; Y	N/A	E	E	N/A	Unknown (402 min)	Deep water beyond the continental shelf	Rare	N/A
Odontocetes										
Sperm whale (*Physeter macrocephalus*)	North Atlantic	MMPA, ESA; E; Y	N/A	E	E	N/A	4,349	Continental shelf break and offshore	Uncommon	Summer and fall

Common Name (Species Name)	Stock	Regulatory/ Federal Status; Strategic (Y = Yes)	CT Status	MA Status	NY Status	RI Status	Stock Abundance	Known Study Area Distribution	Likelihood of Occurrence in Study Area	Seasonal Occurrence in Study Area
Dwarf and pygmy sperm whale *(Kogia sima* and *Kogia breviceps*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	7,750	Offshore	Rare	N/A
Risso's dolphin (*Grampus griseus*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	35,215	Offshore	Uncommon	Year-round
Pilot whale, long-finned (*Globicephalus melas*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	39,215	Continental shelf	Uncommon	Year-round
Pilot whale, short-finned (*Globicephalus macrorhynchus*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	28,924	Offshore	Rare	N/A
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	93,233	Continental shelf	Common	Year-round
Common dolphin (*Delphinus delphis delphis*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	172,974	Coastal and offshore	Common	Year-round
Bottlenose dolphin (*Tursiops truncatus truncatus*)	W. North Atlantic, Offshore	MMPA	N/A	N/A	N/A	N/A	62,851	Offshore	Common	Year-round
Bottlenose dolphin (*Tursiops truncatus truncatus*)	W. North Atlantic, Northern Coastal Migratory	MMPA; Y	N/A	N/A	N/A	N/A	6,639	Coastal, bays, inlets, and offshore	Common	Year-Round
Atlantic spotted dolphin (*Stenella frontalis*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	39,921	Deep slope water and offshore	Uncommon	Year-round

Common Name (Species Name)	Stock	Regulatory/ Federal Status; Strategic (Y = Yes)	CT Status	MA Status	NY Status	RI Status	Stock Abundance	Known Study Area Distribution	Likelihood of Occurrence in Study Area	Seasonal Occurrence in Study Area
Harbor porpoise (*Phocoena phocoena*)	Gulf of Maine/ Bay of Fundy	MMPA	SC	N/A	SC	SGCN	95,543	Coastal to continental shelf	Common	Yea-round
Cuvier's beaked whale (*Ziphius cavirostris*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	5,744	DOW	Rare	N/A
Blainville's, Gervais', True's, and Sowerby's Beaked Whales (*Mesoplodon densitostris, M. europaeus, M. mirus*, and *M. bidens*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	10,107	DOW	Rare	N/A
Striped dolphin (*Stenella coeruleoalba*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	67,036	Offshore	Rare	N/A
Clymene dolphin (*Stenella clymene*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	4,237	DOW	Rare	N/A
Fraser's dolphin (*Lagenodelphis hosei*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	Unknown	DOW	Rare	N/A
Pantropical spotted dolphin (*Stenella attenuata*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	6,593	Deep slope water and offshore	Rare	N/A
Rough-toothed dolphin (*Steno bredanensis*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	136	DOW	Rare	N/A
Spinner dolphin (*Stenella longirostris*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	4,102	DOW	Rare	N/A
White-beaked dolphin (*Lagenorhynchus albirostris*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	536,016	Continental shelf	Rare	N/A

Common Name (Species Name)	Stock	Regulatory/ Federal Status; Strategic (Y = Yes)	CT Status	MA Status	NY Status	RI Status	Stock Abundance	Known Study Area Distribution	Likelihood of Occurrence in Study Area	Seasonal Occurrence in Study Area
Killer whale (*Orcinus orca*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	Unknown	Continental shelf and rise; Open sea and offshore waters	Rare	N/A
Pygmy killer whale (*Feresa attenuata*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	Unknown	DOW	Rare	N/A
False killer whale (*Pseudorca crassidens*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	1,791	DOW	Rare	N/A
Northern bottlenose whale (*Hyperoodon ampullatus*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	Unknown	DOW	Rare	N/A
Melon-headed whale (*Peponocephala electra*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	Unknown	DOW	Rare	N/A
Pinnipeds										
Harbor seal (*Phoca vitulina vitulina*)	W. North Atlantic	MMPA	N/A	N/A	N/A	SGCN	61,336	Coastal, bays, estuaries, inlets	Common	Year-round
Gray seal (*Halichoerus grypus atlantica*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	27,300	Coastal and continental shelf waters	Common	Year-round
Harp seal (*Pagophilus groenlandicus*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	7.6 million	Continental shelf with pack ice	Uncommon	Winter and spring

Common Name (Species Name)	Stock	Regulatory/ Federal Status; Strategic (Y = Yes)	CT Status	MA Status	NY Status	RI Status	Stock Abundance	Known Study Area Distribution	Likelihood of Occurrence in Study Area	Seasonal Occurrence in Study Area
Hooded seal (*Phoca groenlandica*)	W. North Atlantic	MMPA	N/A	N/A	N/A	N/A	Unknown	DOW at edge of continental shelf with pack ice	Rare	N/A

Notes:

CT = Connecticut; DOW = deep ocean water; E = Endangered; ESA = Endangered Species Act; F = Federal; M / SI = Mortality / Serious Injury; MA = Massachusetts; min = minimum; MMPA = Marine Mammal Protection Act; N/A = Not applicable; NY = New York; PBR = Potential Biological Removal; RI = Rhode Island; SC = Special Concern; SGCN = Species of greatest conservation need; W. = Western.

Strategic = marine mammal stocks (defined as a group of nonspecific individuals that are managed separately) may be designated as strategic under the MMPA, which may require the jurisdictional agency to impose additional protective measures.

*Northern migratory species

The estimated abundance for each species is based on the 2020 and most recently updated draft 2021 National Oceanic and Atmospheric Administration Stock Assessment Reports; Hayes *et al.* 2021; NMFS 2021a.

Sources: Commonwealth of Massachusetts 2021; Hayes et al. 2021; Kenney and Vigness-Raposa 2010; Kenney 2013, 2015, 2019; Kraus et al. 2013, 2014, 2016; Muirhead et al. 2018; Pace 2021; Pettis et al. 2021; Roberts and Halpin 2022; New York State Department of Environmental Conservation 2021; State of Connecticut Department of Energy and Environmental Protection, Bureau of Natural Resources 2015.

Rhode Island Wildlife Action Plan 2015, accessed online http://www.dem.ri.gov/programs/fish-wildlife/wildlifehuntered/swap15.php and 2015 Rhode Island Wildlife Action Plan – SGCN Mammal Profiles accessed online http://www.dem.ri.gov/programs/bnatres/fishwild//swap/SGCNMammals.pdf

Blue whales may occur in the region but are not expected to occur in the Study Area. Blue whales have been acoustically detected during the winter and spring off of Long Island, New York (Muirhead et al. 2018), in the New York Bight (Estabrook et al. 2019, 2020). During aerial and acoustic surveys for large whales conducted in the MA/RI WEA from 2011 to 2015, no sightings of blue whales were recorded and this species was the least acoustically present of the five focal cetacean species in the study (Kraus et al. 2016). Although blue whales were acoustically detected in the winter, the vocalizing animals may have been distant from the WEAs given the detection range of blue whale calls can exceed 124 mi (200 km) (Kraus et al. 2016). Likewise, during more recent PAM conducted off Martha's Vineyard, no blue whale vocalizations were detected at any time of year (WHOI 2021). Therefore, while blue whales have been reported in the region of the Study Area, they are considered rare and not discussed further in this analysis. Outside of vessel activity specifically occurring within both the Project Area, installation will require a lesser amount of vessel transits to ports along the Texas coast and overseas to transport Project components to the Lease Area and/or submarine export cable routes, as detailed in **5.6.2.1 Construction**.

The following subsections provide additional information on the biology, habitat use, distribution, abundance, and existing threats to the marine mammals that are considered common in the Study Area (see **Table 5.6-4**).

Most of the large whales generally found in the Study Area are baleen whales (a whale that has plates of whalebone in the mouth for straining plankton from the water). The sperm whale is the only large odontocete (whales with teeth) known to occur in the Study Area. The data referenced throughout this section are derived from various studies listed in subsection Data Relied Upon and Studies Completed; other citations included where relevant.

An overview of the large whales commonly present in the Study Area noted that humpback whales and fin whales are present year-round and have been sighted or acoustically detected in all months, however, they were primarily sighted during the spring and summer seasons (Kraus et al. 2016). Humpback whale and fin whale abundance in the Study area is considered increasing as compared to previous years. Based on the acoustic data from the MA/RI WEA Array, humpback whales have highest abundance between April and June and fin whale have greatest abundance in the summer season. North Atlantic right whales were only sighted in the MA/RI WEA during the winter and spring seasons and the greatest number of sightings occurred in March (n=21) (Kraus et al. 2016). North Atlantic right whales were not observed in Long Island Sound and presence of large marine mammals in Long Island Sound is lower when compared to the offshore New England waters (Roberts et al. 2020, 2021).

The Nantucket Shoals, a shallow water benthic environment located south and west of Nantucket Island, is deemed an ecologically important area by NOAA Fisheries for marine mammals due to its unique oceanographic features. Geographically, it lies to the northeast in proximity of the Lease Area and has been documented as having one of the largest tidal dissipation areas in the New England region (Chen et al. 2018). This tidal mixing results in high primary productivity (Saba et al. 2015) and is important for numerous cetacean and pinniped species, as further detailed herein regarding listed species such as the NARW.

Marine mammal hearing, when noted, is based on the NOAA Fisheries (2018a) categories for low-, mid-, and high-frequency cetacean hearing groups. As part of an effort to assess impacts from anthropogenic sound sources, marine mammal species have been arranged into functional hearing groups based on their generalized hearing sensitivities: high-frequency cetaceans (harbor porpoise), mid-frequency cetaceans (dolphins, toothed whales, beaked whales), low-frequency cetaceans (Mysticetes; i.e., baleen whales), otariid pinnipeds (sea lions and fur seals), and phocid pinnipeds (true seals). These technical guidelines from NOAA Fisheries were updated in 2018; the groupings are listed in **Table 5.6-5** and described in further detail in **Section 4.4.2 Underwater Acoustic Environment**. Note that otariid pinnipeds do not occur in the Study Area.

TABLE 5.6-5. MARINE MAMMAL FUNCTIONAL HEARING GROUPS

Hearing Group	Generalized Hearing Range a/
Low Frequency (LF) Cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-Frequency (MF) Cetaceans (dolphins, toothed whales, beaked whales) b/	150 Hz to 160 kHz
High-Frequency (HF) Cetaceans (harbor porpoise) c/	275 Hz to 160 kHz
Phocid Pinnipeds (true seals) d/	50 Hz to 86 kHz
Otariid Pinnipeds (sea lions and fur seals) e/	60Hz to 39 kHz

Notes:

a/ These hearing ranges are generalized for species included in the entire group as a composite. b/ Renamed High-frequency cetaceans by Southall et al. (2019)

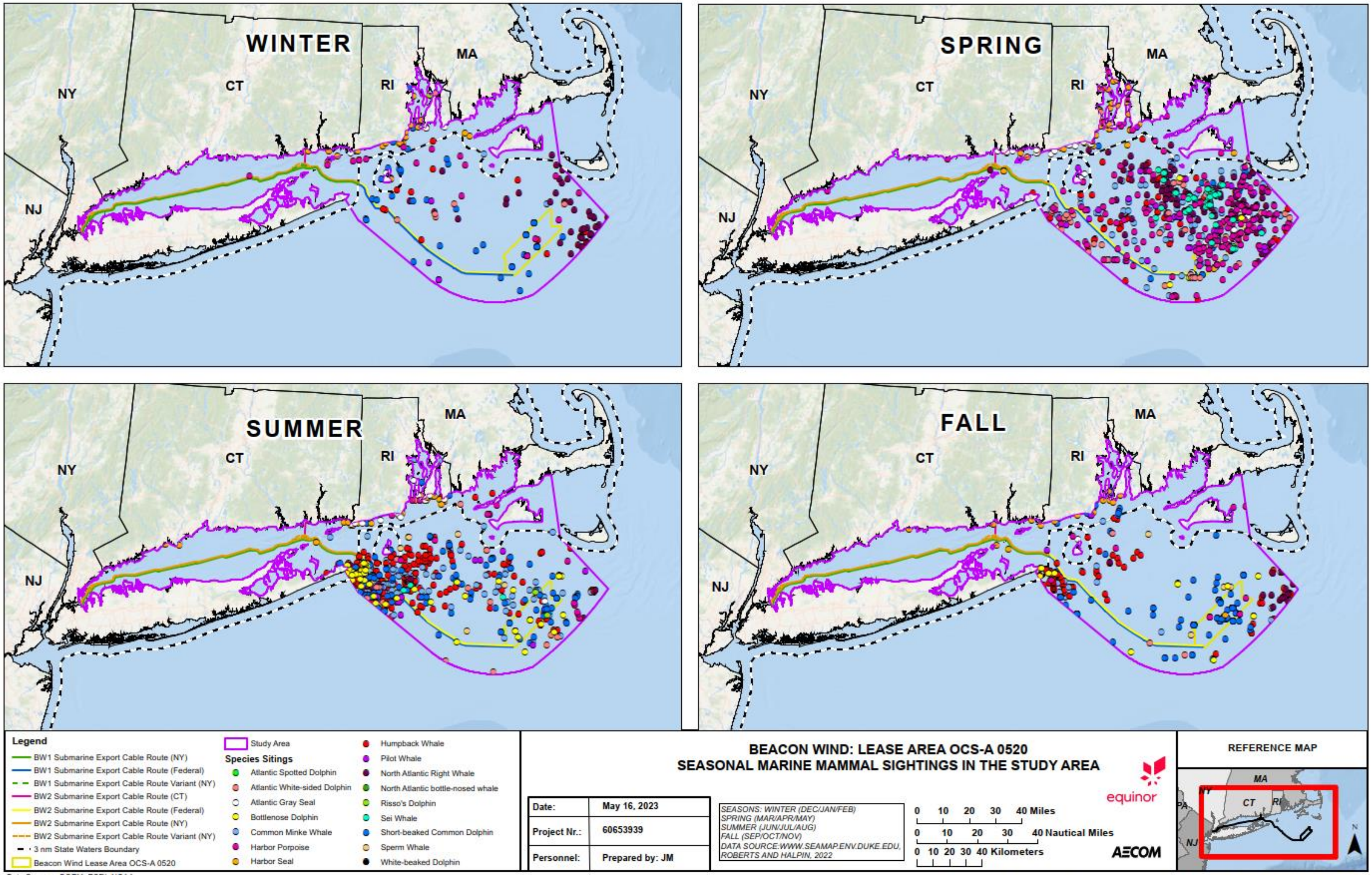
c/ Renamed very high-frequency cetaceans by Southall et al. (2019) d/ Renamed Phocid carnivores in water by Southall et al. (2019)

e/ Termed Other marine carnivores in water by Southall et al. (2019)

Source: NOAA Fisheries 2018f

Human-induced impacts such as underwater noise, vessel collisions, entanglements, and other human disturbances are a threat to multiple marine mammal species. Other disturbances include habitat loss, pollution, and commercial fishing (Kenney 2002). Underwater noise generated from a variety of human activities is a stressor for marine wildlife. Noise sources can potentially include noise from vessels associated with wind farm development or operation; from geophysical survey equipment such as multi-beam echosounders or other bottom survey equipment (typically utilized during pre-construction surveys); and pile driving activities (see **Section 4.4.2 Underwater Acoustic Environment** and **Appendix M United States Fish and Wildlife Service (USFWS) Information for Planning and Conservation (IPaC) Report and State Listed Species** for additional information). Noise in the marine environment may cause injury and displacement and is known to affect marine mammal behavior. Stress from noise may reduce reproductive fitness by increasing energy expenditures, reducing foraging success, or by masking vocalizations, which can also have other indirect effects. Noise mitigations are planned as part of the Project-related avoidance, minimization, and mitigation measures, as described in **Section 5.6.2 Impacts Analysis for Construction, Operations, and Decommissioning** and **Section 5.6.3 Summary of Avoidance, Minimization, Mitigation, and Monitoring Measures**. Increases in ship numbers and changes in vessel traffic associated with pre-construction surveys, wind farm construction, and post-construction operation and maintenance also increase the risk of vessel collisions with marine wildlife. These and other potential impacts to marine mammal species will be discussed further in **Section 5.6.2 Impacts Analysis for Construction, Operations, and Decommissioning**.

FIGURE 5.6-2. SEASONAL MARINE MAMMAL SIGHTINGS IN THE STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

5.6.1.2 *Species Overview*

5.6.1.2.1 ESA-Listed Endangered Species with Occurrence in the Study Area

Four whale species are protected under the MMPA and the ESA and are documented to exist in the Study Area. These include:

- North Atlantic right whale (Eubalaena glacialis);
- Fin whale (Balaenoptera physalus);
- Sei whale (Balaenoptera borealis); and
- Sperm whale (Physeter macrocephalus).

5.6.1.2.2 North Atlantic Right Whale (Eubalaena glacialis) – Strategic

The North Atlantic right whale was listed as a federally protected endangered species in 1970 and is considered one of the most critically endangered large whale species in the world (Clapham et al. 1999; Hayes et al. 2021; Quintana-Rizzo et al. 2021; Weinrich et al. 2000; 71 FR 77704; 73 FR 12024). The North Atlantic right whale belongs to the Western North Atlantic stock and the stock is considered a strategic stock (Hayes et al. 2021). Right whales are considered grazers as they swim slowly with their mouths open. They are the slowest swimming whales and can only reach speeds up to 10 m (16 km) per hour. They typically dive between 263 ft and 574 ft (80 and 175 m) and stay submerged for typically 10 to 15 minutes, following their prey below the surface (Baumgartner and Mate 2003). Right whales' hearing is in the low-frequency range (Southall et al. 2007, 2019).

The North Atlantic right whale is a migratory species that moves annually between high-latitude feeding grounds and low-latitude calving and breeding grounds. The present range of the western North Atlantic right whale population extends from the southeastern U.S., which is utilized for wintering and calving, to summer feeding and nursery grounds in New England, the Bay of Fundy, and the Gulf of St. Lawrence (Kenney 2017; Hayes et al. 2021). The winter distribution of North Atlantic right whales is largely unknown, although offshore surveys have reported one to 13 detections annually from 1996 to 2001 in northeastern Florida and southeastern Georgia (Hayes et al. 2021). A few events of right whale calving have been documented from shallow coastal areas and bays (Kenney 2017). Some evidence provided through acoustic monitoring suggests that some individuals of the population do not participate in annual migrations, with a continuous presence of North Atlantic right whales occupying their entire habitat range throughout the year, particularly north of Cape Hatteras (Davis et al. 2017). These data also recognize changes in population distribution throughout the right whale habitat range that could be due to environmental or anthropogenic effects, a response to short-term changes in the environment, or a longer-term shift in the right whale distribution cycle. For example, since 2010, there has been an apparent shift in North Atlantic right whale habitat use, with decreasing use of the Great South Channel and increasing use of Cape Cod Bay, the Mid-Atlantic Bight, and the Gulf of St. Lawrence (Davis et al. 2017; Mayo et al. 2018; Quintana-Rizzo et al. 2021; Whitt et al. 2013).

The North Atlantic right whale was the first species targeted during commercial whaling operations and was the first species to be greatly depleted as a result of whaling operations (Kenney 2017). North Atlantic right whales were hunted in southern New England until the early 20th century. Shore-based whaling from Long Island involved catches of right whales year-round, with peak catches in spring during the northbound migration from calving grounds off the southeastern U.S. to feeding grounds in the Gulf of Maine (Kenney and Vigness-Raposa 2010). Abundance estimates for the North Atlantic right whale population vary. From the 2003 U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments, there were only 291 North Atlantic right whales in existence, which is fewer than what was reported in the Northern Right Whale Recovery Plan written in 1991 (NMFS 1991a; Waring et al. 2004). Pre-exploitation numbers are estimated at around 1,000 individuals. When the right whale was finally protected in the 1930s, the North Atlantic right whale population was roughly 100 individuals (Waring et al. 2004). In 2015, the Western North Atlantic population was estimated to be at least 476 individuals (Waring et al. 2016). That population size estimate decreased to 440 individuals in 2017 (Hayes et al. 2017), with a median estimate of abundance of 451 in 2018 (Hayes et al. 2019). Additional information provided by Pace et al. (2017) confirms that the probability that the North Atlantic right whale population has declined since 2010 is 99.99 percent. The 2021 NMFS stock assessment report for the western NARW determined that based on sighting histories from the photo-identification database, as it existed in October 2019 including photographic information up through January 2018, a median abundance value of 412 NARW individuals exists (NMFS 2021b, Pace et al. 2017).. Based off the North Atlantic Right Whale Consortium 2020 Annual Report Card, the best estimate for the end of 2019 is 336 North Atlantic right whales (Pettis et al. 2021). However, using the Pace et al. (2017) state–space mark–recapture estimates, the most recent estimate is 368 individuals as of January 2019 (NMFS 2021b; Pace 2021; Pettis et al. 2021). Data indicate that the number of adult females dropped from 200 in 2010 down to 186 in 2015, while males dropped from 283 to 272 in the same timeframe. Also cause for concern is the confirmed mortality of 14 individuals in 2017 alone (Pace et al. 2017).

Three critical habitat areas were designated for this species in 1994: (1) the Cape Cod Bay/Stellwagen Bank, (2) the Great South Channel, and (3) waters adjacent to the coasts of Georgia and the east coast of Florida (59 FR 28805). In 2016, NOAA Fisheries issued a final rule to replace the critical habitat for right whales in the North Atlantic with two new areas. The areas being designated as critical habitat contain approximately 29,763 nm^2 of marine habitat in the Gulf of Maine and Georges Bank region (Northeastern U.S. Foraging Area Unit 1) (**Figure 5.6-3**) and off the Southeast U.S. coast (Unit 2) (81 FR 4837). No critical habitat for the North Atlantic right whale occurs in the Lease Area or along the submarine export cable routes.

Observations in December 2008 noted congregations of more than 40 individual North Atlantic right whales in the Jordan Basin area of the Gulf of Maine, leading researchers to believe this may be a wintering ground (NOAA Fisheries 2008). A right whale satellite tracking study within the northeast Atlantic (Baumgartner and Mate 2005) reported that this species often visited waters exhibiting low bottom water temperatures, high surface salinity, and high surface stratification, most likely for higher food densities. In 2010, the number of North Atlantic right whales returning to the traditional summertime foraging grounds in the eastern Gulf of Maine/Bay of Fundy region began to decline rapidly (Davies and Brillant 2019; Davies et al. 2019; Record et al. 2019; Davis et al. 2020). Since the shift in 2010, North Atlantic right whales have spent less time in the Gulf of Maine/Bay of Fundy, and more time in mid-Atlantic waters along the U.S. east coast and in the Gulf of St. Lawrence (Davis et al. 2017, 2020; Davies et al. 2019). North Atlantic right whales may be found in feeding grounds within New England waters between December and May (NOAA 2005; Leiter et al. 2017); however, PAM detections have demonstrated their year-round presence (Bort et al. 2015; Hayes et al. 2021). While in New England, North Atlantic right whales feed mostly on copepods belonging to the *Calanus* and *Pseudocalanus* genera (Hayes et al. 2021).

The most recent stock assessment report noted that studies by van der Hoop et al. (van der Hoop et al. 2015) have concluded large whale vessel strike mortalities decreased inside active Seasonal Management Areas (SMAs) (**Figure 5.6-3**) but have increased outside active SMAs. In 2017, there were 17 North Atlantic right whale mortalities (Daoust et al. 2017). This number exceeds the largest estimated mortality rate during the past 25 years. Further, despite high survey effort, only 5 and 0 calves were detected in 2017 and 2018, respectively, with seven calves documented in 2019, 10 calves documented in 2020, and 20 calves documented in 2021. An unusual mortality event (UME) for the species was declared in June 2017 and since then, 34 North Atlantic right whales have stranded (21 in Canada; 13 in the U.S.) and 16 live free-swimming non-stranded whales have been documented with serious injuries from entanglements or vessel strikes (NOAA Fisheries 2021a). The major cause of the UME is vessel strikes and gear entanglement. **Figure 5.6-4** presents speed restrictions for vessels during North Atlantic right whale migration season.

North Atlantic right whales have been observed in or near waters south of New England during all four seasons (NJDEP 2010) (**Figure 5.6-5A** - **Figure 5.6-5E**); however, they are most common in the winter and spring months (Kenney and Vigness-Raposa 2010; Kraus et al. 2013, 2014, 2016; Quintana et al. 2019; O'Brien et al. 2020, 2021a, b). In the MA/RI WEA, there were 59 sightings (144 individuals) of this species between 2011 and 2015, with greatest abundance in spring (Kraus et al. 2016; Leiter et al. 2017; Stone et al. 2017). During the New York Bight Whale Monitoring Aerial Surveys March 2017–February 2018, 13 individual North Atlantic right whales were observed during winter (two whales in January and one whale in February), spring (three whales in March and five whales in April) and two whales during fall (November) (Tetra Tech and LGL 2019). Off MA/RI WEA in 2018–2019, North Atlantic right whales occurred in the study area during winter and spring, with a peak in March (O'Brien et al. 2021a). North Atlantic right whales were observed during the summer and fall during the 2020 surveys (O'Brien et al. 2021b). During the 2021 New England Aquarium aerial line-transect surveys of MA and MA/RI WEA, North Atlantic right whales were reported adjacent to the Lease Area (McKenna et al. 2021).

Passive acoustic monitoring (PAM) of North Atlantic right whales has been conducted near the Study Area (Whitt et al. 2013; Davis et al. 2017; Woods Hole Oceanographic Institution (WHOI) 2021; WhaleMap 2021). A DMON moored buoy was deployed 20 mi (32 km) southwest of Martha's Vineyard, Massachusetts, on 29 July 2021, to monitor the presence of baleen whales in near real-time by automatically detecting and identifying their calls (WHOI 2021). Data analyzed to date indicate that North Atlantic right whales were detected during the winter and spring months, which supports the available visual survey data for this species.

Quintana-Rizzo et al. (2021) documented the presence of NARW in Southern New England and the Nantucket Shoals region at specific times during all seasons. More importantly, however, these observations included whales feeding at or near the surface in all observed seasons. It should be noted that significantly more survey effort by multiple research teams has been conducted in the Nantucket Shoals region in recent years, which could lead to a skewed understanding of increased abundance across seasons. Despite consistent summer survey effort, O'Brien et al. (2021) report that the Nantucket Shoals NARW aggregation, or "hotspots," seen by Quintana-Rizzo et al. (2021) from 2017–2019 were not observed during their 2020 field season. This suggests that while the Shoals region does support NARW prey in densities high enough to utilize this area as a preferred foraging ground in winter/spring, oceanic conditions in some years may be suboptimal to support high numbers of whales in the region during all seasons of the year. Additionally, when the abundance of the NARW's primary prey species (copepods of the Calanus genus) in this region typically decreases around late spring, the whales likely shift prey sources to other zooplankton prey such as Centropages sp. and Pseudocalanus sp. (Friedland et al. 2013).

While the shallow depths of the Shoals and strong tidal flow over uneven bathymetry contribute to this tidal mixing may lead to some of the optimal conditions favorable for phytoplankton blooms, the Gulf of Maine is the primary source of seawater inputs to the New England Shelf and is likely the primary source of Calanus spp. to the area (Limeburner and Beardsley, 1982). In fact, the mixing over Nantucket Shoals would likely prevent the formation of persistent vertical layers of prey that have been observed in other NARW foraging areas (Sorochan et al. 2021). This is especially the case for diapausing Calanus spp., and if NARWs are feeding in the Nantucket Shoals area in summer, they are likely targeting an alternative prey type (O'Brien et al. 2021). Additional research is needed to identify the summer prey source for NARW and the oceanographic conditions that give rise to larger NARW aggregations in the summer and fall seasons.

FIGURE 5.6-3. NORTH ATLANTIC RIGHT WHALE CRITICAL HABITAT FORAGING AREA UNIT 1

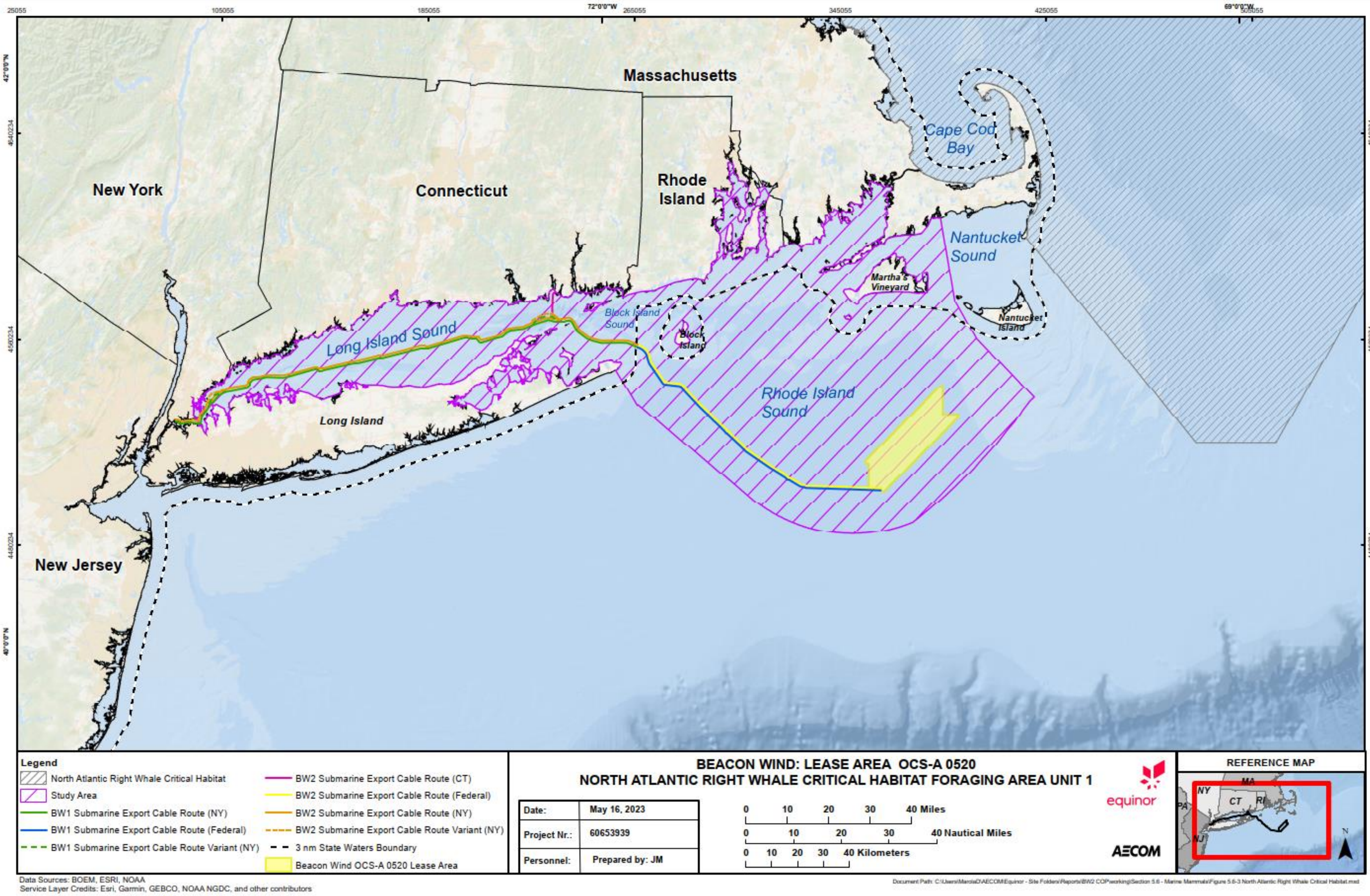


FIGURE 5.6-4. NORTH ATLANTIC RIGHT WHALE SEASONAL MANAGEMENT AREAS AND DESIGNATED CRITICAL HABITAT

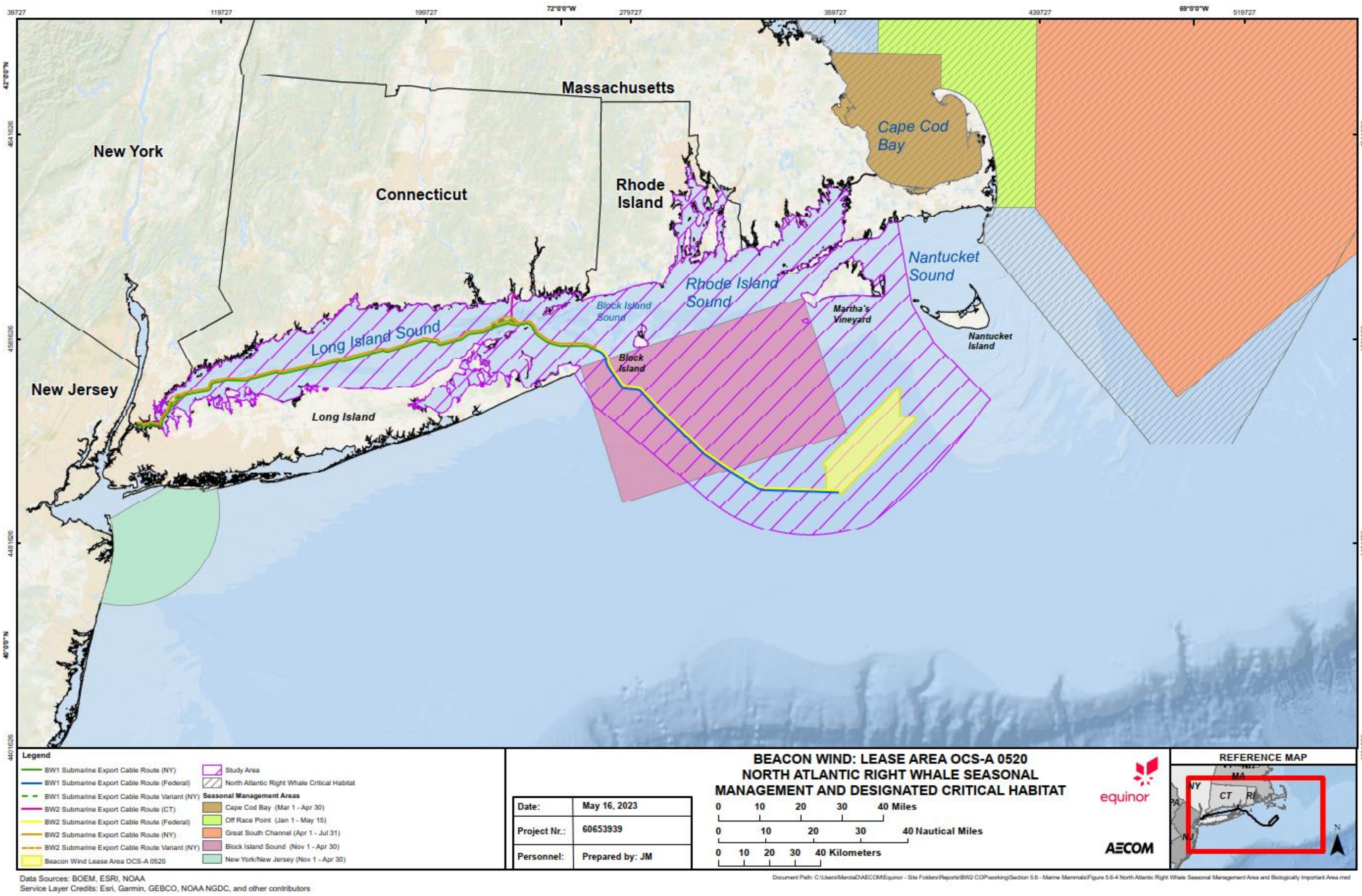
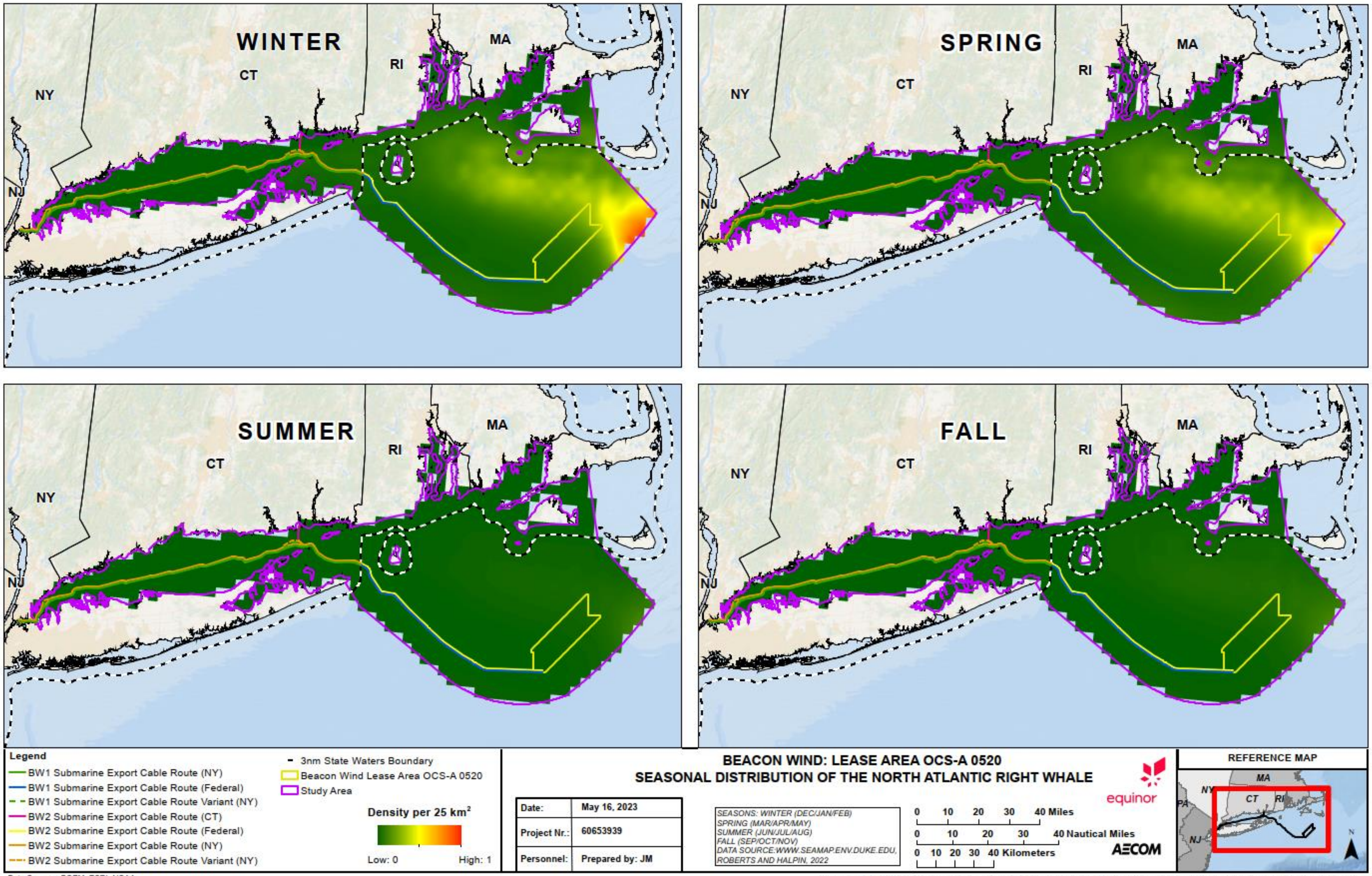


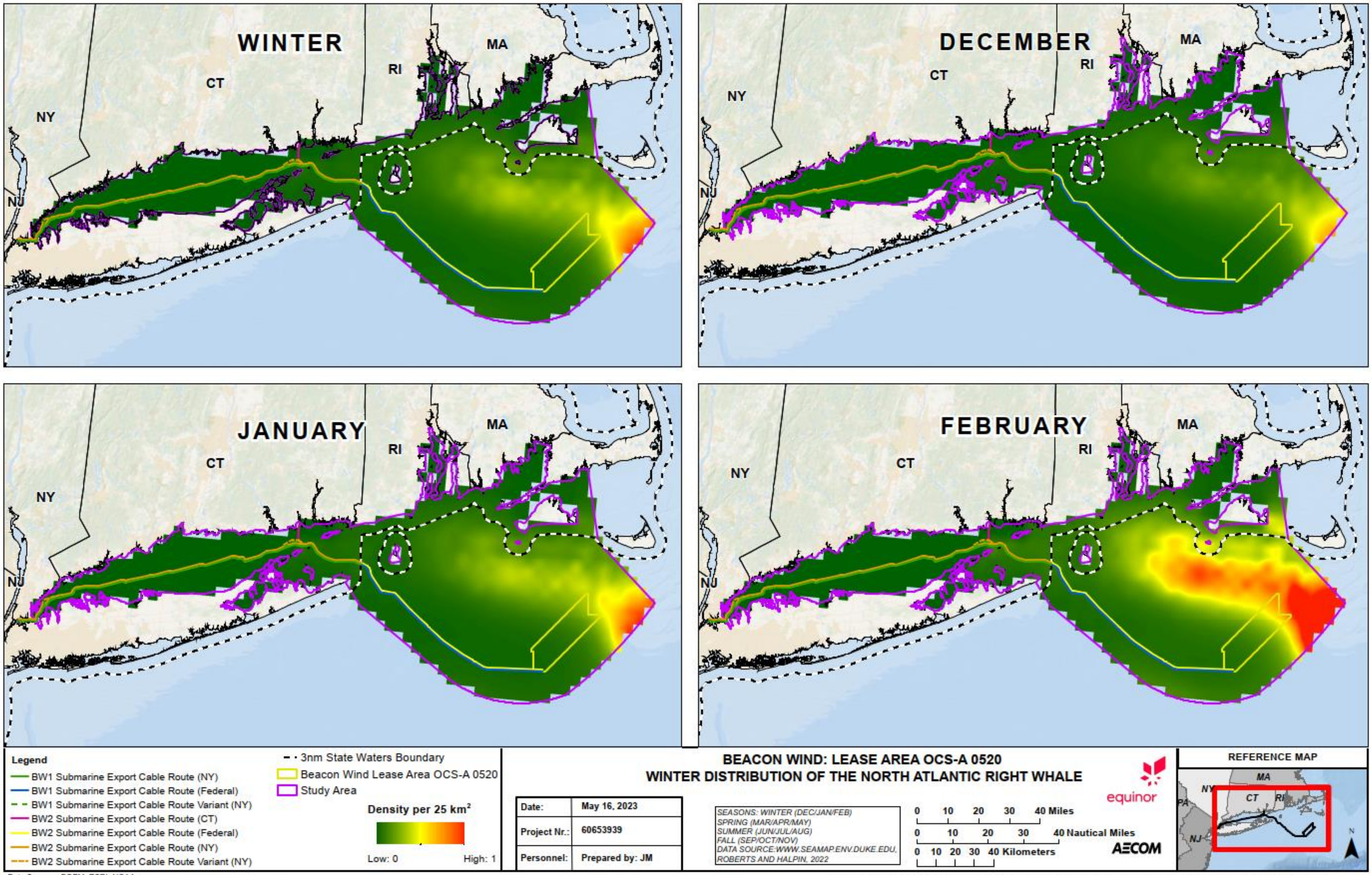
FIGURE 5.6-5A. SEASONAL DISTRIBUTION OF THE NORTH ATLANTIC RIGHT WHALE IN THE STUDY AREA



Data Sources: BOEM, ESRI, NOAA

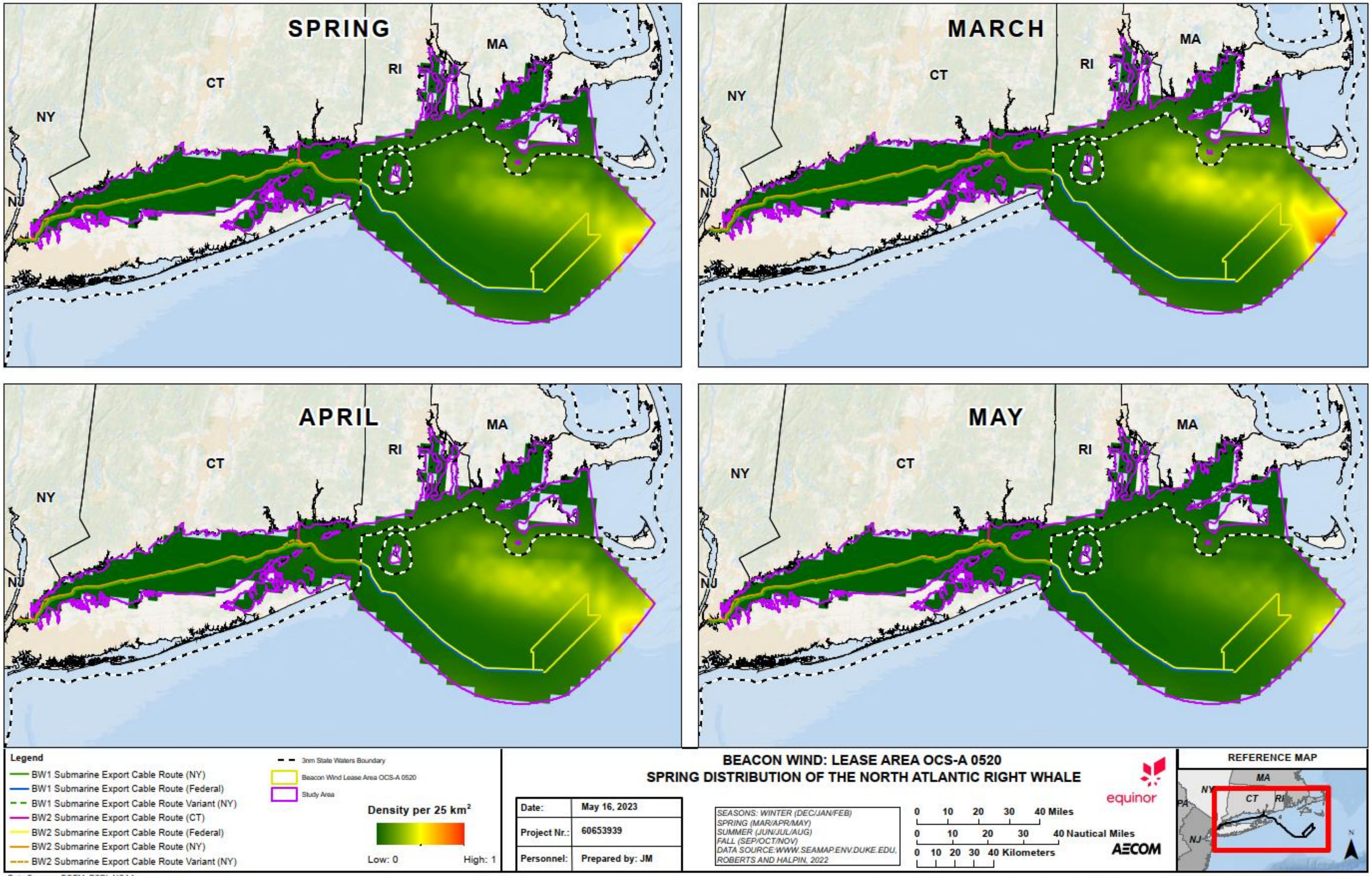
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

FIGURE 5.6- 5B. WINTER DISTRIBUTION OF THE NORTH ATLANTIC RIGHT WHALE IN THE STUDY AREA



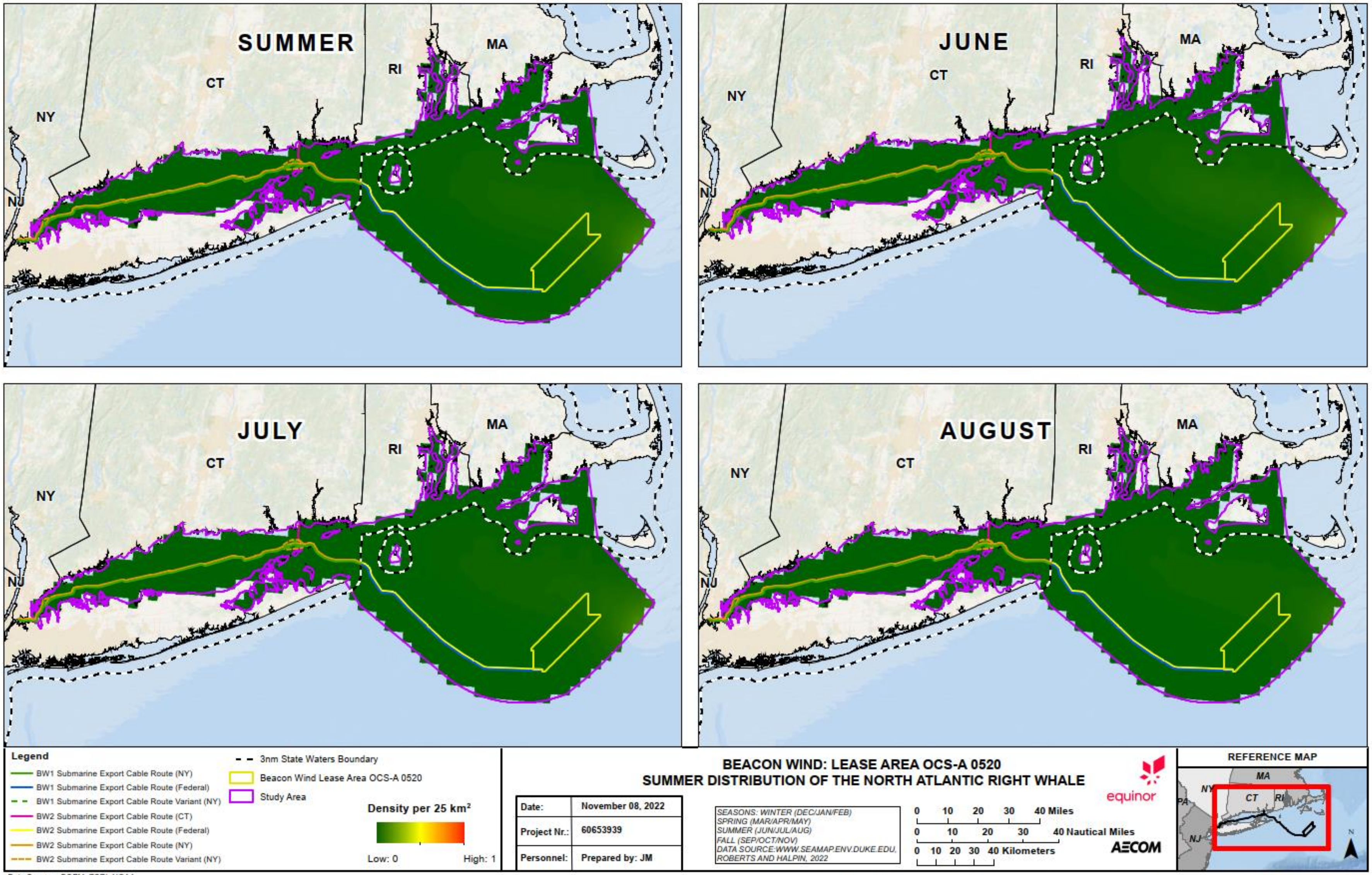
Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

FIGURE 5.6-5C. SPRING DISTRIBUTION OF THE NORTH ATLANTIC RIGHT WHALE IN THE STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

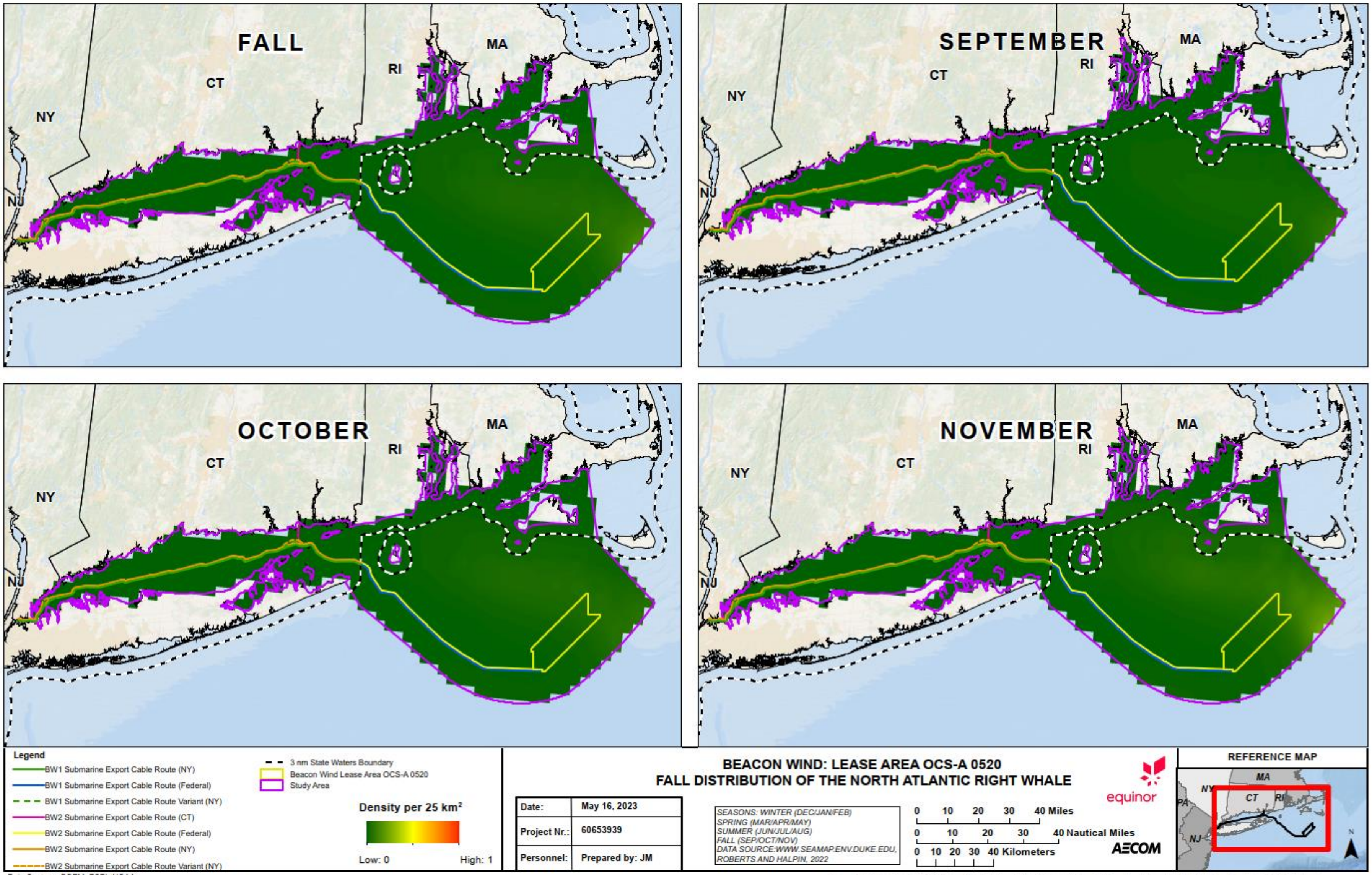
FIGURE 5.6-5D. SUMMER DISTRIBUTION OF THE NORTH ATLANTIC RIGHT WHALE IN THE STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Document Path: C:\Users\burkendn\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\Section 5.6 - Marine Mammals\Figure 5.6-5D Summer Distribution of the North Atlantic Right Whale.mxd

FIGURE 5.6-5E. FALL DISTRIBUTION OF THE NORTH ATLANTIC RIGHT WHALE IN THE STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

5.6.1.2.3 Fin Whale (Balaenoptera physalus) – Strategic

The fin whale was listed as federally endangered in 1970 and is considered a strategic stock although no critical habitat is designated. The fin whale is considered depleted throughout its range under the MMPA. NOAA Fisheries initiated a 5-year review of the fin whale in January 2018 to determine whether a reclassification or delisting may be warranted (83 FR 4032; NMFS 2019). In February 2019, the review indicated that, based on the most reliable available scientific and commercial information, the fin whale status should change from endangered to threatened; however, this status change has not occurred and is recommended for future action (NMFS 2019). A final recovery plan was written for fin whales in 2010 (NMFS 2010).

Fin whales are present in waters south of New England waters during all four seasons (**Figure 5.6-6**). In spring, summer, and fall, the main center of their distribution is in the Great South Channel area to the east of Cape Cod, which is a well-known feeding ground (Kenney and Winn 1986). Winter is the season of lowest overall abundance, but they do not depart the area entirely. Fin whales are the most common large whale encountered in continental shelf waters (Muirhead et al. 2018). They are one of the most often encountered whale species by local whale-watching operations in most years and are likely to occur in the vicinity of the Lease Area and submarine export cable routes. From 2011 and 2012 surveys, the fin whale was the most acoustically present species during the 12 months (Kraus et al. 2013). Fin whales were sighted 86 times (154 individuals) in WEA surveys from 2011 to 2015 in MA/RI WEA and were the most commonly encountered large whale, with highest abundance in spring and summer (Kraus et al. 2016; Stone et al. 2017). During the New York Bight Whale Monitoring Aerial Surveys March 2017–February 2018, fin whales were recorded during all seasons and months with the exception of April and June (Tetra Tech and LGL 2019). Off Rhode Island, fin whales are present year-round in the continental shelf waters but are relatively rare in the shallower waters of Rhode Island Sound (Tetra Tech 2012). During the 2017/2018 and 2018/2019 aerial surveys in the MA WEA and MA/RI WEA, fin whales were observed in the spring, summer, and fall (Quintanta et al. 2019; O'Brien et al. 2021a). Fin whales were observed during the summer in the MA/RI WEA during the 2020 surveys (O'Brien et al. 2020, 2021b). During the 2021 New England Aquarium aerial line-transect surveys of MA and MA/RI WEA, fin whales were reported in and adjacent to the Lease Area (McKenna et al. 2021). During the Vineyard Wind HRG surveys, fin whales were seen offshore of Massachusetts and in the Study Area (Vineyard Wind 2021).

Fin whales' range in the North Atlantic extends from the Gulf of Mexico, Caribbean Sea, and Mediterranean Sea in the south to Greenland, Iceland, and Norway in the north (Gambell 1985; Jonsgård 1966). They are the most commonly sighted large whales in continental shelf waters from the mid-Atlantic coast of the U.S. to Nova Scotia (Cetacean and Turtle Assessment Program (CeTAP) 1982; Hain et al. 1992; Sergeant 1977; Sutcliffe and Brodie 1977; Waring et al. 2008). Fin whales, much like humpback whales, seem to exhibit site fidelity (Kenney and Vigness-Raposa 2010; Hayes et al. 2021). However, fin whale's habitat use has shifted in the southern Gulf of Maine, most likely due to changes in the abundance of sand lance and herring, both of which are major prey species along with squid, krill, and copepods (Kenney and Vigness-Raposa 2010). While fin whales typically feed in the Gulf of Maine and the waters surrounding New England, mating and calving (and general wintering) areas are still largely unknown (Hayes et al. 2021) (**Figure 5.6-6**).

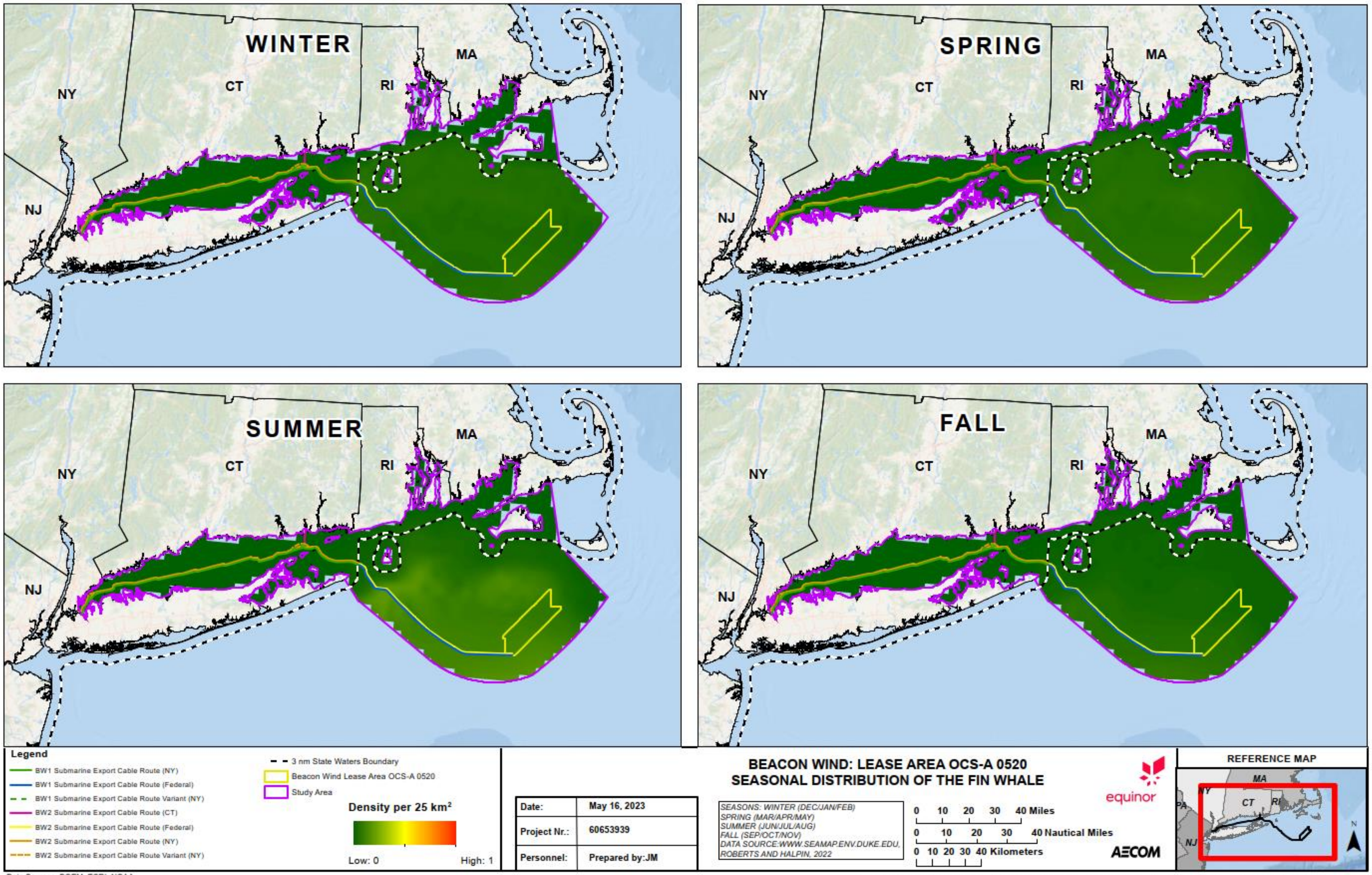
The overall pattern of fin whale movement is complex, consisting of a less obvious north-south pattern of migration than that of right and humpback whales. Based on acoustic recordings from hydrophone arrays, Clark (Clark 1995) reported a general southward flow pattern of fin whales in the fall from the

Labrador/Newfoundland region, past Bermuda, and into the West Indies. The overall distribution may be based on prey availability, as this species preys opportunistically on both invertebrates and fish (Watkins et al. 1984). Fin whale abundance off the coast of the northeastern U.S. is highest between spring and fall, with some individuals remaining during the winter (Hain et al. 1992). Past estimates of fin whale abundance conducted between Georges Bank and the Gulf of St. Lawrence during the feeding season in August 2006, places the western North Atlantic fin whale populations at 2,269 individuals (Waring et al. 2007). More recent estimates indicate the western North Atlantic fin whale population is 6,802 individuals based off the 2016 NOAA Fisheries shipboard and aerial surveys and the 2016 NEFSC and Fisheries and Oceans Canada (DFO) surveys (Lawson and Gosselin 2018; Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC) 2018; Garrison 2020; Palka 2020; Hayes et al. 2021). Fin whales are the second largest living whale species on the planet (Kenney and Vigness-Raposa 2010). The gestation period for fin whales is approximately 11 months and calve births occur between late fall and winter. Females can give birth every two to three years. Their hearing is in the low-frequency range (Southall et al. 2007, 2019).

From 2008 to 2012, the minimum annual rate of mortality for the North Atlantic stock from anthropogenic causes was approximately 3.35 per year (Waring et al. 2015), while from 2010 to 2014, this number increased to 3.8 per year (Hayes et al. 2017). There have not been any UMEs documented for fin whales in the last three decades.

Use of PAM for fin whales has been conducted near the Study Area (WhaleMap 2021; WHOI 2021). A DMON moored buoy was deployed 20 mi (32 km) southwest of Martha’s Vineyard, Massachusetts, on 29 July 2021, to monitor the presence of baleen whales in near real-time by automatically detecting and identifying their calls (WHOI 2021). Fin whales were detected throughout the fall, winter, summer, and spring months.

FIGURE 5.6-6. SEASONAL DISTRIBUTION OF THE FIN WHALE IN THE STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Document Path: C:\Users\MarolaD\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\Section 5.6 - Marine Mammals\Figure 5.6-6 Seasonal Distribution of the Fin Whale.mxd

5.6.1.2.4 Sei Whale (Balaenoptera borealis) – Strategic

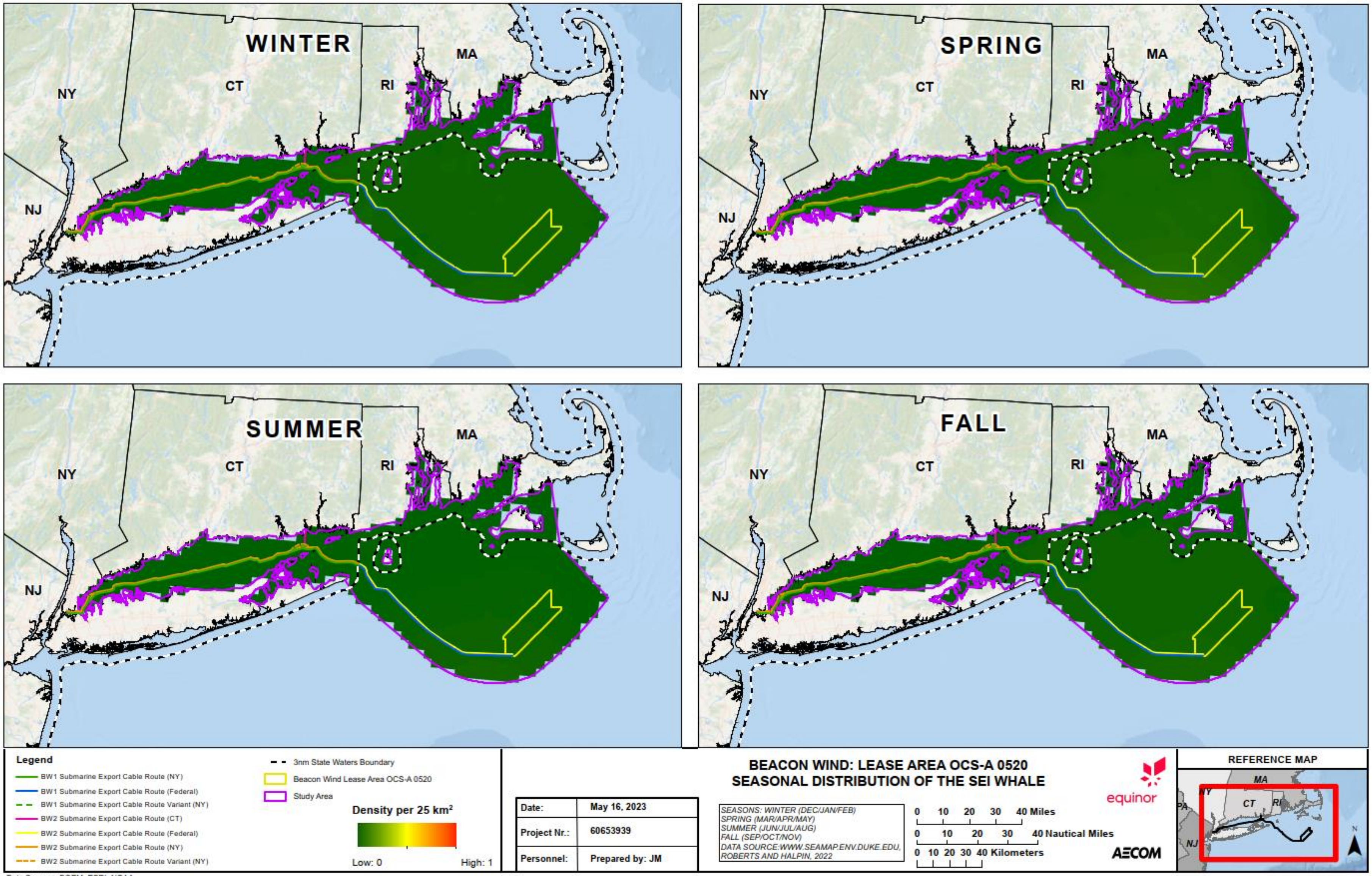
The sei whale was listed as federally endangered in 1970 and a final recovery plan was published for the species in 2011 (NOAA Fisheries 2011). The stock that resides in the U.S. EEZ is the Nova Scotian stock, which is highly migratory from the northeast U.S. to Newfoundland (Hayes et al. 2021) and is considered a strategic stock. Sei whales typically inhabit deeper offshore waters of the OCS (BOEM 2014; Hain et al. 1985). However, they have been known to episodically enter shallow inshore waters (Flinn et al. 2002; Hayes et al. 2017; Payne et al. 1990;). Of the other large whales considered in this application, sei whales are the least abundant species in the Lease Area and submarine export cable routes (Kraus et al. 2016). However, there is still a possibility that this species may be encountered during surveying in the Lease Area and submarine export cable routes (Right Whale Consortium 2014). The major prey of sei whales are copepods, in addition to small schooling fish and squid (Flinn et al. 2002). Sei whales are generally sighted traveling in small groups (less than five individuals), but it is not unusual for larger congregations to be found in feeding grounds (NOAA Fisheries 2018a). Their hearing is in the low-frequency range (Southall et al. 2007, 2019).

Sei whales migrate from south of Cape Cod to the eastern Canadian coast in June and July and return again in September and October (Waring et al. 2014, 2016). Sei whales are most abundant in deep southern New England waters in summer and absent in winter (Waring et al. 2014, 2016; Roberts and Halpin 2022) (**Figure 5.6-7**). This species was sighted 25 times (41 individuals) in the MA/RI WEA from 2011 and 2015 only in spring and summer (Kraus et al. 2016; Stone et al. 2017). During the New York Bight Whale Monitoring Aerial Surveys March 2017–February 2018, no sei whales were confirmed to species (Tetra Tech and LGL 2019). During the 2017 and 2018 aerial surveys in the MA WEA and MA/RI WEA, sei whales were observed in the spring, summer, and fall (Quintana et al. 2019). No sei whales were observed during the 2018/2019, 2020, and 2021 aerial surveys in the MA WEA and MA/RI WEA (O'Brien et al. 2020, 2021a, b; McKenna et al. 2021) (**Figure 5.6-7**).

PAM of sei whales has been conducted near the Study Area (WHOI 2021; WhaleMap 2021). A DMON moored buoy was deployed 20 mi (32 km) southwest of Martha's Vineyard, Massachusetts, on 29 July 2021, to monitor the presence of baleen whales in near real-time by automatically detecting and identifying their calls (WHOI 2021). Sei whales were detected most frequently in March, and also in October, January, February, and April.

The most recent estimate of abundance for the Nova Scotia stock of sei whales is 6,292 individuals based on spatially- and temporally explicit density models derived from abundance survey data collected between 2010 and 2013 (Hayes et al. 2021; Palka et al. 2017). This is considered a low estimate as sei whales inhabit deep offshore waters that have not been surveyed to a great extent. In addition, there is insufficient information to determine population trends for the species.

FIGURE 5.6-7. SEASONAL DISTRIBUTION OF THE SEI WHALE IN THE STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Document Path: C:\Users\MerolaD\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\Section 5.6 - Marine Mammals\Figure 5.6-7 Seasonal Distribution of the Sei Whale.mxd

5.6.1.2.5 Sperm Whale (Physeter macrocephalus) – Strategic

Sperm whales are listed as endangered under the ESA and are considered a strategic stock by NOAA Fisheries (Hayes et al. 2021). Data are insufficient to assess population trends, and the current abundance estimate was based on only a fraction of the known stock range (Hayes et al. 2021). For the North Atlantic, the most reliable estimate of abundance is 4,349 and the minimum population size estimate is 3,451 individuals (Garrison 2020; NEFSC and SEFSC 2018; Palka 2020; Hayes et al. 2021).

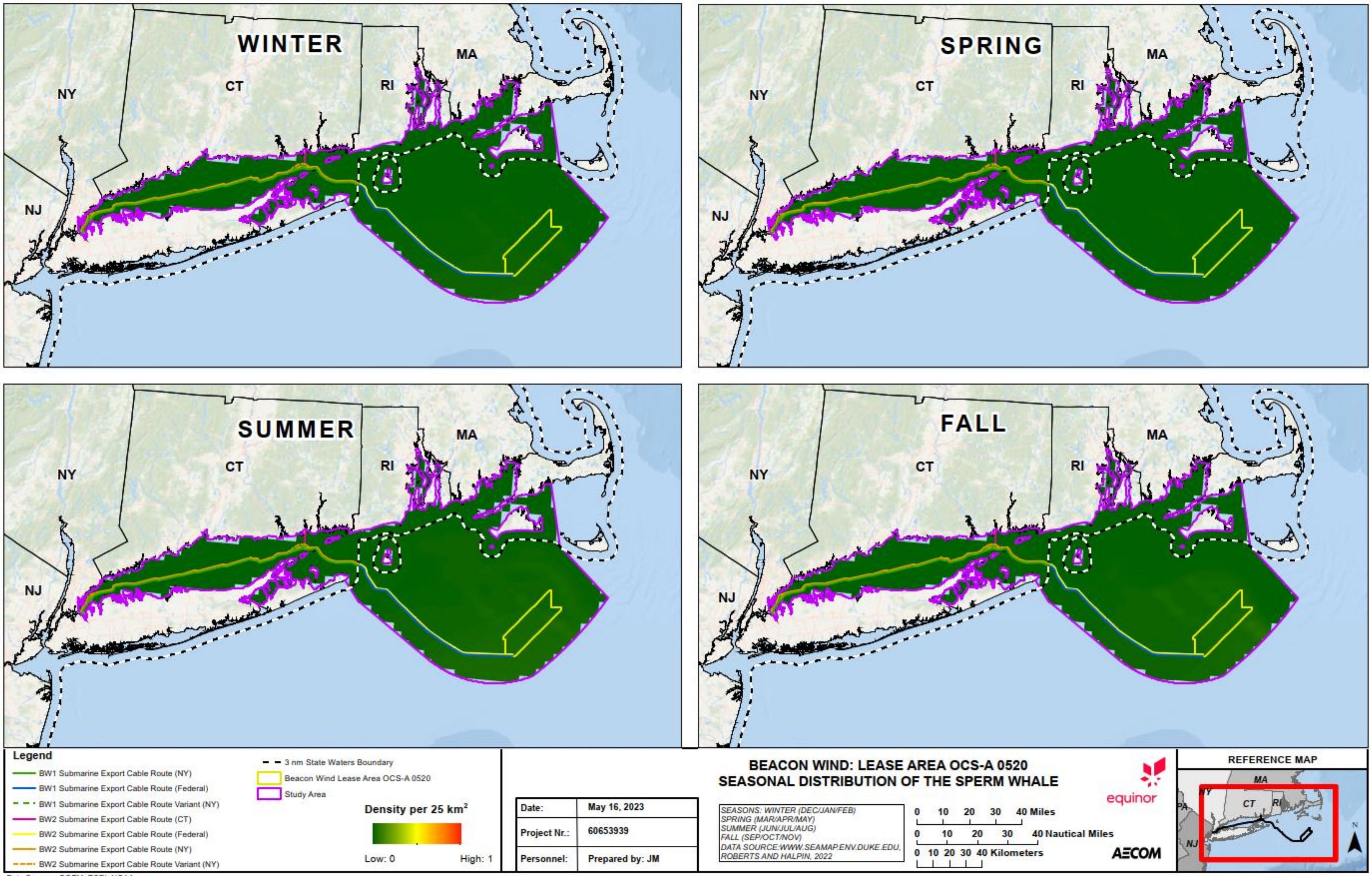
Sperm whales are highly social, with a basic social unit consisting of 20 to 40 adult females, calves, and some juveniles (Rice 1998; Whitehead 2017). During their prime breeding period and old age, male sperm whales are essentially solitary. Males rejoin or find nursery groups during prime breeding season. While foraging, sperm whales typically gather in small clusters. Between diving bouts, sperm whales are known to raft together at the surface. Adult males often forage alone. Groups of females may spread out over distances greater than 0.5 nm (0.9 km) when foraging. When socializing, they generally gather into larger surface-active groups (Jefferson et al. 2015; Whitehead 2003). In the Northern Hemisphere, the peak breeding season for sperm whales occurs between March and June, and in the Southern Hemisphere, between October and December (Best et al. 1984; NMFS 2015). Sperm whale hearing is in the mid-frequency range (Southall et al. 2007, 2019).

This species primarily preys on squid and octopus and is also known to prey on fish, such as lumpsuckers and redfish (Clarke 1980, 1996; Martin and Clarke 1986). Although sperm whales are generalists in terms of prey, specialization does appear to occur in a few places. The main sperm whale feeding grounds are correlated with increased primary productivity caused by upwelling.

The sperm whale is thought to have a more extensive distribution than any other marine mammal, except possibly the killer whale. Sperm whales are found in deep polar to tropical waters, from the pack ice in the Arctic to the Antarctic (Rice 1998; Whitehead 2003). This species has a range throughout global deep oceans, essentially from equatorial zones to the edges of the polar pack ice. In the Atlantic, sperm whales are found throughout the Gulf Stream and North Central Atlantic Gyre. Sperm whales were sighted four times (nine individuals) in 2011 to 2015 surveys in the MA/RI WEAs (Kraus et al. 2016; Stone et al. 2017). During the 2017 and 2018 MA WEA and MA/RI WEA surveys, one deceased sperm whale was observed floating south of Nantucket (Quintana et al. 2019). Sperm whales were observed in the summer during the 2018 and 2019 MA/RI WEA surveys (O'Brien et al. 2021a). Sperm whales were not observed during the 2020 or 2021 MA WEA and MA/RI WEA surveys (O'Brien et al. 2021b; McKenna et al. 2021) (**Figure 5.6-8**).

Sperm whales show a strong preference for deep waters (Rice 1998; Whitehead 2003). Sperm whale concentrations near bathymetric drop-offs and areas with strong currents and steep topography are correlated with high prey productivity. These whales occur almost exclusively at the shelf break, regardless of season (NYSDOS 2013) (**Figure 5.6-8**). Their distribution is typically associated with waters over the continental shelf break and the continental slope and into deeper waters (Jefferson et al. 2015; Whitehead et al. 1992). Migrations of sperm whales are not as regular or as well understood as those of most baleen whales. Sperm whales are widely distributed and dependent on their food source. Their migrations are not as specifically tied to seasons as seen in large baleen whale species. In some mid-latitudes, there appears to be a general seasonal north-south migration, with whales moving poleward in summer, but, in equatorial and some temperate areas, there is no clear seasonal migration. In the North Atlantic, specifically off New York and Nova Scotia, sperm whales are sighted regularly in waters less than 98 ft (300 m) deep (Rice 1998; Whitehead 2003). During the New York Bight Whale Monitoring Aerial Surveys March 2017–February 2018, sperm whales were observed during all four seasons and most frequently during summer and fall (Tetra Tech and LGL 2019).

FIGURE 5.6-8. SEASONAL DISTRIBUTION OF THE SPERM WHALE IN THE STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

5.6.1.2.6 MMPA Protected Species (Non-ESA-Listed) with Common Occurrence in Study Area

5.6.1.2.6.1 Minke Whale (Balaenoptera acutorostrata) – Non-Strategic

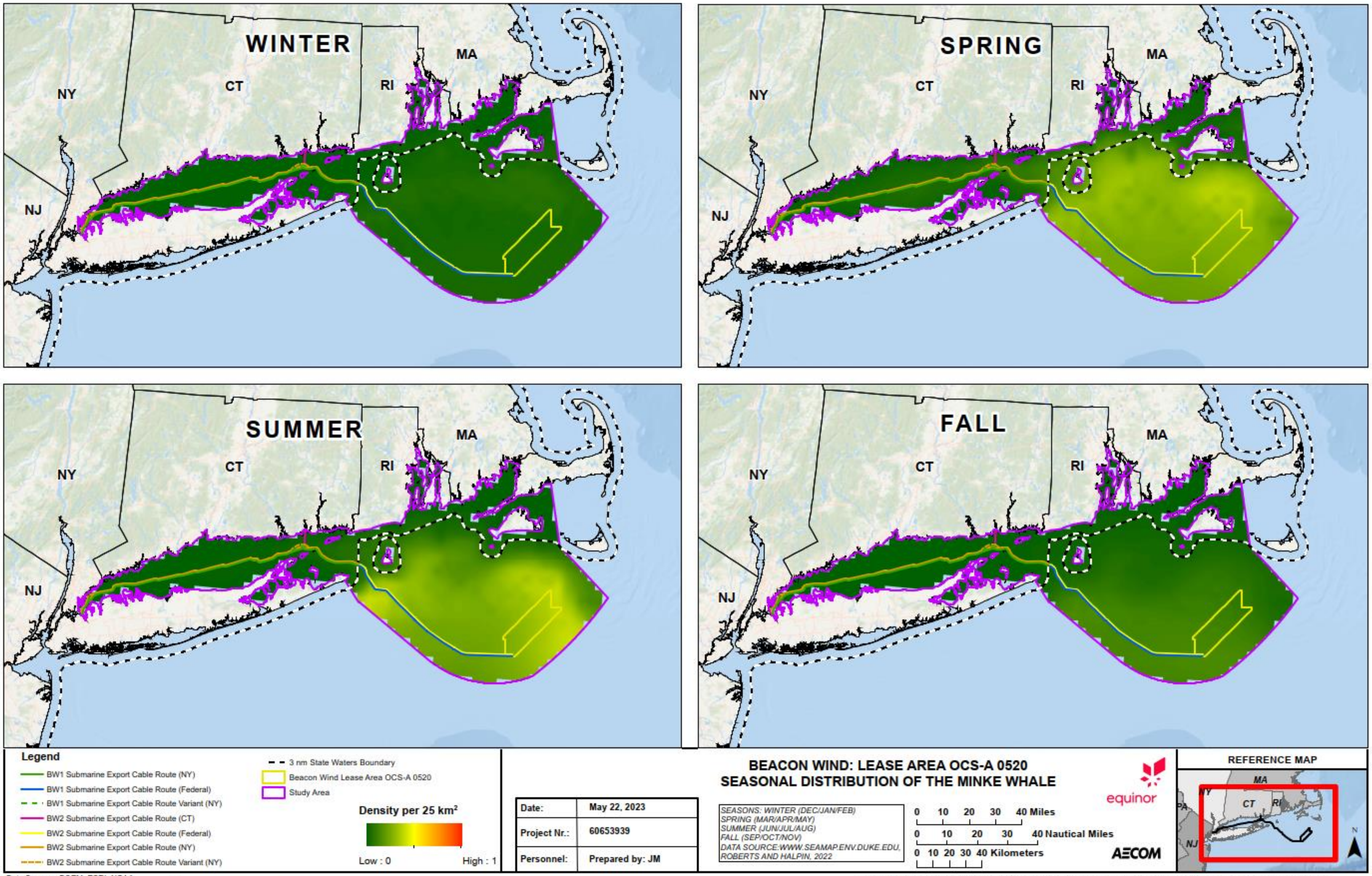
Minke whales are not listed as threatened or endangered under the ESA. Minke whales are among the most widely distributed of the baleen whales. They occur in the North Atlantic and North Pacific, from tropical to polar waters. Minke whales' range between 20 and 30 ft (6 and 9 m) in length with maximum lengths of 30 to 33 ft (9 to 10 m) and are the smallest of the North Atlantic baleen whales (Jefferson et al. 1993; Kenney and Vigness-Raposa 2010; Wynne and Schwartz 1999). The primary prey species for minke whales are most likely sand lance, clupeids, gadoids, and mackerel (Kenney and Vigness-Raposa 2010). These whales feed below the surface of the water, and calves are usually not seen in adult feeding areas. Minke whales are almost absent from OCS waters off the western Atlantic in winter; however, they are common in the fall and abundant in spring and summer (CeTAP 1982; Kenney and Vigness-Raposa 2010). In the 2015 stock assessment, the estimate for minke whales in the Canadian East Coast stock was 20,741 (Waring et al. 2016). The most reliable available current abundance estimate is 5,036 individuals (Palka 2020); however, this estimate only covers U.S. waters and slightly beyond into Canadian waters, and thus does not cover the habitat of the entire Canadian East Coast stock. The recent abundance estimate for the entire Canadian East Coast stock is 21,968 individuals, which covers a larger portion of this stock including Nova Scotian and Newfoundland Canadian waters (Hayes et al. 2021; Lawson and Gosselin 2018; NEFSC and SEFSC 2018; Palka 2020). Their hearing is in the low-frequency range (Southall et al. 2007, 2019).

Minke whales have been observed south of New England during all four seasons (**Figure 5.6-9**); however, widespread abundance is highest in spring through fall (Waring et al. 2016). This species has been sighted in the vicinity of the Lease Area and submarine export cable route areas on surveys from 2011 and 2012 in every month except for October and December (Kraus et al. 2013). During MA/RI WEA surveys from 2011 to 2015, 105 minke whales were sighted 85 times, with highest abundance in spring (Kraus et al. 2016; Stone et al. 2017). Minke whales were observed during the spring, summer and winter during the 2017/2018 and 2018/2019 aerial surveys and during the summer and fall in 2020 in the MA WEA and MA/RI WEA (Quintana et al. 2019; O'Brien et al. 2021a, b). Off Rhode Island, minke whales are present year-round in the continental shelf waters but are relatively rare in the shallower waters of Rhode Island Sound (Tetra Tech 2012). During the Vineyard Wind HRG surveys, minke whales were seen offshore of Massachusetts and in the Study Area (Vineyard Wind 2021). Minke whales were observed in the MA WEA and MA/RI WEA during 2020 aerial surveys (McKenna et al. 2021).

Minke whales are usually seen either alone or in small groups, although large aggregations sometimes occur in feeding areas (Reeves et al. 2002). Minke whale populations are often segregated by sex, age, or reproductive condition. Known for their curiosity, minke whales often approach boats.

A UME was declared for minke whales in January 2017, with 122 total strandings since then from Massachusetts to South Carolina due to entanglement and infectious disease (NOAA Fisheries 2021c). In addition, hunting for minke whales continues today, occurring by Norway in the northeastern North Atlantic, and by Japan in the North Pacific and Antarctic Oceans (Reeves et al. 2002). International trade in the species is currently banned. Average annual fishery-related mortality and serious injury does not exceed the potential biological removal (PBR) for this species; therefore, NOAA Fisheries considers this species as "non-strategic" (Hayes et al. 2021).

FIGURE 5.6-9. SEASONAL DISTRIBUTION OF THE MINKE WHALE IN THE STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Document Path: C:\Users\MarolaD\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\Section 5.6 - Marine Mammals\Figure 5.6-9 Seasonal Distribution of the Minke Whale.mxd

5.6.1.2.6.2 Humpback Whale (Megaptera novaeangliae) – Non-Strategic

The humpback whale was listed as endangered in 1970 due to population decreases resulting from overharvesting. In September 2016, NOAA Fisheries revised the ESA listing for the humpback whale to identify 14 Distinct Population Segment (DPSs) based on breeding populations: West Indies, Cape Verde Islands/Northwest Africa, Hawaii, Mexico, Central America, Brazil, Gabon/Southwest Africa, Southeast Africa/Madagascar, West Australia; East Australia, Oceania, Southeastern Pacific, and Arabian Sea (81 FR 62259). Under this new final rule, humpback whales are considered endangered in the Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, and Arabian Sea DPSs and are considered threatened in the Mexico DPS. For the remaining DPSs, including the West Indies DPS, to which humpback whales along the east coast of the U.S. belong, humpback whales are no longer listed as endangered or threatened.

A UME for humpback whales was declared in January 2016, and since then, 154 humpback whales have stranded between Massachusetts and Florida, with approximately 50 percent due to ship strike or entanglement (NOAA Fisheries 2021b). The humpback whale population within the North Atlantic has been estimated to include approximately 11,570 individuals (Waring et al. 2015, 2016). According to the latest stock assessment report, the most reliable estimate of abundance for the Gulf of Maine stock of humpback whales is 1,396 individuals based on a state-space model of the sighting histories of individual whales identified using photo-identification techniques (Hayes et al. 2021; Pace et al. 2017).

Humpback whales feed on small prey that is often found in large concentrations, including krill and fish such as herring and sand lance (Hayes et al. 2021; Kenney and Vigness-Raposa 2010). Humpback whales are thought to feed mainly while migrating and in summer feeding areas; little feeding is known to occur in their wintering grounds. Humpback whales feed over the continental shelf in the North Atlantic between along the east coast of the U.S, the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland (Katona and Beard 1990), consuming roughly 95 percent small schooling fish and five percent zooplankton (i.e., krill), and they will migrate throughout their summer habitat to locate prey (Kenney and Winn 1986). They swim below the thermocline to pursue their prey, so even though the surface temperatures may be warm, they are frequently swimming in cold water (NMFS 1991b). Humpback whales from the North Atlantic migrate to the breeding grounds in the West Indies during winter (Clapham and Mayo 1987; Hayes et al. 2021; MacKay et al. 2016; Robbins et al. 2001), where calves are born between January and March (Baraff and Weinrich 1993; Robbins 2007). Their hearing is in the low-frequency range (Southall et al. 2007, 2019).

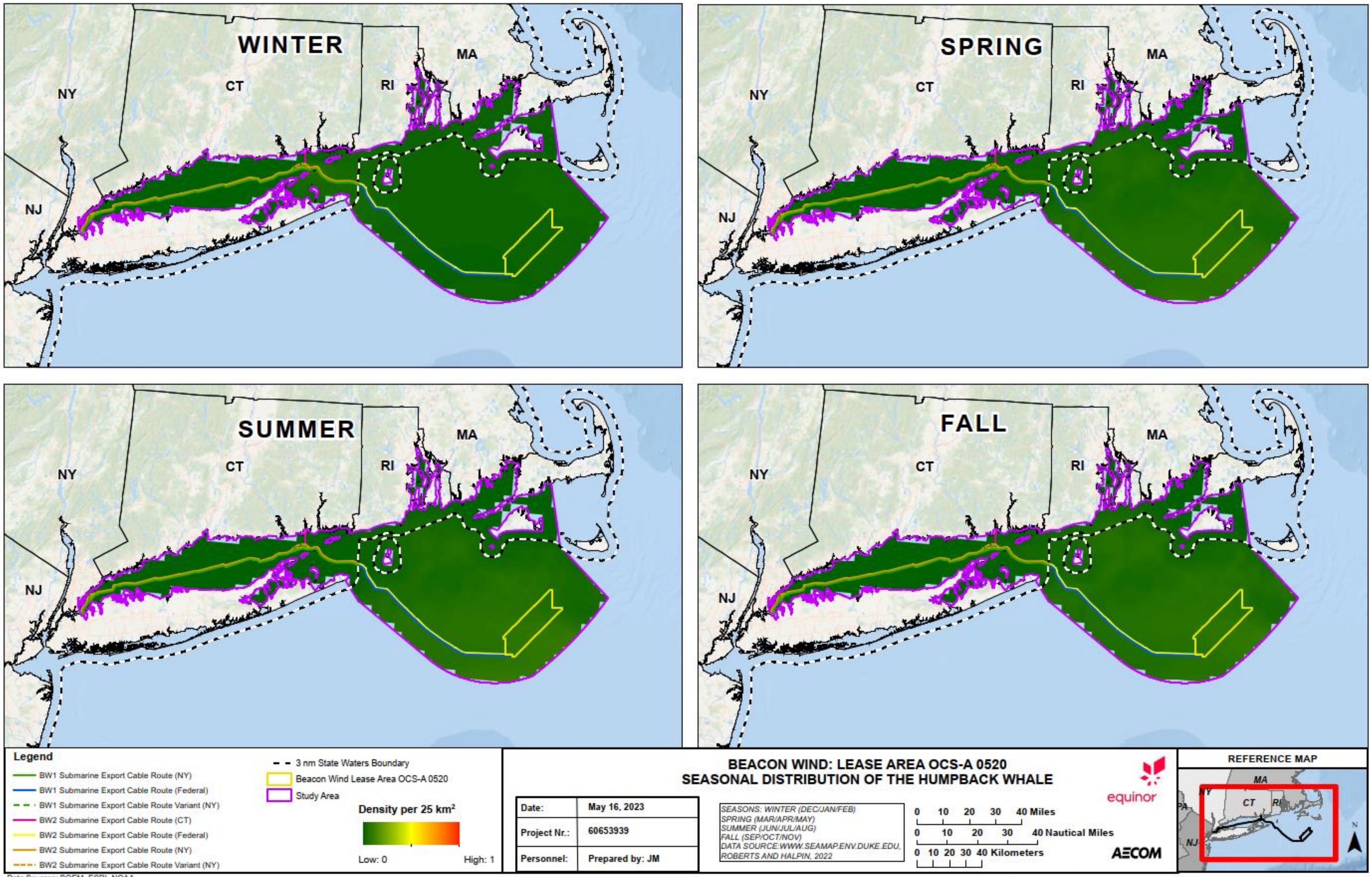
Humpback whales occur off southern New England in all four seasons, with peak abundance in spring and summer. The whales exhibit consistent fidelity to feeding areas within the northern hemisphere (Stevick et al. 2006). In winter, whales from waters in the Gulf of Maine, Gulf of St. Lawrence, western Greenland, Iceland, and Norway migrate to mate and calve primarily in the West Indies (including the Bahamas, Turks and Caicos Islands, Silver Bank, Samaná Bay, Puerto Rico and the Lesser Antilles), where spatial and genetic mixing among these groups occurs (Katona and Beard 1990; MacKay et al. 2016; Mattila et al. 1989; Stevick et al. 2018). While migrating, humpback whales utilize the mid-Atlantic as a migration pathway between calving/mating grounds to the south and feeding grounds in the north (Waring et al. 2007). Since 1989, observations of juvenile humpback whales in the mid-Atlantic have been increasing during the winter months, peaking January through March (Swingle et al. 1993). Biologists theorize that non-reproductive animals may be establishing a winter-feeding range in the mid-Atlantic since they are not participating in reproductive behavior in the Caribbean. Swingle et al. (Swingle et al. 1993) identified a shift in distribution of juvenile humpback whales in the nearshore waters of Virginia, primarily in winter months (Aschettino et al. 2015, 2016, 2017, 2018, 2019, 2020a, 2021) (Virginia had the greatest number of strandings from 2016 to 2019; NOAA Fisheries 2021b). This is exemplified from 2016 to May 2019, where Virginia had the highest number of strandings along the western Atlantic coast from Massachusetts to Florida (NOAA Fisheries 2021b).

Humpback whales were hunted as early as the 17th century, with most whaling operations having occurred in the 19th century (Kenney and Vigness-Raposa 2010). Before whaling activities began, it was thought that the abundance of whales in the North Atlantic stock was in excess of 15,000 (Nowak 2002). By 1932, commercial hunting within the North Atlantic may have reduced the humpback whale population to as few as 700 individuals (Breiwick et al. 1983). Humpback whales were commercially exploited by whalers throughout their range until they were protected in the North Atlantic in 1955 by the International Whaling Commission ban. Humpback whaling ended worldwide in 1973 (Jefferson et al. 2015).

Humpback whales have been observed in or near waters south of New England during all four seasons; however, they are most common in the spring and summer when they are migrating north (Brown et al. 2018, 2019; Roberts and Halpin 2022; Stone et al. 2017) (**Figure 5.6-10**). Twelve humpback whales were sighted in the vicinity of the Lease Area and submarine export cable route areas between 2011 and 2012 in the southern portion of the MA WEA (Kraus et al. 2013). In the MA/RI WEA, there were 82 sightings (160 individuals) of this species between 2011 and 2015, with greatest abundance in spring (Kraus et al. 2016; Stone et al. 2017). During the New York Bight Whale Monitoring Aerial Surveys March 2017 to February 2018, humpback whales were recorded during all four seasons and most frequently during spring and winter (Tetra Tech and LGL 2019). Off Rhode Island, humpback whales are present year-round in the continental shelf waters but are relatively rare in the shallower waters of Rhode Island Sound (Tetra Tech 2012). During the Beacon Wind HRG Survey Campaign from April to July 2019 off New York and New Jersey, humpback whales occurred in the Study Area (Milne 2019). Humpback whales were observed in all seasons during the 2017/2018 and 2018/2019 aerial surveys and during the spring, summer, and fall in 2020 in the MA WEA and MA/RI WEA (Quintana et al. 2019; O'Brien et al. 2021a, b). Humpback whales were observed in the MA WEA and MA/RI WEA during 2020 aerial surveys (McKenna et al. 2021).

Passive Acoustic Monitoring (PAM) of humpback whales has been conducted near the Study Area (WhaleMap 2021; WHOI 2021). A DMON moored buoy was deployed approximately 20 mi (32 km) southeast of Martha's Vineyard, Massachusetts on 29 July 2021, to monitor the presence of baleen whales in near real-time by automatically detecting and identifying their calls (WHOI 2021). Humpback whales were detected during the fall, winter, and spring months.

FIGURE 5.6-10. SEASONAL DISTRIBUTION OF THE HUMPBACK WHALE IN THE STUDY AREA



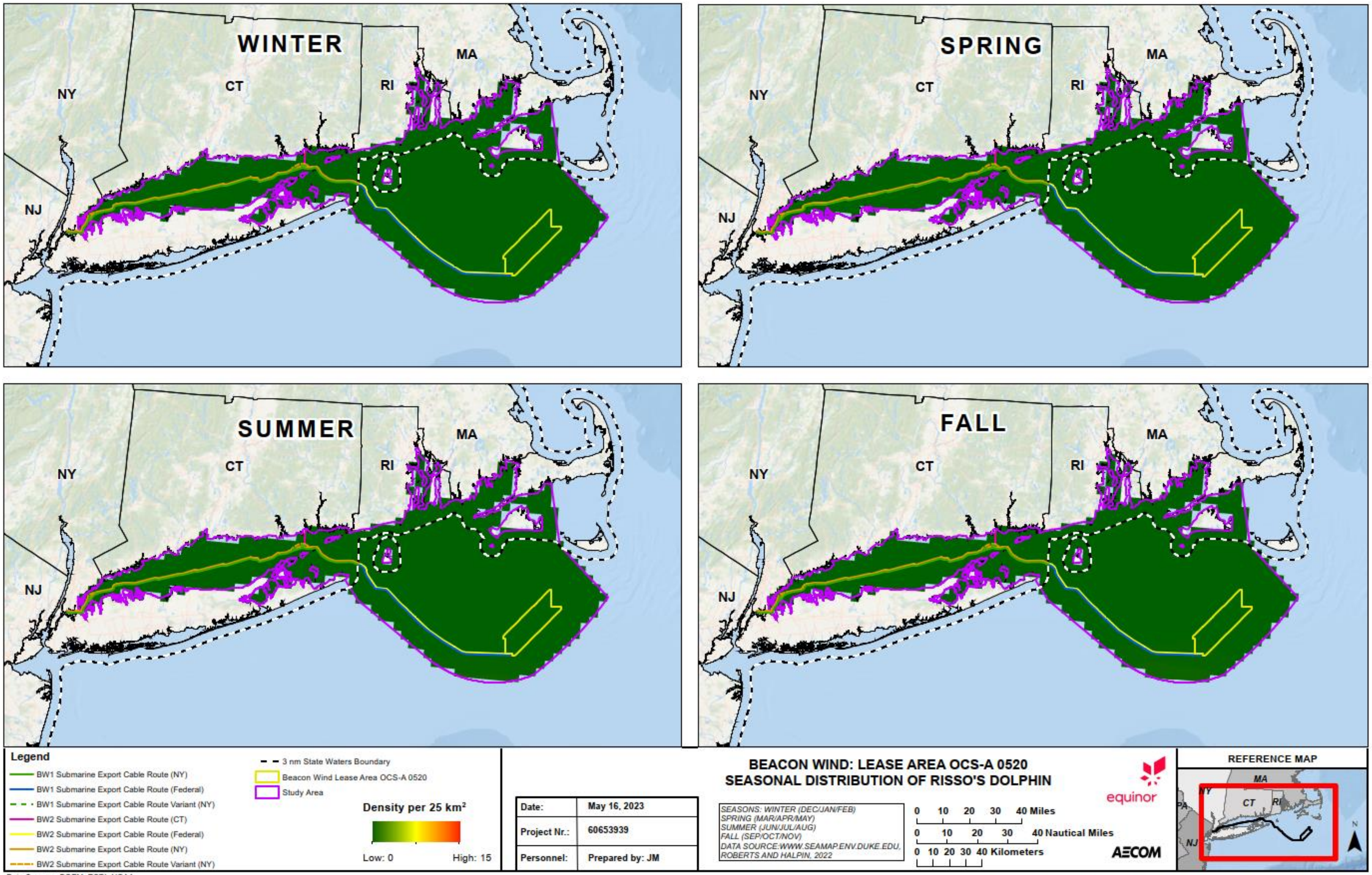
Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

5.6.1.2.6.3 Risso's Dolphin (Grampus griseus) – Non-Strategic

Risso's dolphins are not listed as threatened or endangered under the ESA. Risso's dolphins have a worldwide distribution (CeTAP 1982; Jefferson et al. 2014, 2015), and are common to the U.S. East Coast OSC and shelf edge (BOEM 2014) and are found in the northwest Atlantic from Florida to Newfoundland (Baird and Stacey 1991; Hayes et al. 2021; Leatherwood et al. 1976). Risso's dolphins tend to feed primarily on squid, but also prey on anchovies, krill, or other cephalopods (NOAA Fisheries 2018b). There is currently not enough information to distinguish between separate stocks in the northwest Atlantic, but the Gulf of Mexico and Atlantic are treated as two separate stocks (Hayes et al. 2021). Their hearing is in the mid-frequency range (Southall et al. 2007, 2019).

Risso's dolphins are common on the continental northwest Atlantic shelf in summer and fall, with low abundance in winter and spring (Payne et al. 1984; Roberts and Halpin 2022) (**Figure 5.6-11**). They have been sighted mostly outside and south of the MA WEA, primarily in summer and fall (BOEM 2014). Risso's dolphins were only sighted three times (one individual for each sighting) in the MA/RI WEA surveys from 2011 to 2015 (Kraus et al. 2016; Stone et al. 2017); however, they have not been observed since (Quintana et al. 2019; O'Brien et al. 2021a, b; McKenna et al. 2021). While the Risso's dolphin is thought to be relatively abundant in New England waters, they inhabit deeper, offshore waters compared to the Lease Area and submarine export cable areas (Kenney and Vigness-Raposa 2010). The most reliable abundance estimate for Risso's dolphin is 35,215, as derived from 2016 NEFSC and DFO surveys (Garrison 2020; Palka 2020; Hayes et al. 2021; Lawson and Gosselin 2018; NEFSC and SEFSC 2018; NMFS 2021a).

FIGURE 5.6-11. SEASONAL DISTRIBUTION OF THE RISSO'S DOLPHIN IN THE STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Document Path: C:\Users\MarciaD\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\Section 5.6 - Marine Mammals\Figure 5.6-11 Seasonal Distribution of the Risso Dolphin.mxd

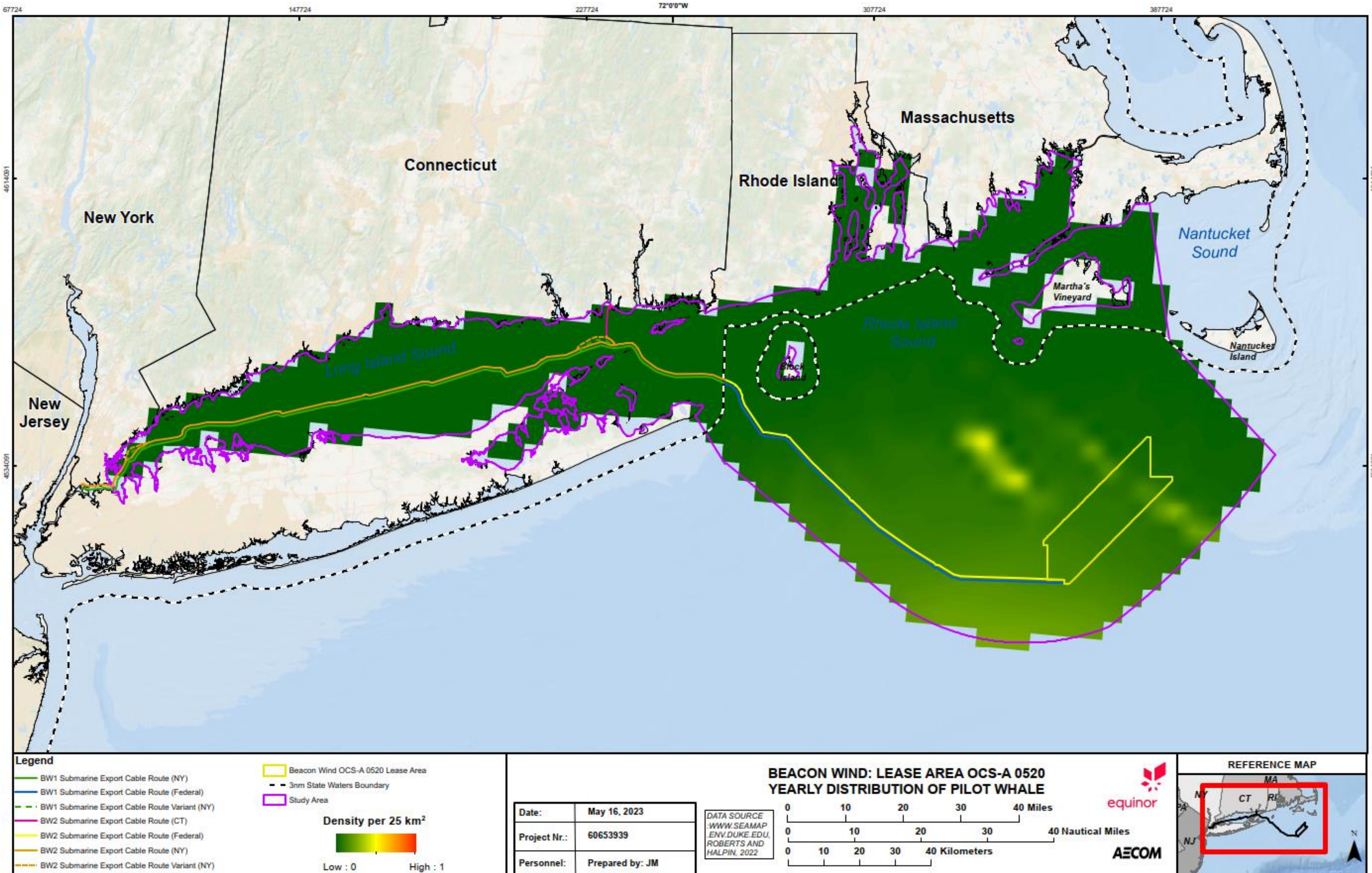
5.6.1.2.6.4 Pilot Whale (Globicephala spp.) – Strategic

Pilot whales are not listed as threatened or endangered under the ESA. There are two species of pilot whales that occur in the western North Atlantic. These two species, the long-finned pilot whale (*Globicephala melas*) and short-finned pilot whale (*Globicephala macrorhynchus*), are difficult to identify to species level at sea (Hayes et al. 2017; Rone et al. 2012). Pilot whales are social animals that tend to be found in large, stable aggregations (Olson 2017). They feed on squid, but also prey on small and medium-sized fish (NOAA Fisheries 2018c,d). Their hearing is in the mid-frequency range (Southall et al. 2007, 2019).

While long- and short-finned pilot whales are likely to overlap between New Jersey and Georges Bank (Payne and Heinemann 1993; Hayes et al. 2017), long-finned pilot whales have the more northerly distribution and are more likely to be found in the Lease Area and submarine export cable routes than short-finned pilot whales. Long-finned pilot whales have been found stranded as far south as South Carolina while short-finned pilot whales have been found stranded as far north as Massachusetts (Hayes et al. 2017; Pugliares et al. 2016). However, the latitudinal distributions of these two species are uncertain (Hayes et al. 2021). Both species are present in deep offshore waters of the U.S. East Coast in winter and spring (Abend and Smith 1999; CeTAP 1982; Hamazaki 2002; Payne and Heinemann 1993) (**Figure 5.6-12**). Pilot whales also tend to follow migrations of their prey and move inshore in summer and fall (Reeves et al. 2002). One hundred twenty-one mixed pilot whale individuals were sighted 15 times from 2011 to 2015 in surveys of the MA/RI WEAs (Kraus et al. 2016; Stone et al. 2017). One sighting of pilot whales were observed in the spring during the 2017 and 2018 MA WEA and MA/RI WEA large whale surveys (Quintana et al. 2019). Pilot whales have not been observed during the 2018/2019, 2020 or 2021 MA WEA and MA/RI WEA large whale surveys (McKenna et al. 2021; O'Brien et al. 2021a, b). During the Vineyard Wind HRG surveys, pilot whales were seen offshore of Massachusetts and in the Study Area (Vineyard Wind 2021).

The most reliable estimate of abundance for western North Atlantic long-finned pilot whales is 39,215 individuals and for short-finned pilot whales is 28,924 individuals (Garrison 2020; Hayes et al. 2021; Lawson and Gosselin 2018; Palka 2020).

FIGURE 5.6-12. ANNUAL DISTRIBUTION OF PILOT WHALES IN THE STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

5.6.1.2.6.5 Atlantic White-Sided Dolphin (Lagenorhynchus acutus) – Non-Strategic

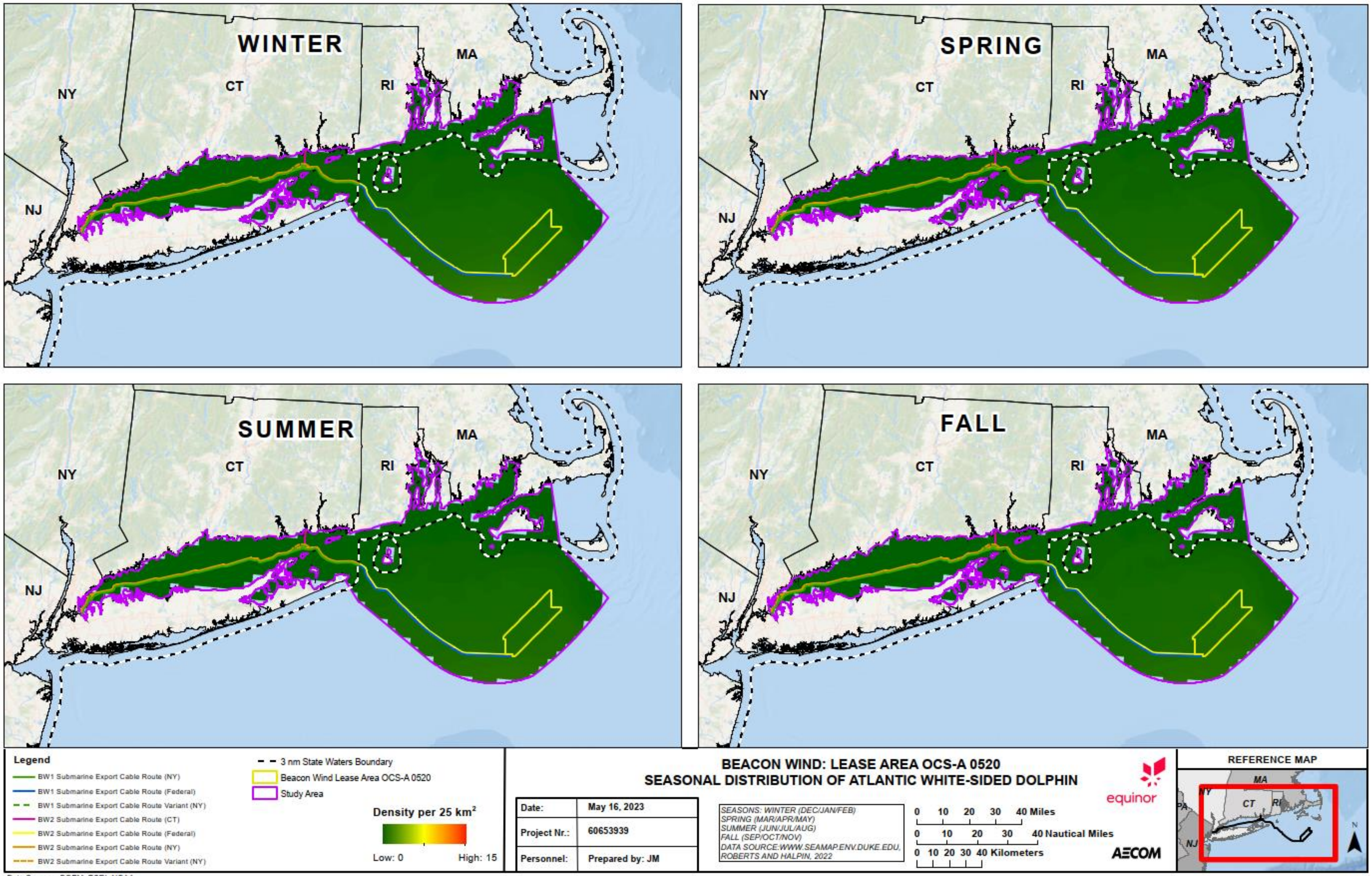
Atlantic white-sided dolphins are not listed as threatened or endangered under the ESA. The Atlantic white-sided dolphin is typically found in the cool temperate and subpolar waters of the North Atlantic, generally along the continental shelf between the Gulf Stream and the Labrador current to as far south as North Carolina (Bulloch 1993; Jefferson et al. 2015; Reeves et al. 2002). They are the most abundant dolphin in the Gulf of Maine and the Gulf of St. Lawrence but seem relatively rare along the North Atlantic coast of Nova Scotia (Kenney and Vigness-Raposa 2010).

Atlantic white-sided dolphins' range between 8.2 ft and 9.2 ft (2.5 m and 2.8 m) in length, with females being approximately 8 in (20 cm) shorter than males (Kenney and Vigness-Raposa 2010). Their hearing is in the mid-frequency range (Southall et al. 2007, 2019). This species is highly social and is commonly seen feeding with fin whales (NOAA 1993). Atlantic white-sided dolphins feed on a variety of small species, such as herring, hake, smelt, capelin, cod, and squid, with regional and seasonal changes in the species consumed (Kenney and Vigness-Raposa 2010). Sand lance is an important prey species for these dolphins in the Gulf of Maine during the spring. Other fish prey include mackerel, silver hake (*Merluccius bilinearis*), herring, smelt, and several other varieties of gadoids (Kenney and Vigness-Raposa 2010). Their hearing is in the mid-frequency range (Southall et al. 2007, 2019).

There are seasonal shifts in the distribution of Atlantic white-sided dolphins off the northeastern U.S. coast (**Figure 5.6-13**), with low abundance in winter between Georges Basin and Jeffreys Ledge and high abundance in the Gulf of Maine during spring. During the summer, Atlantic white-sided dolphins are most abundant between Cape Cod and the lower Bay of Fundy. During the fall, the distribution of Atlantic white-sided dolphins is similar to that in the summer, although they are less abundant (Department of the Navy (DoN) 2005). Recent population estimates for Atlantic white-sided dolphins in the western North Atlantic Ocean places this species at 93,233 individuals (Hayes et al. 2021; Lawson and Gosselin 2018; Palka 2020;).

This species may be found off the coast of southern New England during all four seasons of the year but is usually most numerous in areas farther offshore at depth range of 330 ft (100 m) (Bulloch 1993; Kenney and Vigness-Raposa 2010; Reeves et al. 2002). Atlantic white-sided dolphins were sighted 7 times (222 individuals) in 2011 to 2015 surveys of the MA/RI WEAs (Kraus et al. 2016; Stone et al. 2017). One group of Atlantic white-sided dolphins were observed during the 2020 MA WEA and MA/RI WEA large whale surveys (O'Brien et al. 2021b). Atlantic white-sided dolphins were not observed during the 2017/2018 and 2018/2019, or 2021 surveys (McKenna et al. 2021; O'Brien et al. 2021a; Quintana et al. 2019).

FIGURE 5.6-13. SEASONAL DISTRIBUTION OF THE ATLANTIC WHITE-SIDED DOLPHIN IN THE STUDY AREA



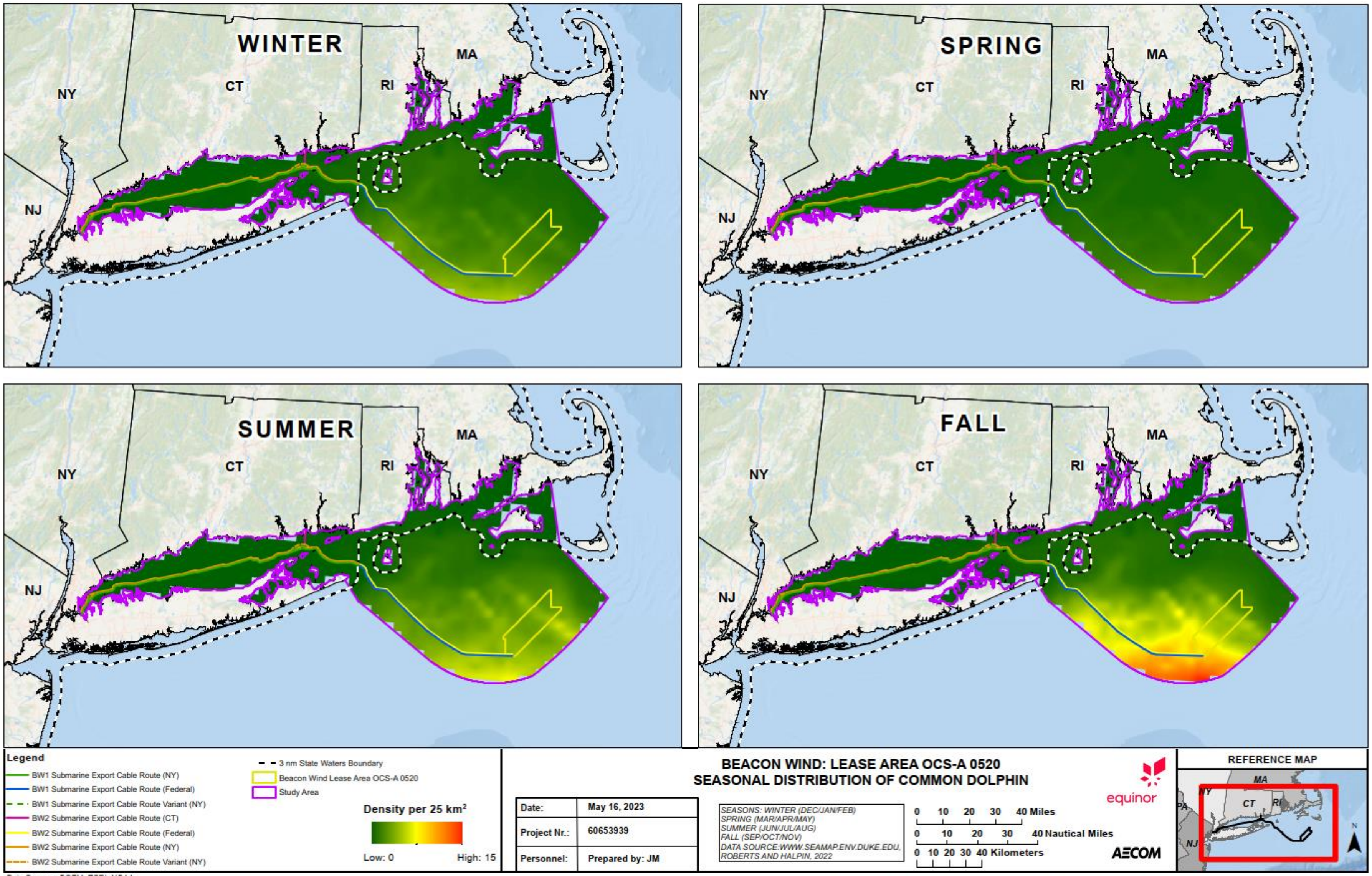
Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

5.6.1.2.6.6 Common Dolphin (Delphinus delphis) – Non-Strategic

Common dolphins are not listed as threatened or endangered under the ESA. The common dolphin is a widely distributed cetacean globally and occurs in temperate, tropical, and subtropical regions (Hayes et al. 2021; Jefferson et al. 2015;). Common dolphins feed on squids and small fish, including species that school in proximity to surface waters as well as mesopelagic species found near the surface at night (Jefferson et al. 2015; Perrin 2017). They have been known to feed on fish escaping from fishermen's nets or fish that are discarded from boats (NOAA 1993). This species is found between Cape Hatteras and Georges Bank from mid-January to May, although they migrate onto Georges Bank and the Scotian Shelf between mid-summer and fall, where large aggregations occur on Georges Bank in fall (Hayes et al. 2021). These dolphins can gather in schools of hundreds or thousands, although the schools generally consist of smaller groups of 30 or fewer. They are eager bow riders and are active at the surface (Reeves et al. 2002). The Common dolphin feeds on small schooling fish and squid. While this dolphin species can occupy a variety of habitats, common dolphins occur in greatest abundance within a broad band of the northeast edge of Georges Bank in the fall (Kenney and Vigness-Raposa 2010). According to the species stock report, the most reliable population estimate for the western North Atlantic common dolphin is approximately 172,947 individuals (Garrison 2020; Hayes et al. 2021; Lawson and Gosselin 2018; NEFSC and SEFSC 2018; Palka 2020). Their hearing is in the mid-frequency range (Southall et al. 2007, 2019).

Common dolphins can be found either along the 650- to 6,500-ft (198- to 1,981-m) isobaths over the continental shelf and in pelagic waters of the Atlantic and Pacific Oceans (**Figure 5.6-14**) (Hayes et al. 2021). They are present in the western Atlantic from Newfoundland to Florida (Hayes et al. 2021; Perrin 2017). The common dolphin is especially common along shelf edges and in areas with sharp bottom relief such as seamounts and escarpments (Reeves et al. 2002). They show a strong affinity for areas with warm, saline surface waters. Off the coast of the eastern U.S., they are particularly abundant in continental slope waters from Georges Bank southward to about 35 degrees north (Reeves et al. 2002) and usually inhabit tropical, subtropical, and warm-temperate waters (Hayes et al. 2021). This species has been sighted in the vicinity of the Lease Area and submarine export cable areas in 2011 and 2012 surveys (Kraus et al. 2013). 2,634 individuals were sighted over 64 sightings from 2011 to 2015 surveys of the MA/RI WEA areas (Kraus et al. 2016; Stone et al. 2017). Common dolphins were observed winter, summer, and fall during the 2017/2018, 2018/2019 MA WEA and MA/RI WEA large whale surveys, 2020, and during the winter and spring in 2021 (Quintana et al. 20219; O'Brien et al. 2021a, b; McKenna et al. 2021). During the 2021 New England Aquarium aerial line-transect surveys of MA and MA/RI, common dolphins were reported adjacent to the Lease Area (McKenna et al. 2021). During the Vineyard Wind HRG surveys, common dolphins were seen offshore of Massachusetts and in the Study Area (Vineyard Wind 2021).

FIGURE 5.6-14. SEASONAL DISTRIBUTION OF THE COMMON DOLPHIN IN THE PROJECT AND STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Document Path: C:\Users\MerolaD\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\Section 5.6 - Marine Mammals\Figure 5.6-14 Seasonal Distribution of the SB Common Dolphin.mxd

5.6.1.2.6.7 Common Bottlenose Dolphin (Tursiops truncatus) – Non-Strategic and Strategic

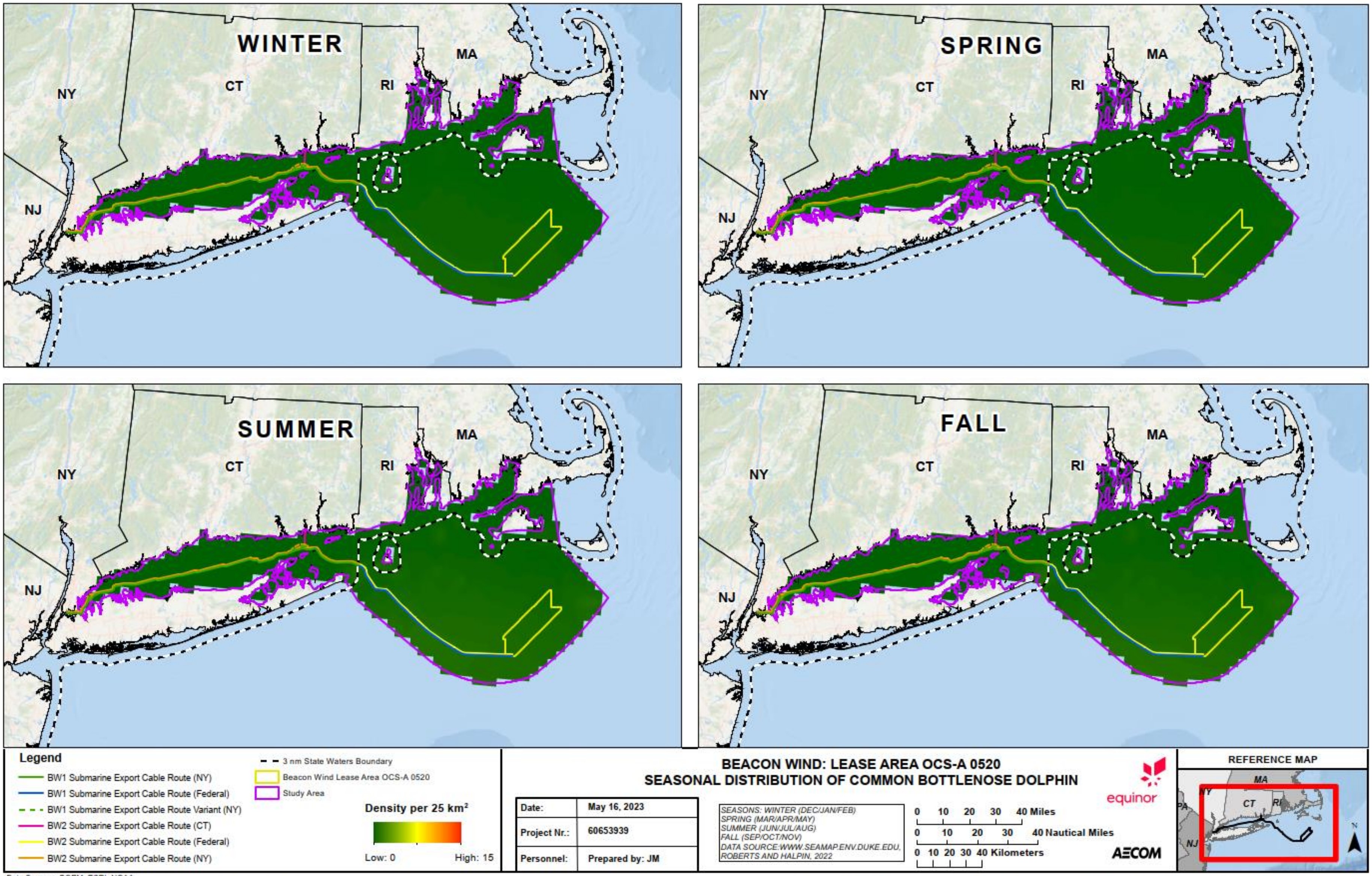
Common bottlenose dolphins (referred to as bottlenose dolphin) are not listed as threatened or endangered under the ESA. The common bottlenose dolphin is a light- to slate-gray dolphin, roughly 8 to 12 ft (2.4 to 3.7 m) long with a short, stubby beak. Because this species occupies a wide variety of habitats, it is regarded as possibly the most adaptable cetacean (Reeves et al. 2002). It occurs in oceans and peripheral seas at both tropical and temperate latitudes. In North America, bottlenose dolphins are found in surface waters with temperatures ranging from 10 to 32°C (50 to 90°F). Their hearing is in the mid-frequency range (Southall et al. 2007, 2019).

There are two distinct bottlenose dolphin morphotypes: coastal and migratory. The coastal morphotype resides along the inner continental shelf (within 4.5 mi [7.5 km] of shore) and around islands and is subdivided into seven stocks based largely upon spatial distribution (Hayes et al. 2021). These animals often move into or reside in bays, estuaries, and the lower reaches of rivers (Reeves et al. 2002). Generally, the offshore migratory morphotype is found exclusively seaward of 21 mi (34 km) and in waters deeper than 112 ft (34 m) (Hayes et al. 2017). This offshore population extends along the entire continental shelf break from Georges Bank to Florida during the spring and summer months and has been observed in the Gulf of Maine during the late summer and fall. However, south of Cape Hatteras, these morphotype ranges overlap to some degree. NOAA Fisheries species stock assessment report estimates the population of Western North Atlantic Offshore bottlenose dolphin stock at approximately 62,851 individuals and the Northern Migratory Coastal Stock at 6,639 individuals (Garrison 2020; Hayes et al. 2021; NEFSC and SEFSC 2018; Palka 2020). The Western North Atlantic Offshore stock is non-strategic; however, the Northern Migratory Coastal Stock is a strategic stock due to their depleted status under the MMPA (Waring et al. 2016).

This species has been sighted in the vicinity of the Lease Area and submarine export cable routes in 2011 and 2012 (Kraus et al. 2013) (**Figure 5.6-15**). In addition, there were 34 sightings of 275 individual common bottlenose dolphins during 2011 to 2015 surveys of the MA/RI WEA (Kraus et al. 2016; Stone et al. 2017). During the Beacon Wind High Resolution Geophysical Survey Campaign from April to July 2019 off New York, bottlenose dolphins occurred in the Study Area (Milne 2019). During the 2017 and 2018 MA WEA and MA/RI WEA large whale surveys, bottlenose dolphins were seen during all seasons (Quintana et al. 2019). Bottlenose dolphins were observed in the spring and summer of 2018/2019 and in the summer of 2020 during the MA WEA and MA/RI WEA large whale surveys (O'Brien et al. 2021a, b). During 2021, bottlenose dolphins were only seen in the winter (McKenna et al. 2021). During the Vineyard Wind HRG surveys, bottlenose dolphins were seen offshore of Massachusetts and in the Study Area (Vineyard Wind 2021).

Bottlenose dolphins feed on a large variety of organisms depending on their habitat. The coastal, shallow population tends to feed on benthic fish and invertebrates, while deepwater populations consume pelagic or mesopelagic fish such as croakers, sea trout, mackerel, mullet, and squid (Reeves et al. 2002). Bottlenose dolphins appear to be active both during the day and night. Their activities are influenced by the seasons, time of day, tidal state, and physiological factors such as reproductive seasonality (Wells and Scott 2017).

FIGURE 5.6-15. SEASONAL DISTRIBUTION OF THE COMMON BOTTLENOSE DOLPHIN IN THE PROJECT AND STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Document Path: C:\Users\MarolaD\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\Section 5.6 - Marine Mammals\Figure 5.6-15 Seasonal Distribution of the Common Bottlenose Dolphin.mxd

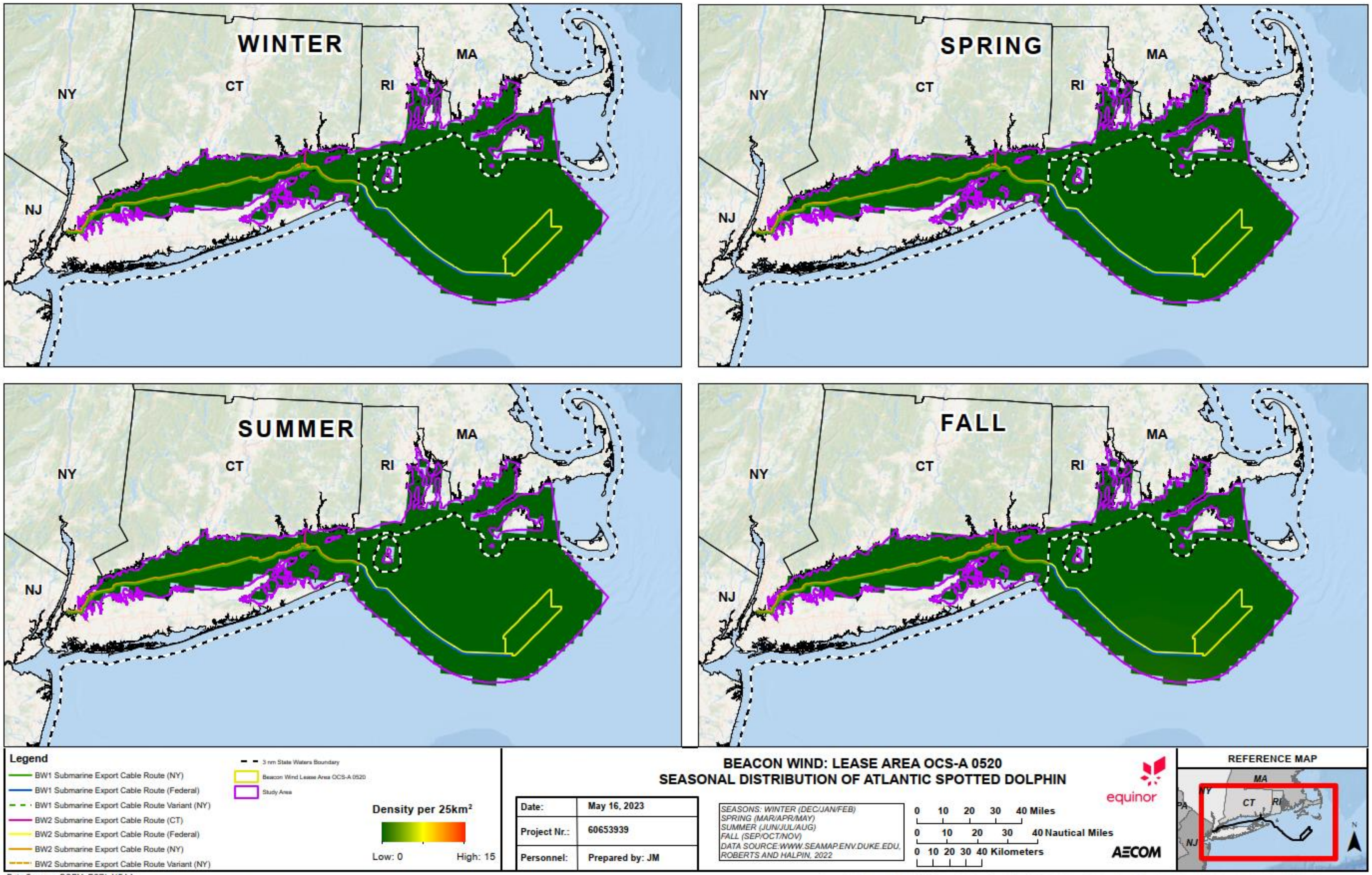
5.6.1.2.6.8 Atlantic Spotted Dolphin (Stenella frontalis) – Non-Strategic

Atlantic spotted dolphins are not listed as threatened or endangered under the ESA. The Atlantic spotted dolphin inhabits tropical, warm waters of the western North Atlantic typically along the continental shelf (Leatherwood et al. 1976). They have a wide range of distribution in the western North Atlantic from southern New England through the Gulf of Mexico, extending south to the Caribbean and Venezuela (Leatherwood et al. 1976; Perrin et al. 1994). The diet of the Atlantic spotted dolphin consists of a wide variety of prey, such as fish, squid, and benthic invertebrates (Herzing 1997). Their hearing is in the mid-frequency range (Southall et al. 2007, 2019).

The seasonal distribution of the Atlantic spotted dolphin is not well known, but it has been suggested that they travel more inshore in spring (Caldwell and Caldwell 1966; Fritts et al. 1983). The Atlantic spotted dolphin is hard to distinguish from the pantropical spotted dolphin (*S. attenuata*) at sea, and their range is likely to overlap in tropical waters (Fulling et al. 2003; Mullin and Fulling 2003; Perrin et al. 1987; Waring et al. 2016). Additionally, there are two ecotypes of Atlantic spotted dolphin; the smaller, less-spotted ecotype is not likely to occur in the Gulf of Mexico (Fulling et al. 2003; Mullin and Fulling 2003; Viricel and Rosel 2014).

It is likely that the Atlantic spotted dolphin is relatively rare in the Lease Area and near the submarine export cable routes, as these dolphins typically spend their time along the continental shelf and southern New England is the northernmost area of their range (**Figure 5.6-16**), but they may still be affected by surveying activities (BOEM 2014). Their hearing is in the mid-frequency range (Southall et al. 2007, 2019). The most reliable abundance estimates for Atlantic spotted dolphins, from 2016 surveys, is 39,921 individuals (Garrison 2020; Hayes et al. 2021; NEFSC and SEFSC 2018; Palka 2020). There have been no recent UMEs declared for the Atlantic spotted dolphin. During the 2011 to 2015 surveys of the MA/RI WEA, Atlantic spotted dolphins were not seen (Kraus et al. 2016; Stone et al. 2017). Atlantic spotted dolphins have not been observed during the 2017 through 2021 surveys (McKenna et al. 2021; O'Brien et al. 2021a, b; Quintana et al. 2019).

FIGURE 5.6-16. SEASONAL DISTRIBUTION OF THE ATLANTIC SPOTTED DOLPHIN IN THE PROJECT AND STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Document Path: C:\Users\MarolaD\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\Section 5.6 - Marine Mammals\Figure 5.6-16 Seasonal Distribution of the Atlantic Spotted Dolphin.mxd

5.6.1.2.6.9 Harbor Porpoise (Phocoena phocoena) – Non-Strategic

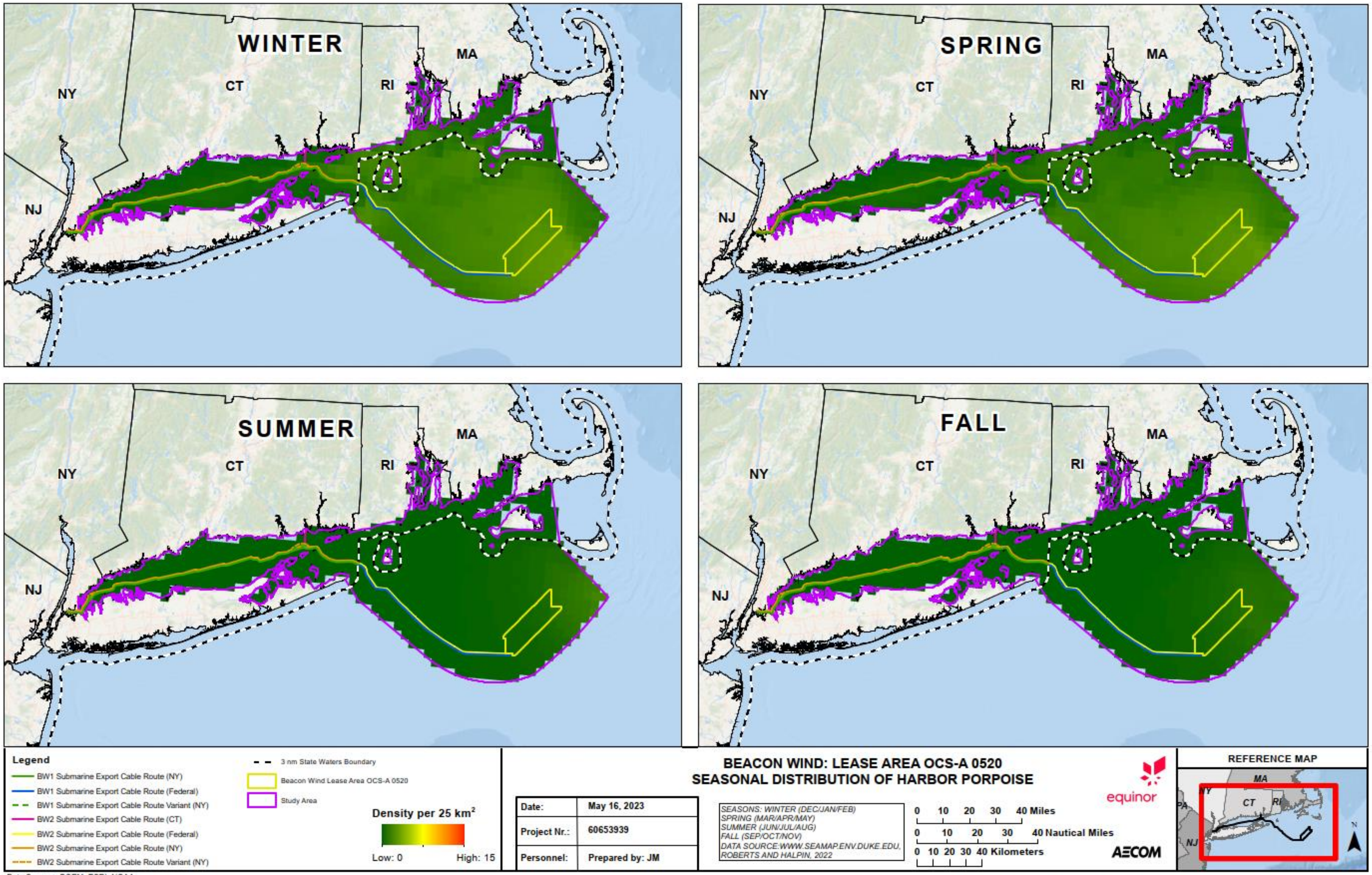
Harbor porpoise are not listed as threatened or endangered under the ESA. The harbor porpoise inhabits shallow, coastal waters, often found in bays, estuaries, and harbors. In the western Atlantic, they are found from Cape Hatteras north to Greenland (Hayes et al. 2021). They are likely to occur frequently in southern New England waters year-round but are most likely to be present in spring when migration brings them toward the Gulf of Maine feeding grounds from their wintering areas offshore and in the mid-Atlantic (Kenney and Vigness-Raposa 2010). After April, they migrate north towards the Gulf of Maine and Bay of Fundy. Harbor porpoises are the smallest North Atlantic cetacean, measuring at only 4.6 to 6.2 ft (1.4 to 1.9 m), and feed primarily on fish, but also prey on squid and crustaceans (Kenney and Vigness-Raposa 2010; Reeves and Reed 2002).

Sighting records from the 1978 to 1981 CeTAP surveys showed porpoises in spring exhibited highest densities (**Figure 5.6-17**) in the southwestern Gulf of Maine in proximity to the Nantucket Shoals and western Georges Bank, with presence throughout the southern New England shelf and Gulf of Maine (CeTAP 1982). While strandings have occurred throughout the south shore of Long Island and coastal Rhode Island, many sightings have occurred offshore in the OCS area (Kenney and Vigness-Raposa 2010). From 2011 to 2015, there were 18 sightings of 91 total harbor porpoises in the MA/RI WEAs (Kraus et al. 2016; Stone et al. 2017). Harbor porpoises were regularly detected during PAM offshore of Maryland during the winter and spring, particularly from January to May between November 2014 to May 2016 (Wingfield et al. 2017). During the 2017 and 2018 MA WEA and MA/RI WEA large whale surveys, harbor porpoise were observed during all seasons (Quintana et al. 2019). Harbor porpoise were observed in the winter, spring, and summer during the 2018 and 2019 and in the summer during the 2020 MA WEA and MA/RI WEA large whale surveys (O'Brien et al. 2021a, b). During the 2020-2021 MA WEA and MA/RI WEA large whale surveys, harbor porpoise were observed during the winter (McKenna et al. 2021).

The North Atlantic harbor porpoise population is likely to be over 500,000 (Kenney and Vigness-Raposa 2010). The current population estimate for harbor porpoise for the Gulf of Maine/Bay of Fundy stock is 95,543 (Hayes et al. 2021; Lawson and Gosselin 2018; Palka 2020). Harbor porpoise hearing is in the high-frequency range (Southall et al. 2007, 2019).

In 2001, the harbor porpoise was removed from the candidate species list for the ESA; a review of the biological status of the stock indicated that a classification of "Threatened" was not warranted (Waring et al. 2009). This species has been listed as "non-strategic" because average annual human-related mortality and injury does not exceed the potential biological removal (Hayes et al. 2021).

FIGURE 5.6-17. SEASONAL DISTRIBUTION OF THE HARBOR PORPOISE IN THE PROJECT AND STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

Document Path: C:\Users\MarcelaD\AECOM\Equinor - Site Folders\Reports\BW2 COP\working\Section 5.6 - Marine Mammals\Figure 5.6-17 Seasonal Distribution of the Harbor Porpoise.mxd

5.6.1.2.6.10 Harbor Seal (Phoca vitulina) – Non-Strategic

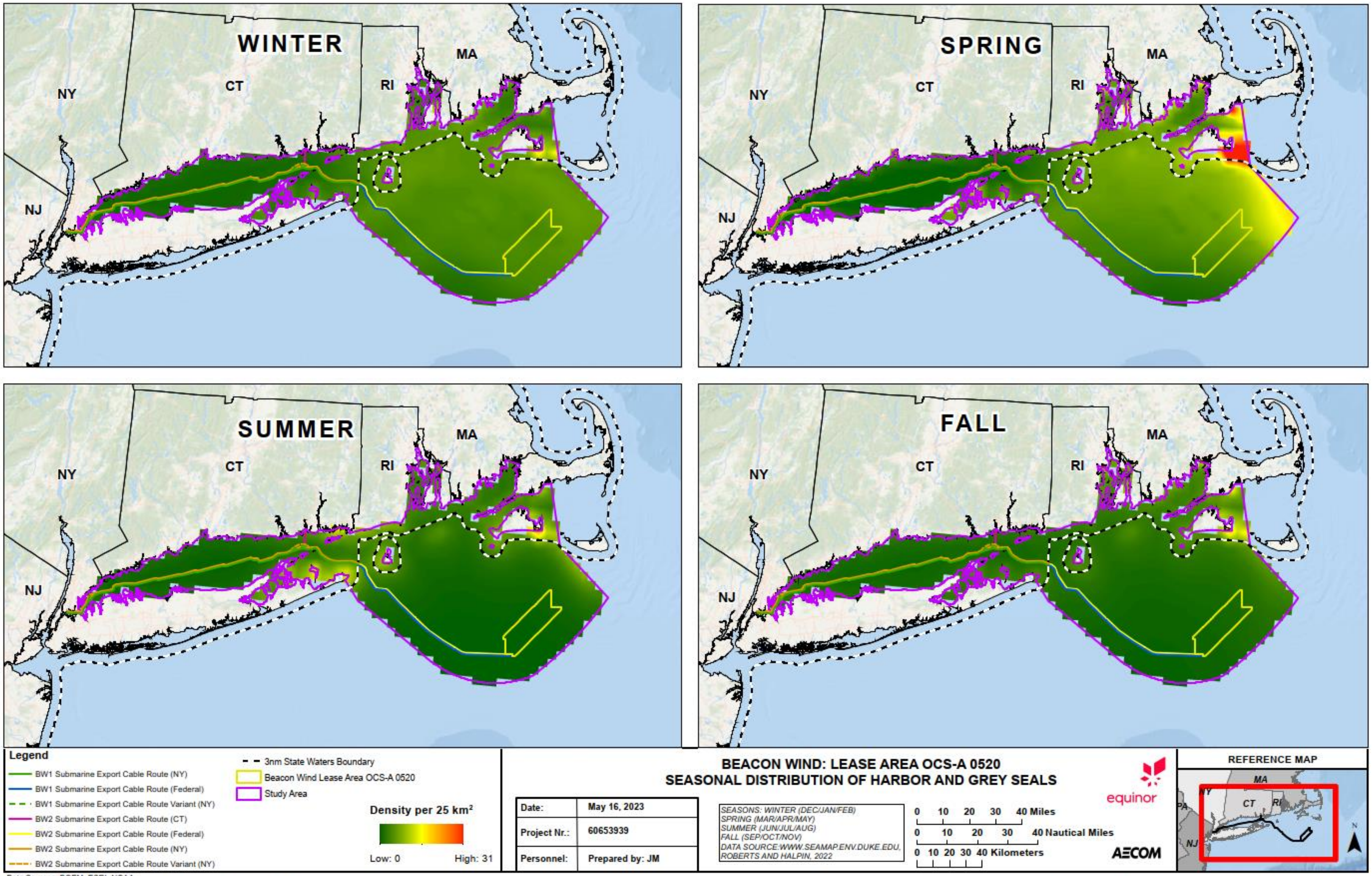
Harbor seals are not listed as threatened or endangered under the ESA. Harbor seals are the most abundant seals in eastern U.S. waters and are commonly found in nearshore waters of the Atlantic Ocean and adjoining seas above northern Florida; however, their "normal" range is probably only south to New Jersey. While harbor seals occur year-round north of Cape Cod, they only occur during winter migration, typically September through May, south of Cape Cod (Southern New England to New Jersey) (Hayes et al. 2021; Kenney and Vigness-Raposa 2010) (**Figure 5.6-18**). During the summer, most harbor seals can be found north of New York, within the coastal waters of central and northern Massachusetts, as well as the Bay of Fundy (DoN 2005). Harbor seals are relatively small pinnipeds, with adults ranging between 5.6 and 6.2 ft (1.7 and 1.9 m) in length, with females being slightly smaller than males (Kenney and Vigness-Raposa 2010; Jefferson et al. 1993; Wynne and Schwartz 1999). Their hearing ranges from 100 Hz to 12 kHz (Southall et al. 2007). WEA surveys from MA/RI have not reported any harbor seal sightings; however, there were vertical camera detections of this species (Kraus et al. 2016; McKenna et al. 2021; O'Brien et al. 2021a, b; Quintana et al. 2019).

Harbor seals prey upon small to medium-sized fish, octopus, and squid, and to some extent shrimp and crabs (Kenney and Vigness-Raposa 2010). Fish eaten by harbor seals include commercially important species such as mackerel, herring, cod, hake, smelt, shad, sardines, anchovy, capelin, salmon, rockfish, sculpins, sand lance, trout, and flounders. They spend about 85 percent of the day diving, and much of the diving is presumed to be active foraging in the water column or on the seabed. They dive to depths of about 30 to 500 ft (10 to 150 m), depending on location. Harbor seals forage in a variety of marine habitats, including deep fjords, coastal lagoons and estuaries, and high-energy, rocky coastal areas. They may also forage at the mouths of freshwater rivers and streams, occasionally traveling several hundred miles upstream (Reeves et al. 2002). They haul out on sandy and pebble beaches, intertidal rocks and ledges, and sandbars, and occasionally on ice floes in bays near calving glaciers. Major harbor seal haul-outs occur off New York, Connecticut, Rhode Island, and Massachusetts (Kenney and Vigness-Raposa 2010; McCormack 2015; Pace et al. 2019; Woo and Biolsi 2018) (**Figure 5.6-18**, **Table 5.6-2**). See gray seal section for harbor seal haul-outs.

Except for a strong bond between mothers and pups, harbor seals are generally intolerant of close contact with other seals. Nonetheless, they are gregarious, especially during the molting season, which occurs between spring and autumn, depending on geographic location. They may haul out to molt at a tide bar, sandy or cobble beach, or exposed intertidal reef. During this haul-out period, they spend most of their time sleeping, scratching, yawning, and scanning for potential predators such as humans, foxes, coyotes, bears, and raptors (Reeves et al. 2002). In late autumn and winter, harbor seals may be at sea continuously for several weeks or more, presumably feeding to recover body mass lost during the reproductive and molting seasons and to fatten up for the next breeding season.

Beginning in July 2018, increased numbers of gray seal and harbor seal mortalities occurred across Maine, New Hampshire, and Massachusetts (NOAA Fisheries 2021d). The event was declared the 2018–2020 Pinniped UME along the northeast coast which encompassed seal strandings from Massachusetts to Virginia (NOAA Fisheries 2021d); however, the UME has been deemed non-active and is pending closure by NOAA Fisheries. Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NOAA Fisheries considers this species as "non-strategic" (Hayes et al. 2021). Currently, the most reliable abundance estimate for harbor seals is approximately 61,336 for the Western North Atlantic stock (Waring et al.et al. 2015; Hayes et al. 2021).

FIGURE 5.6-18. SEASONAL DISTRIBUTION OF THE HARBOR SEAL AND GRAY SEAL IN THE PROJECT AND STUDY AREA



Data Sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

5.6.1.2.6.11 Gray Seal (Halichoerus grypus) – Non-Strategic

Gray seals are not listed as threatened or endangered under the ESA. The gray seal occurs in cold temperate to sub-arctic waters in the North Atlantic and is partitioned into three major populations occurring in eastern Canada, northwestern Europe, and the Baltic Sea (Jefferson et al. 2015; Kenney and Vigness-Raposa 2010). The western North Atlantic stock is considered to be the same population as the one found in eastern Canada, and ranges between New England and Labrador (Waring et al. 2007). As exhibited in harbor seal populations, gray seals occur most often in the waters off of Massachusetts during winter and spring and spend summer and fall off northern Massachusetts and in Canadian waters (DoN 2005). Gray seals exhibit sexual dimorphism, with adult males reaching 7.5 ft (2.3 m) long and females reaching 6.6 ft (2.0 m) (Jefferson et al. 1993; Kenney and Vigness-Raposa 2010; Wynne and Schwartz 1999). The gray seal is primarily found in coastal waters and forages in OCS regions (Lesage and Hammill 2001).

Gray seals are gregarious, gathering to breed, molt, and rest in groups of several hundred or more at island coasts and beaches or on land-fast ice and pack-ice floes. They are thought to be solitary when feeding and telemetry data indicates that some seals may forage seasonally in waters close to colonies, while others may migrate long distances from their breeding areas to feed in pelagic waters between the breeding and molting seasons (Reeves et al. 2002). Gray seals molt in late spring or early summer and may spend several weeks ashore during this time. When feeding, most seals remain within 45 mi (72 km) of their haul out sites. Gray seals feed on numerous fish species and cephalopods (Kenney and Vigness-Raposa 2010). Gray seal scat samples from Muskeget Island, Massachusetts, included species such as sand lance, skates, flounder, silver hake, and gadids (Kenney and Vigness-Raposa 2010). Their hearing ranges from 75 Hz to 75 kHz (Southall et al. 2007).

Gray seals form colonies on rocky island or mainland beaches, though some seals give birth in sea caves or on sea ice, especially in the Baltic Sea. Gray seals prefer haul out and breeding sites that are surrounded by rough seas and riptides where boating is hazardous. Pupping colonies have been identified at Muskeget Island (Nantucket Sound), Monomoy National Wildlife Refuge, and in eastern Massachusetts (Rough 1995) (**Figure 5.6-18**). Total western Atlantic gray seal population estimates in U.S. waters are 27,300 individuals derived from total population size to pup ratios in Canada, applied to U.S. pup counts (Hayes et al. 2021; NMFS 2021a). However, the gray seal colony off Massachusetts has more than 5,600 seals total and there are more than 1,700 individuals in Massachusetts (Waring et al. 2007). This species has been reported with greater frequency in waters south of Cape Cod in recent years, likely due to a population rebound in southern New England and the mid-Atlantic (Kenney and Vigness-Raposa 2010); however, most gray seals present are juveniles dispersing in the spring. The only consistent haul-out locations within the vicinity of the Lease Area and submarine export cable routes are on Muskeget Island and Nantucket in Massachusetts, Fisher's Island in Connecticut, and Great and Little Gull Islands just off Long Island, New York (**Figure 5.6-19**). MA/RI WEA surveys during the 2011 to 2015 did not report any gray seal sightings; however, there were vertical camera detections of this species (Kraus et al. 2016). Gray seals were observed during the 2017/2018, 2018/2019, and 2020 MA WEA and MA/RI WEA large whale surveys (O'Brien et al. 2021a, b; Quintana et al. 2019). During the 2021 MA WEA and MA/RI WEA large whale surveys, gray seals have been observed during the winter and spring (McKenna et al. 2021). During the Vineyard Wind HRG surveys, gray seals were observed offshore of Massachusetts and in the Study Area (Vineyard Wind 2021).

See the harbor seal section above regarding the 2018-2020 Pinniped UME along the northeast coast. Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NOAA Fisheries considers this species as “non-strategic” (Hayes et al. 2021).

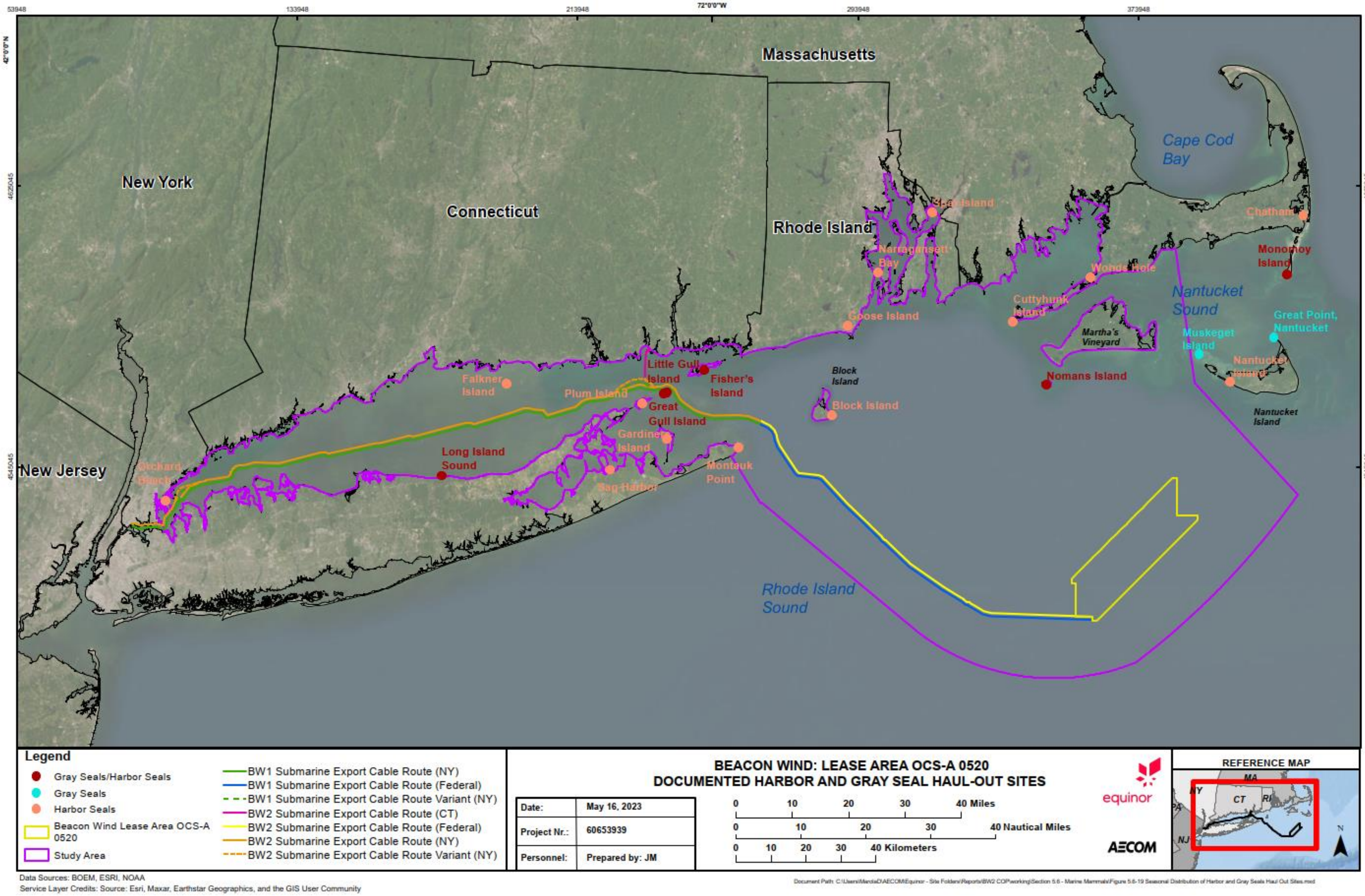
The major harbor seal and gray seal haul-outs found off New York, Connecticut, Rhode Island, and Massachusetts are detailed in **Table 5.6-6** (Kenney and Vigness-Raposa 2010; Pace et al. 2019) and are shown in **Figure 5.6-19.**

TABLE 5.6-6. MAJOR HARBOR AND GRAY SEAL HAUL-OUT LOCATIONS OFF NEW YORK, CONNECTICUT, RHODE ISLAND, AND MASSACHUSETTS

Haul-out Location	State	Harbor Seal	Gray Seal
Nantucket Island	Massachusetts	X	
Cuttyhunk Island	Massachusetts	X	
Woods Hole	Massachusetts	X	
Narragansett Bay	Rhode Island	X	
Block Island	Rhode Island	X	
Montauk Point	New York	X	
Gardiners Island	Connecticut	X	
Sag Harbor	Connecticut	X	
Falkner Island	Connecticut	X	
Long Island Sound	New York	X	
Spar Island	Rhode Island	X	
Chatham	Massachusetts	X	
Plum Island	Massachusetts	X	
Goose Island	New York	X	
Orchard Beach	New York	X	
Hoffman Island	New York	X	
Swinburne Island	New York	X	
Muskeget Island	Massachusetts		X
Great Point	Massachusetts		X
Nomans Island	Massachusetts	X	X
Monomoy Island	Massachusetts	X	X
Fisher’s Island	Connecticut	X	X
Great Gull Island	New York	X	X
Little Gull Island	New York	X	X

Source: Kenney and Vigness-Raposa 2010; McCormack 2015; Pace et al. 2019; Woo and Biolsi 2018.

FIGURE 5.6-19. SEAL HAUL-OUT SITES IN AND NEAR THE STUDY AREA



5.6.1.2.6.12 Harp Seal (Pagophilus groenlandicus) – Non-Strategic

Harp seals are not listed as threatened or endangered under the ESA. The harp seal occurs throughout much of the North Atlantic and Arctic Oceans (Lavigne and Kovacs 1988; Ronald and Healey 1981). The Western North Atlantic stock is also known as the Front/Gulf stock, which is a combination of the Front and Gulf herds that breed off the coast of Newfoundland and Magden Island in the Gulf of St. Lawrence, respectively (Hayes et al. 2021). Harp seals consume a variety of prey, such as pelagic and benthic fish species, invertebrates, and krill (NOAA Fisheries 2018e). They are a highly migratory species that congregate for breeding from late February to April then assemble again for the annual molt (Sergeant 1965; Stenson and Sjare 1997). They continue north in the summer to their feeding grounds in the Arctic. Their hearing ranges from 50 Hz to 86 kHz (Southall et al. 2007).

The southern limit of the harp seal's range extends into the U.S. EEZ in winter and spring (Hayes et al. 2021). Since the 1990's, harp seal sightings and strandings have increased in the U.S. from the coasts of Massachusetts to New Jersey and have even been sighted as far south as North Carolina (Katona et al. 1993; Lacoste and Stenson 2000; McAlpine 1999; Rubinstein 1994; Stevick and Fernald 1998; Soulen et al. 2013). Although harp seal sightings have increased along the U.S. Atlantic coastline, currently the species has no established haul out locations exhibiting site fidelity, with individual seals occasionally hauling out in areas where they are sighted or stranded. Most sightings or strandings have occurred from January to May when harp seals are at the southern extent of their yearly migration (Harris et al. 2002). While harp seals are the least likely pinniped to occur in the Lease Area and submarine export cable routes compared to gray seals or harbor seals (Kenney and Vigness-Raposa 2010), there is potential they may be encountered. However, MA/RI WEA surveys have not reported any harp seal sightings (Kraus et al. 2016; McKenna et al. 2021; O'Brien et al. 2021a, b; Quintana et al. 2019).

There are insufficient data to calculate the minimum population present in the U.S. due to low sighting rates (Hayes et al. 2021). The most reliable abundance estimate of the Western North Atlantic stock is 7.6 million harp seals (NMFS 2021a). From 2012 to 2016, 174 harp seals stranded in the U.S. Since July 2018, increased numbers of gray seal and harbor seal mortalities had occurred across Maine, New Hampshire, and Massachusetts (NOAA Fisheries 2021d). The event was declared the 2018–2020 Pinniped UME along the northeast coast which encompassed seal strandings from Massachusetts to Virginia (NOAA Fisheries 2021d). Harp seals also started stranding with clinical signs, again not in elevated numbers, and this species was added to the UME investigation (NOAA Fisheries 2021d); however, the UME has been deemed non-active and is pending closure by NOAA Fisheries.

5.6.2 Impacts Analysis for Construction, Operations, and Decommissioning

The potential impacts resulting from the construction, operations, and decommissioning of the Project are based on the maximum design scenario from the PDE (see **Section 3 Project Description**). For marine mammals, the maximum design scenarios based on a full Project build-out are outlined in detail in **Table 5.6-7**. The maximum design scenario for assessments with full build-out of the Project includes the installation of up to 155 wind turbines and two offshore substation facilities within the Lease Area, with one submarine export cable corridor route for BW1 to Queens, New York and one submarine export cable corridor route for BW2 to Queens, New York or to Waterford, Connecticut. The foundation types that will be used for the Project include monopiles, piled jackets, or suction bucket jackets for wind turbines, and piled jacket or suction bucket foundations for the two offshore substation facilities (see **Section 3.3.1 Offshore Infrastructure** for descriptions). Supporting calculations for the maximum design scenario are provided in **Table 5.6-7, Table 5.6-8,** and **Table 5.6-9**.

TABLE 5.6-7. SUMMARY OF MAXIMUM DESIGN SCENARIO PARAMETERS FOR MARINE MAMMALS

Parameter	Maximum Design Scenario	Rationale
Construction		
Offshore structures	Based on full build-out of the Project (BW1 and BW2) (155 turbines and two offshore substation facilities).	Representative of the maximum number of structures.
Wind turbine foundation	Monopile, piled jacket	Representative of foundation options that have installation methods that would result in the maximum introduction of underwater noise.
Wind turbine foundation installation method underwater noise	Pile driving	Representative of the installation method that would result in the loudest underwater noise generated.
Duration foundation installation	Based on full build-out of the Project (BW1 and BW2) (155 wind turbines and two offshore substation facilities).	Representative of the longest period of foundation installation via pile driving.
Underwater noise pile driving – single monopile	Pile diameter: 43 ft (13 m) Max penetration: 180 ft (55 m) Max hammer energy: 6,600 kJ[10] Total max pile driving duration per foundation: 4.8 hours Total duration for 155 wind turbines: BW1 and BW2: 744 hours	The longest temporal duration of impact for monopiles, which equates to the maximum number of pile driving events.
Underwater noise pile driving – piled jacket	Pile diameter: 14.7 ft (4.5 m) Max penetration: 230 ft (70 m) Number of piles per foundation: 4 Max hammer energy: 2,300 kJ[11] Total max pile driving duration per foundation: 24 hours (6.1 hours per pile) Total duration for 155 wind turbines: BW1 and BW2: 3,100 hours	The longest temporal duration of impact for piled jackets, which equates to the maximum number of pile-driving events.

[10] Total rated energy shown; actual effective energy level will not exceed 6,208 kJ.
[11] Total rated energy shown; actual effective energy level will not exceed 2,168 kJ.

Parameter	Maximum Design Scenario	Rationale
Underwater noise pile driving – piled offshore substation facilities	Pile diameter: 9.8 ft (3 m) Max penetration: 328 ft (100 m) Max number of corner legs piled: 4 Max hammer energy: 2,850 kJ[12] Total max pile driving duration per pile: 8.3 hours Total number of piles for: BW1: 3 BW2: 6 Total number of piles per leg: BW1: 12 BW2: 24 Total duration for two offshore substation facilities: BW1 and BW2: 299 hours	The longest temporal duration of impact for piled jackets for offshore substation facilities, which would result in the maximum of two offshore substation facilities. 299 hours is considered the maximum amount of time required to drive pile driven jackets for two offshore substation facilities (active pile driving).
Project-related vessels collision risk underwater noise	Based on full build-out of the Project (BW1 and BW2) (155 wind turbines, two offshore substation facilities, submarine export cables, and associated interarray cables) and maximum associated vessels.	Representative of the maximum predicted Project-related vessels for collision risk and underwater vessel noise.
Operations and Maintenance		
Wind turbines underwater noise	Based on a full build-out of the Project (BW1 and BW2) (155 wind turbines).	Representative of the maximum underwater noise generated by the operational wind turbines.
Project-related vessels collision risk underwater noise	Based on full build-out of the Project (BW1 and BW2) (155 wind turbines, two offshore substation facilities, submarine export cables, and associated interarray cables). Based on maximum number of vessels and movements for servicing and inspections.	Representative of the maximum predicted Project-related vessels for collision risk and underwater vessel noise.
Wind turbine and offshore substation facilities foundation and scour protection habitat loss	Wind turbine Based on suction bucket jacket which represent the maximum overall footprint (155 x 3.0 ac [1.2 ha] with scour protection). Total 465 ac (188 ha) including scour protection. Offshore Substation Facilities Based on suction bucket jacket, which represents the maximum overall footprint (2 x 5.2 ac [2.1 ha] with scour protection). Total 10.4 ac (4.2 ha) including scour protection.	Representative of the maximum area of foundation and scour protection installed, which would result in the maximum long-term loss of seabed habitat.

[12] Total rated energy shown; actual effective energy level will not exceed 2,168 kJ.

Parameter	Maximum Design Scenario	Rationale
Electromagnetic fields (EMF) interarray cables	Based on full build-out of the Project (BW1 and BW2) with the maximum number of structures (155 wind turbines and two offshore substation facilities) to connect: BW1: 162 nm (300 km) BW2: 162 nm (300 km)	Representative of the maximum length of interarray cables, which would result in the maximum exposure to EMF within the Lease Area.
EMF submarine export cables	Based on full build-out of the Project (BW1 and BW2): • BW1to Queens, New York (202 nm [375 km]). • BW2: ○ To Queens, New York (202 nm [375 km]) or ○ To Waterford, Connecticut (113 nm [209 km]).	Representative of the maximum number and length of submarine export cables, which would result in the maximum exposure to EMF on the cable routes.

Table 5.6-8. Supporting Calculations: Maximum Design Scenario for Benthic Impacts Offshore – Total Habitat Conversion to Hardbottom

Type and Size	Number of Structures	Foundation Diameter at Substrate	Total Foundation Footprint with Scour Protection	Total Benthic Habitat Conversion	Rank by Total Habitat Conversion (max. first)
Wind Turbines					
Suction Bucket jacket	155	66 ft (20 m) a/	3.0 ac (1.2 ha)	465 ac (188 ha)	1
Piled Jacket	155	14.7 ft (4.5 m) b/	1.9 ac (0.77 ha)	295 ac (119 ha)	2
Monopile	155	43 ft (13 m)	1.24 ac (0.50 ha)	192 ac (78 ha)	3
Offshore Substation Facilities					
Suction Bucket Jacket	2	65 ft (20 m) a/	5.2 ac (2.1 ha)	10.4 ac (4.2 ha)	1
Piled Jacket	2	9.8 ft (3.0 m) b/	4.0 ac (1.6 ha)	8.0 ac (3.2 ha)	2

Note: Additional information about foundations and scour protection is provided in **Section 3.3.1 Offshore Infrastructure**.

a/ Maximum diameter of individual bucket; represents up to four buckets per wind turbine or offshore substation foundation.

b/ Maximum diameter of individual piles; represents up to four piles per wind turbine foundation and up to 16 piles per offshore substation foundation.

TABLE 5.6-9. SUPPORTING CALCULATIONS: TOTAL TEMPORARY BENTHIC IMPACT FROM OTHER PROJECT COMPONENTS

Component	Distance	Width of Impact	Total Benthic Temporary Habitat Impact
Submarine Export Cables a/			
BW1 to Queens, New York	202 nm (375 km)	33 ft (10m)	929 ac (376 ha)
BW2 to Queens, New York	202 nm (375 km)	33 ft (10m)	929 ac (376 ha)
BW2 to Waterford, Connecticut	113 nm (209 km)	33 ft (10m)	520ac (210 ha)
Interarray Cables a/			
BW1	162 nm (300 km)	33 ft (10m)	746 ac (302 ha)
BW2	162 nm (300 km)	33 ft (10m)	746 ac (302 ha)
Other Construction Components b/ c/			
Anchoring	TBD	3,000 ft (914 m)	TBD

Note:
TBD – To be determined
a/ Footprint is a conservative estimate based on the widest trench generating tool (e.g., jet plow) and its outer width of disturbance.
b/ Mats are installed within the same footprint as proposed scour measures and therefore do not incur a separate temporary impact outside of what has already been accounted with permanent scour conversion.
c/ Project is not proposing chain sweep during vessel installation activities.

As discussed in **Section 5.6.1.2,** there is no critical habitat for marine mammals in the Project Area under the current design; however, the western boundary for critical habitat (Northeastern U.S. Foraging Area, Unit 1) for the North Atlantic right whale is located northeast of Nantucket and Martha's Vineyard and adjacent to the Lease Area approximately 40 mi (64 km) away (See **Figure 5.6-4**). As part of the Final Rule 81 CFR 4837, timing (seasonal) and geographic area (spatial) restrictions for construction and decommissioning activities may be recommended by NOAA Fisheries to address potential impacts to North Atlantic right whales. Examples of these restrictions will be discussed in more detail in this section as they relate to specific impact producing factors.

NOAA Fisheries has also designated certain geographic locations as SMAs for North Atlantic right whales with the intent to reduce the likelihood of vessel collisions. While the Lease Area lies fully outside of any SMA, the cable corridor crosses the Block Island Sound SMA. This SMA is active annually between November 1 and April 30 and requires vessels 65 feet (20 m) or greater in length to adhere to a mandatory 10-knots or less speed limit. Construction that occurs in the portion of the submarine export cable corridors that coincides with the SMA inherently increases the impact producing factors for North Atlantic right whales and will be examined in more detail in **Sections 5.6.2.1** and **5.6.3.1**.

There are several documented haul-out areas for pinnipeds across Connecticut, Massachusetts, New York, and Rhode Island, (see **Section 5.6.1.2.6.11 Gray Seal (*Halichoerus grypus*) – Non-Strategic** and **Figure 5.6-19**). Some of these are located adjacent to the planned submarine export cable routes and landfall locations, with both gray and harbor seal locations (Great and Little Gull Islands, and Plum Island, respectively) being the closest to the submarine export cable routes through Block Island Sound. These haul-outs are approximately 0.65 nm (1.2 km) and 2.62 nm (4.86 km) away from the proposed submarine export cable routes (**Figure 5.6-18**). There is another documented gray seal haul-out located at Orchard Beach in The Bronx, New York west of and approximately 1.60 nm (2.96 km) from the submarine export cable routes (Woo and Biolsi 2018). The installation work may have short-term temporary effects at haul-outs at Great and Little Gull Islands and Orchard Beach. Despite the two planned submarine export cable routes coming into New York and Connecticut state waters in the vicinity of known seal haul-outs, it is not expected to have significant impacts to seals using the majority of onshore haul-outs in the region. Any potential impacts to seal haul-outs in the region are expected to be negligible, with temporary turbidity and disturbance of habitat being the most likely impact producing factors to consider and will be discussed in more detail below.

5.6.2.1 *Construction*

During construction, the potential impact-producing factors affecting marine mammal species may include:

- Installation of offshore components, including foundations, wind turbines, offshore substation facilities, the submarine export cables and interarray cables, and associated vessel traffic.

The following impacts may occur as a consequence of factors identified above:

- Short-term (<2 year) disturbance of habitat;
- Short-term (<2 year) loss of local prey species and availability;
- Short-term (<2 year) increase in marine debris;
- Short-term (<2 year) increase in Project-related underwater noise;
- Short-term (<2 year) increased risk for vessel strike and collisions due to the increase in vessel traffic;
- Short-term (<2 year) increased risk for entanglement and entrapment in Project-related equipment; and
- Short-term (<2 year) change in water quality, including oil spills.

Short-term disturbance of habitat. Installation of wind turbine foundations and submarine interarray and submarine export cables could result in short-term temporary changes to seafloor and benthic habitat communities. Within the wider Project Area, the disturbance of habitat is expected to be limited due to confinement to small areas and due to the dynamic and sequential nature of installation for foundations and cables. This will restrict the area of disturbance and reduce the impacts to smaller areas of marine mammal habitat at any given time. Since marine mammals are extremely mobile species, with most ranging over very broad geographical scales, individual animals can choose to move away from temporary localized construction activities. Marine mammals are expected to return to temporarily disturbed areas once construction is complete. **Appendix S Benthic Resources Characterization Reports** and **Appendix T Essential Fish (EFH) Habitat Assessment** describe the temporary loss of suitable habitat and displacement of potential marine mammal prey sources in more detail as well as the addition of new habitat, and **Section 4.2 Water Quality** and **Appendix I Sediment Transport Analysis** provide additional detail regarding the expected durations of temporary habitat disturbance from Project-related construction activities. Beacon Wind has been proactive in the selection of siting locations for foundations and cables to avoid known areas and habitats considered to be particularly sensitive in nature which will significantly reduce the disturbance to marine mammal species to a negligible level.

Assessments for MEC/UXO hazards and risks have been performed by Beacon Wind to produce an MEC/UXO risk mitigation strategy. This risk mitigation strategy has been developed for the Project based on industry best practice and guidance from Construction Industry Research and Information Association (CIRIA) and BOEM's Munitions and Explosives of Concern Survey Methodology and In-field Testing for Wind Energy Areas on the Atlantic Outer Continental Shelf. The MEC/UXO risk mitigation strategy will be refined and finalized prior to construction and, if necessary, specific MEC/UXO surveys will be performed. If MEC/UXO is identified within any portion of the Project Area, appropriate mitigation measures will be taken, including recommended avoidance and removal, if necessary. If removal is required, the choice of removal method and suitable safety measures will be made with the assistance of an MEC/UXO specialist and the appropriate agencies.

Short-term loss of local prey species availability. Pile-driving during installation of the turbines and seabed preparation prior to laying the submarine export and interarray cables may temporarily disturb the benthic ecosystem and increase water turbidity, resulting in potentially lower biomass and availability of marine mammal prey species. As discussed above, abiotic anthropogenic underwater sound introduced by Project vessels and construction equipment is another impact-producing factor that could indirectly impact marine mammals by masking or impairing their ability to successfully forage for otherwise available prey. Additionally, the same introduced noise has been shown to have effects on many fish species encompassing multiple lifestyles (e.g., pelagic, epibenthic, demersal), and the measured frequency range of pile-driving activities directly overlaps the auditory bandwidth of many fish species that comprise the diets of various marine mammal species (Popper et al. 2019; Mooney et al. 2020). Predicting effects to fish can be complex, but physiological or behavioral effects that result in displacement from an area could potentially have indirect effects that alter the foraging efficiency of marine mammals. These effects are considered temporary and short-term and are localized to the specific areas in which construction is occurring.

Effects of construction on prey species availability could also occur throughout the water column based on the amount of turbidity produced, though most of the impacts would be expected to affect benthic organisms because of seafloor disturbance with foundation pile-driving and submarine export and interarray cable preparation and installation (see **Section 5.5 Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat**, **Appendix T Essential Fish Habitat (EFH) Assessment**, **Appendix S Benthic Resources Characterization Reports, Section 4.2 Water Quality,** and **Appendix I Sediment Transport Analysis**). A previous study following the installation of a subsea cable off California found that the benthic substrate and surrounding ecosystem was only minimally disturbed, and in some areas the epifauna and infauna diversity surprisingly increased (Kogan et al. 2006).

The marine mammal species largely expected to be foraging in the Project Area primarily target plankton (copepods; krill), small schooling fish such as capelin, mackerel, or herring; mesopelagic finfish and squids; or benthic species including crustaceans, cephalopods, and flounders. Underwater portions of foundations are expected to be newly colonized by encrusting and attaching organisms, creating an array of biogenic reefs in the Project Area (Degraer et al. 2020; Hutchison et al. 2020), which in turn will attract prey species for marine mammals. Therefore, it is possible that the temporarily affected benthic substrate will eventually provide a beneficial impact for marine mammals.

Primary production as well as zooplankton production of copepods (the main prey source of North Atlantic right whales and other marine species) are not expected to be impacted by Project-related construction and installation activities, although it should be noted that NOAA Fisheries uses the example of dispersants and other chemicals as part of a spill response that would be considered an impact-producing factor for North Atlantic right whale critical habitat. Although the Beacon Wind Lease

Area is fully outside of North Atlantic right whale critical habitat boundary, it is conceivable that the use of dispersants or similar chemicals in the Project Area could end up drifting via ocean currents into nearby North Atlantic right whale critical habitat where it could affect copepods levels that North Atlantic right whales depend on to survive.

Beacon Wind has actively avoided sensitive benthic habitats, where feasible, in the siting of submarine export and interarray cables and foundations, further minimizing the disturbance of sensitive habitat features that may impact marine mammal preferred prey resource. Further detailed assessments on the potential impacts on prey species and embedded and proposed mitigation are described in **Section 5.5 Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat**.

Short-term increase of marine debris. Marine debris, or anthropogenic litter, can be introduced to the ocean and other waterways in a variety of ways. This pollution by human-generated objects affects the environment and impacts organisms on numerous levels. For marine mammals, the main impact producing factors stemming from marine debris includes direct impact through ingestion of foreign material and entanglement or entrapment in debris and derelict gear (e.g., from materials used in the fishing industry). Both impact producing factors can result in the acute injury or immediate death of the animal, as well as chronic conditions that affect the animals' normal functions, ultimately leading to decreased fitness and possibly death (e.g., Laist 1997; Derraik 2002; Gregory 2009; NOAA Marine Debris Program 2014; Gall and Thompson 2015).

Although more difficult to detect through direct observation, marine mammals can also be indirectly impacted by marine debris through the ingestion of contaminated prey and cumulative habitat degradation that results in an unhealthy environment with less prey availability. Large pieces of debris that are initially too large to be consumed by an organism are likely to gradually degrade into smaller pieces over time and are then even more likely to be ingested as they work up to higher trophic levels (NOAA Marine Debris Program 2014). Micro plastics, or "scrubbers", are a prime example of debris degradation and the capacity for debris to create lasting effects in the environment for decades to come (Gregory 2009).

Despite widespread reports and observations of debris ingestion by marine mammals, most data have been collected from stranded and dead individuals, with very little scientific information available on the true frequency or volume of ingested materials. Walker and Coe (1989) reviewed reports that identified over 26 species of odontocetes, manatees, and multiple seal species that were confirmed to ingest debris.

Marine debris has the highest potential to be introduced to the marine environment during the construction and decommissioning phases of this Project (e.g., from Project-related construction vessels). .

To avoid the potential for the introduction of marine debris, project-related personnel and vessel contractors will be required to implement appropriate debris control practices and protocols to effectively control and prevent the release of marine debris into the Project Area. Project-related vessels will also operate in accordance with applicable laws regulating the at-sea discharges of vessel-generated waste. Therefore, Beacon Wind does not anticipate impact producing factors related to marine debris during any phase of this Project.

Short-term increase in Project-related underwater noise. Construction and associated activities during the installation of wind turbine foundations typically introduce the highest levels of anthropogenic sound into the Project Area and surrounding waters. Examples of these activities include pile-driving (both vibratory and impact), HRG surveys to support final engineering design (pre-construction), HRG surveys to confirm burial of submarine export and interarray cables (post-construction), casing pipe and goalpost installation, and other noise introduced by Project-related vessels. Anthropogenically-introduced underwater noise has the potential to affect marine mammal species both behaviorally and physiologically.

The use of sound is important for marine mammal species to thrive in their environment. They use sound to forage and capture prey, navigate, communicate (both over very long distances and socially in proximity to nearby conspecifics), and detect predators. Effects of anthropogenic noise on marine mammals can include acute and chronic bodily injury (including temporary or permanent hearing loss, changes in diving behaviors, and stress responses), behavioral modification (which can cause changes in foraging or habitat-use patterns, socializing, breeding, calving, vocalization, startle and flight response, and aggressive behavior), and masking (which prevents animals from hearing important sounds from prey, predators, conspecifics, and approaching vessels; Nowacek et al. 2007). Noise that simply causes animals to leave an area is still considered modification of behavior since it reduces available preferred habitat (Tyack 2009).

Currently accepted data using the best available science splits cetaceans into three distinct hearing groups based on their perceived range of hearing frequency. Cetacean species are classified as low-frequency (mysticetes or baleen whales) between 7 Hz and 35 kHz, mid-frequency (odontocetes; delphinids, beaked whales) between 150 Hz and 160 kHz, and high-frequency (porpoises, *Kogia* spp., and other odontocetes) from 275 Hz to 160 Hz. Pinniped species are divided into two distinct hearing groups based on their two families, Phocidae and Otariidae. Phocid seal ears are anatomically distinct from otariid ears and are more adapted for underwater hearing and an extended higher-frequency range (Reichmuth et al. 2013). The phocid hearing group is classified as in-water (50 Hz to 86 kHz), and the otariid group as in-water (60 Hz to 39 kHz) (Southall et al. 2007, 2019).

Beacon Wind anticipates a temporary, short-term increase in underwater noise generated from Project-related construction activities and is working to complete sound propagation modeling for each activity, using the maximum design scenario in order to conservatively predict expected exposure levels. The representative acoustic modeling scenarios will be derived from descriptions of the expected construction activities through consultations between the Project design and engineering teams. Based on these findings, Beacon Wind has assessed and will implement necessary mitigation measures, where applicable, to minimize the risks that elevated noise levels pose to marine mammals. **Appendix L Underwater Acoustic Assessment** entails a full description of the underwater noise modeling with methodology and inputs.

<u>Acoustic and Exposure Modeling</u>

In support of this COP, underwater sound propagation modeling was completed in order to predict the level of underwater noise expected during Project-related construction activities in the Project Area. Sound fields produced during impact pile driving for installation of foundations were estimated by modeling the vibration of the pile when struck with a hammer, determining a far-field representation of the pile as a sound source, and then propagating the sound from the apparent source into the environment. Piles deform when driven with impact hammers, creating a bulge that travels down the pile and radiates sound into the surrounding air, water, and seabed. This sound may be received as a direct transmission from the sound source to biological receivers (such as sea turtles) through the water or as the result of reflected paths from the surface or re-radiated into the water from the seabed. Sound transmission depends on many environmental parameters, such as the sound speeds in water and substrates. It also depends on the sound production parameters of the pile and how it is driven, including the pile material, size (length, diameter, and thickness) and the make and energy of the hammer.

As detailed in **Appendix L Underwater Acoustic Assessment** sound fields were modeled for tapered monopile foundations and piled jacket foundations to determine the acoustic propagation and to develop estimates for the numbers of marine mammals that could potentially be exposed to sound levels above regulatory thresholds.. These models account for several parameters that describe the operation—pile type, material, size, and length—the pile driving equipment, and approximate pile penetration depth.

The analysis and results detailed in **Appendix L Underwater Acoustic Assessment,** will be used to inform development of mitigation measures that may be applied during construction of the Project, in consultation with BOEM and NOAA Fisheries. The Project will obtain necessary permits to address potential impacts to marine mammals from underwater noise and will establish appropriate and practicable mitigation and monitoring measures through discussions with regulatory agencies.

Exposure Estimates

Appendix L Underwater Acoustic Assessment details the exposure estimates calculated for marine mammals using the potential construction schedules with results detailed for each species. Sound fields were sampled by simulating animal movement within the sound fields and determining if the levels experienced by simulated marine mammal animats (simulated animals) exceed regulatory thresholds. Exposure range estimates, or ER95%, are detailed in the findings, which are the horizontal distances that include 95 percent of the closest points of approach of animats exceeding a given impact threshold. Single strike ranges to various isopleths from acoustic modeling can also be found in **Appendix L Underwater Acoustic Assessment**, along with per pile SEL acoustic ranges to isopleths for all marine mammal functional hearing groups.

Appendix L Underwater Acoustic Assessment details the source modeling results, acoustic propagation modeling results, and exposure modeling results for marine mammals.

Goal Posts and Casing Pipe Modeling

Submarine export cable landfall construction activities will include the installation of temporary casing pipe and goalpost which would require impact pile driving, and/or pneumatic pipe ramming to install casing pipe in support of horizontal directional drilling which would require the temporary installation of cylindrical steel “goal post” piles via impact pile driving. Pneumatic pipe ramming and impact pile driving produce underwater sounds that have the potential to exceed regulatory thresholds for auditory injury and behavioral disruption in marine mammals. The isopleth distances to thresholds corresponding to potential injury and behavioral disruption of marine mammals were computed by propagating measured source levels at potential cable landfall construction areas and then comparing the resulting sound fields to regulatory thresholds. Marine mammal exposure estimates were then calculated based on expected construction scenarios for, casing pipe installation and goal post pile driving, incorporating marine mammal density estimates in the Project area. **Appendix L Underwater Acoustic Assessment** details the results of acoustic and exposure modeling forgoal posts and casing pipe.

Underwater Noise Measures

Beacon Wind expects to propose and implement the following measures during construction to avoid, minimize, and mitigate impacts of underwater noise :

- Soft-start, pre-clearance and shutdown procedures implemented to minimize potential impacts associated with noise generating activities, where feasible, for an agreed upon duration;
- Where pile-driven foundations are selected, Beacon Wind will apply clearance and exclusion zones as appropriate to underwater noise assessments and impact thresholds with:
  - Qualified NOAA Fisheries approved PSO;
  - Real-time monitoring systems, as appropriate;
  - Use of PAM systems;
  - Use of reduced visibility monitoring tools/technologies (e.g., infrared and/or thermal cameras).
- Where pile-driven foundations are selected, Beacon Wind will adhere to established North Atlantic right whale pile driving seasonal restrictions in the geographic region of the Lease Area;
- Where pile-driven foundations are selected, Beacon Wind will consider the potential use of commercially available noise-reducing technologies, when technically feasible; and
- Where pile driven foundations are selected, pile driving will commence only when clearance zones can be fully monitored.

Short-term increase in vessel collision risk due to increased vessel traffic. A temporary increase in the number of vessels operating in the Project Area during Project construction is anticipated, and an increase in baseline vessel traffic will bring an increased risk of collision (vessel strike) with marine mammals. Large whale species are most at risk of collision, although vessel strikes involving any marine mammal species can occur. Some species are at higher risk of collisions due to their morphology and normal behavior, and slow-moving large whale species that spend vast amounts of time at the surface are inherently more at risk (Parks et al. 2012). For example, North Atlantic right whales are typically slow-moving, spend large amounts of time at the surface both skim-feeding and socializing with conspecifics, and lack of a dorsal fin which makes their profile at the surface hard to detect for vessel captains.

The main factors that increase the likelihood of collision are vessel speed, vessel type, marine weather and visibility, and the animal's size and behavior (Douglas et al. 2008). Studies of whale strikes have established that vessel speed is correlated with risk of striking a whale and with the resulting level of injury (Laist et al. 2001; Neilson et al. 2012; Vanderlaan and Taggart 2007). Laist et al. (2001) correlates the lethality of vessel strikes with ships that are 262 ft (80 m) and greater in length traveling at speeds greater than 14 knots. Vanderlaan et al. (Vanderlaan et al. 2008) developed a methodology for estimating the likelihood of interactions between North Atlantic right whales and vessels in the Bay of Fundy. More recently, a vessel encounter risk model tool was developed to help assess potential vessel strike impacts to large whales from offshore wind activities along the U.S. Atlantic OCS (Barkaszi 2020).

During the construction phase of the Project, the increased presence of Project-related vessels increases the probability of a vessel strike with a marine mammal occurring (see **Section 3 Project Description** and **Appendix J Air Emissions Calculations and Methodology** for anticipated types of vessels, numbers of transits, and ports of origin). It is estimated that the Project will require approximately 40 vessels for construction of BW1 and approximately 40 vessels for construction of BW2. **Table 5.6-10** summarizes the types and number of offshore vessels to be used during construction. For completion of air emission modeling the following vessel round trips from the following locations were estimated: total of six from a Texas port, 1,860 from SBMT, 233 from the Port of Albany, 260 from a Canadian port, and 312 from overseas locations.

Appendix BB Navigation Safety Risk Assessment assessed existing vessel traffic within the Project Area utilizing a one year data set. A NVIC-01-19 compliant survey providing a breakdown of vessel traffic was completed in 2019 for the Project. This assessment documented, throughout the 2019 survey period, an average of approximately 10 unique vessels per day within the Lease Area Study Area. The busiest month in 2019 was June, with an average of approximately 34 unique vessels per day, while the busiest day was July 17, 2019 with 57 unique vessels recorded. Vessel traffic was observed to be highest during the summer months, which is reflected in the high numbers of fishing vessels recorded in the data and which exhibited seasonal variation with higher vessel numbers between May and September.

For construction related activities, the installation of the monopile/jacket foundations for wind turbines and offshore substation facilities, the installation of submarine export and interarray cables, and vessels transiting between shore and the Project Area are the activities that pose the largest threats to marine mammals. Overall, collisions may occur anywhere vessels and associated construction barges cross paths with marine mammals, which could potentially occur anywhere in the Project Area or along the submarine export cable routes towards the Long Island Sound area of New York. The large wind turbine installation vessels, as well as any supporting tugboats and construction barges, typically travel at slower speeds and pose only minor risks when working in the Project Area.

To help minimize vessel collisions with large whales, mainly the critically endangered North Atlantic right whale, Project-related vessels will comply with NOAA Fisheries speed restrictions within the Mid-Atlantic U.S. SMAs for North Atlantic right whales of 10 knots (18.5 km/hr) or less for vessels 65 ft (20 m) or greater in length during the period of November 1 through April 30 (see **Section 5.6.1.2**).

TABLE 5.6-10. PRELIMINARY SUMMARY OF OFFSHORE VESSELS FOR CONSTRUCTION

Vessel	Description	Foundations			Wind Turbines	Offshore Substation Topside & Foundation	Submarine Export Cables	Interarray Cables	Scour Protection
		Monopile	Piled Jacket	Suction Jacket					
Heavy Transport Vessel	Vessel for transport of foundations/wind turbines (0-14 knots [kts])	X	X	X	X				
Heavy Lift Vessel	Vessel for installation of foundations (0-14 kts)	X	X	X		X			
Wind Turbine Installation Vessel	Vessel for installation of wind turbine components (0-10 kts)				X				
Wind Turbine Supply Vessel / Barge	Vessel / Barge for transport of wind turbine components (0-10 kts)				X				
Heavy Transport Vessel / Barge	Vessel / Barge for transport of offshore substation topside/jacket (0-14 kts)					X			
Cable Lay Vessel / Barge	Vessel for installation of submarine export cable (0-14 kts)						X	X	
Cable Lay Support Vessel	Support vessel for cable lay operations (0-14 kts)						X	X	
Route Preparation / Trenching Support Vessel	Vessel for seabed clearance along cable routes (0-12 kts)						X	X	

Vessel	Description	Foundations			Wind Turbines	Offshore Substation Topside & Foundation	Submarine Export Cables	Interarray Cables	Scour Protection
		Monopile	Piled Jacket	Suction Jacket					
Fall Pipe Vessel	Vessel for installation of scour protection (0-12 kts)								X
Crew Transfer Vessel	Vessel for transporting workers to and from shore (0-30 kts)	X	X	X	X	X	X	X	
Construction Support Vessel	Vessel for general construction support (0-12 kts)	X	X	X	X	X	X	X	
Tugboat	Vessel for transporting and maneuvering barges (0-8 kts)	X	X	X	X	X	X	X	
Barge	Vessel for transport of construction materials (0-8 kts)	X	X	X	X	X	X	X	
Safety Vessel	Vessel for protection of construction areas (0-12 kts)	X	X	X	X	X	X	X	X

Short-term risk of entanglement and entrapment in Project-related equipment. One of the leading causes of marine mammal mortality is entanglement in fishing gear and marine debris, and this is especially true for the critically endangered North Atlantic right whale. Between the years of 1970 to 2009, 44 percent of the diagnosed North Atlantic right whale mortality cases were attributed to entanglements (Kraus et al. 2016b). Other marine mammal species are also susceptible to entanglements of some kind, but large baleen whales in particular are most prone to this impact producing factor because of their size and ecology.

The construction phase will bring an increased number of vessels and related equipment into the Project Area to complete preparation and installation of wind turbines and submarine cables. However, this increase in vessels does not necessarily translate to increased risk of entanglement and entrapment of marine mammals in Project-related equipment. Entanglement and entrapment occur when marine wildlife is caught inadvertently, or captured or restrained, by strong, flexible, man-made materials such as nets, fishing line, or buoy lines, most attached to crustacean trap pots. It is common for animals to initially still be able to continue swimming with the gear, sometimes picking up more gear as time goes on with the animal's health decreasing over time due to a calorie deficit. Other scenarios include entanglements that more directly affect and restrict the ability to feed, leading to starvation if the animal cannot be freed from the entanglement.

For this Project, the lines that will be used are associated with the construction barge anchor cables and cable plow/trencher towing cables and umbilicals. While most scientific studies have focused on entanglement as bycatch, recent work explored the entanglement risk to marine wildlife from offshore renewable developments (Reeves et al. 2013; Benjamins et al. 2012, 2014; Harnois et al. 2015). The key parameters used in these risk assessments were tension characteristics, line swept volume ratio, and line curvature of moorings. These assessments concluded that taut configurations present a low risk of entanglement to marine mammals. Due to the weight of the lines, and tension under which the cables will be operating, it is unlikely that entanglement will occur with marine mammal species from Project construction materials and activities, including the anchoring associated with the temporary mooring concept.

In addition, installation activities will be short-term and localized, and the area of risk will be a very small portion of available habitat, further minimizing the impact producing factors of entanglement from Project-related assets. As such, with the likelihood of conditions for entanglement being low and the likelihood for marine mammals to encounter entanglement or entrapment risks low, it is anticipated that entanglement and entrapment will not occur from installation activities. Mitigation measures in place to avoid marine mammals before the start-up of activities and avoidance of vessel collisions will also act to reduce the risk of entanglement and entrapment.

Short-term change in water quality. The installation activities expected to occur during the construction phase could potentially result in short-term, temporary changes in water quality based on increased turbidity and sedimentation as a by-product of pile-driving and seabed preparation for foundations and cabling. The increased turbidity is not expected to have deleterious effects on marine mammals based on the small construction footprint in relation to the size of the Lease Area and the overall habitat. There are numerous marine mammal species that preferentially choose to live in turbid environments and can successfully forage in low visibility conditions (Cronin et al. 2017). This is possible since vision is not the primary factor in how marine mammals forage and hunt for prey, rather they use echolocation (odontocetes) and hearing and other senses (mysticetus) to navigate prey patchiness. These impact producing factors are discussed in more detail in **Section 4.2 Water Quality** and **Appendix I Sediment Transport Analysis**.

In addition to turbidity, water quality has the potential to be impacted through the introduction of contaminants, including oil and fuel spills. Oil and fuel spills by Project-related vessels have the potential to affect marine mammals over a short duration of time with just a small amount of contaminate if left unchecked or without proper spill response. Ingestion and coating of heavy petroleum products can occur, leading to both short- and long-term effects on the health and fitness of an individual (Godard-Codding and Collier 2018). Spills can also impact marine mammals' ability to successfully forage, both directly and indirectly, for example by fouling the baleen plates of a baleen whale and ultimately resulting in the inability of the animal to eat. Dispersants can also impact the prey of large whales, most notably the copepod prey of North Atlantic right whales that are known to feed in and around the Lease Area waters.

Oil spills pose a risk to marine mammals through direct contamination and destruction of foraging and reproductive habitats. Most petroleum products that would be carried on the construction vessels would be light, remaining on the surface of the water and evaporating in the event of a spill. These spills would be expected to adversely affect any marine mammals in the area that are co-located with the toxins. Heavier petroleum products that create a sheen and remain on the water's surface could affect marine mammals diving through the water's surface when breathing or looking for food. Ingestion of oil and dispersants directly, or indirectly via feeding on contaminated prey sources that have eaten dispersants, can lead to short- or long-term effects from inflammation, bleeding, and possible damage to liver, kidney, and brain tissue in marine mammals (Godard-Codding and Collier 2018.). Exposure to oil spills may cause marine mammals acute or chronic impacts with lethal or sub-lethal effects depending on the size and duration of the spill. For large baleen whales, oil can foul the baleen they use to filter-feed, decreasing their ability to eat, and resulting in the ingestion of oil (Godard-Codding and Collier 2018). Impacts from exposure may also include reproductive failure, lung and respiratory impairments, decreased body condition and overall health, and increased susceptibility to other diseases.

Beacon Wind has developed an Oil Spill Response Plan (see **Appendix E Oil Spill Response Plan**) with mitigation measures to prevent unintended spills, along with specific protocols for Project crew to follow should an accidental spill occur. Project-related vessels will operate in accordance with laws and regulation in regarding at-sea discharges of vessel waste.

5.6.2.2 *Operations and Maintenance*

During operations, the potential impact-producing factors to marine mammal species may include:

- The presence of new permanent structures (i.e., foundations for wind turbines and offshore substation facilities) and vessel traffic during maintenance; and
- The presence of new buried submarine export and interarray cables.

The following impacts may occur as a consequence of factors identified above:

- Modification of habitat;
- Project-related underwater noise;
- Short-term increased risk for vessel strikes due to increase in vessel traffic;

- Project-related EMF;
- Project-related thermal effects;
- Project-related marine debris; and
- Changes in water quality, including oil spills.

Modification of habitat. Beacon Wind proposes to develop the entire Lease Area in what could potentially be up to a maximum of two individual wind farms (BW1 and BW2) with a 1x1 nm (1.9x1.9 km) separation for individual wind turbine foundations, with BW1 located in the northern 56,530 ac (22,877 ha) of the Lease Area and BW2 located in the southern 51,610 ac (20,886 ha) of the Lease Area, with a 20,665-ac (8,362-ha) Overlap Area that could be included in either BW1 or BW2. In the context of marine mammals, this does not significantly reduce available habitat, and the proposed layout with a more even distribution of wind turbines would serve to lessen the impact-producing factors of displacement and maneuverability through the Lease Area even further, particularly for larger whale species.

Johnson et al. (2021) examined how oceanic responses may be affected by turbine operation, specifically with regards to turbulent mixing, bed shear stress, and larval transport. Hydrodynamic and agent-based modeling was conducted to better understand the potential effects of offshore development in the Massachusetts-Rhode Island marine areas on larval transport of three key commercial fish species: Atlantic sea scallops (*Placopecten magellanicus*), silver hake (*Merluccius bilinearis*), and summer flounder (*Paralichthys dentatus*). Results indicated that the introduction of turbine structures in the water column can modify oceanic responses by reducing the current magnitude via added flow resistance, reducing the current magnitude and wave height via the extraction of energy from the wind by the offshore turbines, and by influencing the temperature stratification by introducing additional mixing. Johnson et al. (2021) found that the modeled changes in currents led to varying degrees of discernable increases and decreases in larval settlement density across the three focal species. However, these shifts in larval settlement density were not considered to be overly relevant at a regional fisheries management level since larval settlement for these species occurs at broad spatial scales across the continental shelf (Johnson et al. 2021).

It should be noted that the Johnson et al. (2021) analysis focused on larval transport of a small number of commercial fish species and did not include key prey species of ESA-listed cetaceans (e.g., krill, copepods, squid, Atlantic herring (*Clupea harengus*) and sand lance (*Ammodytes spp*)). Several non-ESA listed marine mammals, such as seals and some delphinids, are known to consume hake and flounder (Kenney and Vigness-Raposa 2010) in addition to a variety of other prey species. Due to the complexity of the marine food webs and predator-prey dynamics involved, as well as the limited number of species studied, Johnson et al. (2021) provides insufficient information to support conclusions about the potential effects of the turbine structures on marine mammal prey distribution and/or abundance.

The only permanent loss of habitat would be up to 661 ac (268 ha) of soft-bottom in the Lease Area converted to hardbottom by foundations and scour protection (**Table 5.6-8**). While operation of the wind farm will incur permanent conversion of habitat, the foundations for the wind turbines and substation structures will quickly become colonized by the benthic ecosystem, and during the operations and maintenance phase of the Project, will function as a type of artificial reef and increase organism diversity to support multiple trophic levels of prey for numerous fish, turtles, and mammals (Reubens et al. 2013). The resulting biogenic reefs could eventually provide a beneficial impact to higher trophic levels, including marine mammals (Russell 2014). **Section 5.5.2.2** further details the expected recolonization of benthic habitat in the Lease Area after completion of installation activities and into operation of the wind farm. A study in the Alpha Ventus wind farm in the Netherlands, tracked grey and harbor seals to identify their movements among anthropogenic structures, and finding that a proportion of seals adjust their behavior to make use of such structures, and the artificial reefs they introduce, for foraging (Russell 2014).

Another type of offshore structure associated with the Beacon Wind Project is an offshore converter station, located within the offshore substation facilities. Each offshore substation will include a CWIS to regulate temperature of the electrical converter equipment, that will utilize up to 10.6 mgd of once-through non-contact cooling water that may result in the entrainment of egg and larval stages of ichthyoplankton species, as discussed in **Section 5.5 Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat**. Ocean water will be drawn in from the water column, approximately 49-131 ft (15-40 m) below the water surface. The flow required by the converter station is several orders of magnitude lower than the flow (500 to 2,900 mgd) required for similar cooling water intake structures for many coastal power plants throughout the northeast (EPA 2010). While individual eggs and larvae of commercially or recreationally-managed species in the immediate vicinity of the intake may be subject to entrainment through the cooling water system, this discrete intake location is not expected to result in measurable impacts to fish or shellfish populations or managed fisheries stocks on a local or regional scale. The CWIS will discharge heated, treated seawater below the platform jacket approximately 66-112 ft (20-34 m) below the water surface. Discharged water temperature will be approximately 87.8°F (31°C) when the seawater inlet temperature is 68°F (20°C), though for much of the year the seawater will be cooler and the discharge temperature will accordingly be lower. Discharged water will not exceed 96.8°F (36°C), and this maximum temperature would correlate to a CWIS operating at a much smaller discharge volume than the maximum. This release of heated water will be localized to the area around the discharge points at the two offshore substation facilities and is expected to dissipate into the surrounding water column, resulting in an increase in the temperature of the water in the immediate vicinity of the offshore substation facilities. Within a short distance from the CWIS, the temperature difference from surrounding seawater will drop to undetectable levels, and is not expected to result in measurable impacts to fish or shellfish populations or managed fisheries stocks. No impingement of juvenile or adult fish is anticipated from operation of the CWIS

The design, configuration, and operation of the offshore substation facilities' cooling systems will be permitted as part of an individual NPDES permit and additional details will be included in the permit application submitted to the EPA. Beacon Wind will actively work with EPA to understand any additional modelling and assessment that may be required for this system.

Beacon Wind will complete a Project Fisheries Monitoring Plan, which will detail those monitoring activities that will be implemented during the operations phase and will coordinate the completion of this document with BOEM per their guidance.

Project-related underwater noise. Operational wind turbines and operations and maintenance activities will result in an increase in the ambient underwater noise in the Project Area (**Appendix L Underwater Acoustic Assessment** details anticipated noise levels). Studies have shown that offshore wind facilities produce noise in the water, with the higher impacts of noise occurring during the construction phase, as opposed to the operation and maintenance, and decommissioning phases (Mooney et al. 2020). Operational noise from wind turbine structures is likely only to be measurable above ambient levels at frequencies below 1,000 Hz and is likely to be masked by ambient noise at distances beyond a few kilometers (Bergström et al. 2013, Tougaard et al. 2020). Likewise, measurements of airborne noise from turbine operations at the Block Island Wind Farm indicated minimal increase in noise levels both onshore and offshore (HDR 2019). Additionally, studies from an offshore wind farm in 2017 showed no significant displacement of harbor porpoise post-construction, compared to preconstruction surveys (Vallejo et al. 2017; Dahne et al. 2017; Graham et al. 2017).

Noise from Project-related operations and support vessel traffic is not anticipated to be greater than the ambient noise levels in the Project Area, as vessel traffic is expected to have an insignificant increase above the existing baseline conditions as a result of the Project. Vessel traffic will increase during operation mainly for the transportation of supplies and maintenance crews. Given the amount of existing vessel traffic in the area, the noise associated with supply vessels transiting to the offshore facilities will have a negligible contribution to total ambient underwater sound levels. Therefore, impacts from underwater sound due to Project operations,[13] including vessel activity, will be negligible and are unlikely to affect biological resources in the Project Area.

Vessel collisions from increased vessel traffic. Project-related vessel operations expected during the operations and maintenance phase will be significantly less and result in a much smaller vessel footprint within and transiting to and from the Project Area. The expected number of support vessels in relation to existing baseline conditions are discussed in **Section 8.7 Marine Transportation and Navigation**.

Beacon Wind's preferred operations and maintenance solution for the Project is a SOV concept, supported by a CTV or smaller support vessel. The SOV is expected to remain offshore in the Project Area for a period of approximately two weeks, returning to the O&M Base every two weeks for 24 hours for refueling, re-supplying, and crew changes. Therefore, the SOV concept significantly reduces the overall vessel transits from Project Area to base, compared to the maximum design scenario of multiple crew transfer vessels making daily return trips.

Therefore, under these conditions, there is a resulting reduction of vessel traffic that will minimize the risk of ship-strike and vessel noise. Final vessel traffic protocol will be outlined and assessed through NOAA Fisheries and any associated mitigation measures will be outlined through related authorizations and consultations.

Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Project-related vessels will comply with NOAA Fisheries speed restrictions within the Mid-Atlantic U.S. SMA for North Atlantic right whales of 10 knots (18.5 km/hr) or less for vessels 65 ft (20 m) in length or greater during the period of November 1 through April 30. Project-related vessels will also comply with the 10-knot (less than18.5-km/hr) speed restrictions in any Dynamic Management Area (DMA);
- Vessel collision avoidance (ship strike) mitigation measures for Project-related vessels working in or in transit to and from the Lease Area, including a 328-ft (100-m) separation distance from marine mammals, except for the North Atlantic right whale, which requires a

[13] The Project notes that during O&M additional survey activities may be required. Those survey activities will comply with the additional applicable permits relative to the underwater noise levels associated with them.

1,640-ft (500-m) separation, as well as adherence to vessel strike avoidance measures as advised by NOAA Fisheries;

- Any vessel larger than 300 gross tonnes moving into North Atlantic right whale habitat will check in as part of the North Atlantic right whale Mandatory Ship Reporting System. They will be immediately responded to with updated reports of North Atlantic right whale sightings in the area, in addition to reminders of safe vessel speeds and movements within the management area. In the event of contact with a North Atlantic right whale, a report must be made immediately to NOAA's National Marine Mammal Stranding Network; and
- PSOs and/or Project personnel will check NOAA Fisheries' website for any update on DMAs / Slow Zones and will respond with vessel movement strategies or planned working hours.

Project-related EMF. The installation of submarine export and interarray cables in the Project Area during the construction phase may result in the emittance of small EMF around these components (see **Section 8.12 Public Health and Safety** and **Appendix CC Offshore Electric and Magnetic Field Assessment**, for additional information).

Current literature suggests cetaceans can potentially perceive the earth's magnetic fields, but there is no evidence for electrosensitivity in any marine mammal species. The evidence that suggests certain marine mammal species may be able to sense geomagnetic fields is largely theoretical, but some (e.g., humpback whale, common dolphin, common bottlenose dolphin) have been found to have anatomical features such as magnetite in the dura matter of their brains (Normandeau et al. 2011). These species could potentially use the EMFs during migrations, although it is not clear which components they are sensing or how potential disturbances to the geomagnetic field caused by EMF near the buried submarine export and interarray cables in the Project Area may affect migrations of marine mammals (Normandeau et al. 2011).

Strandings of marine mammals have been statistically linked to variations in localized geomagnetic anomalies (Oregon Wave Energy Trust 2010). There is no evidence indicating magnetic sensitivity in seals, but other marine mammals appear to have a detection threshold for magnetic sensitivity gradients of 0.1 percent of the Earth's magnetic fields and are likely to be sensitive to minor changes (Kirschvink 1990; Normandeau et al. 2011; Walker et al. 2003). Existing data indicates that any EMF effect on marine mammals is unlikely to be significant (Normandeau et al. 2011; Oregon Wave Energy Trust 2010;). There are no data indicating that heat generated from the cables may affect marine mammals (Ospar 2012).

Indirect effects on marine mammals from alterations in prey due to EMF are also unlikely, as the average magnetic-field strengths in proximity to the submarine export and interarray cables are below levels documented to have adverse impacts to fish behavior. As detailed in **Section 5.5 Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat**, impacts to mid-water fish species including small schooling fish (e.g., mackerel, herring, capelin) consumed by marine mammals would not be affected by the EMF associated with Project-related cables. For similar wind farm operations, modeling determined that the intensity of the magnetic fields generated by the submarine export cables is expected to be low and localized, and therefore, EMF as a significant impact-producing factor affecting marine mammals is not expected.

Thermal Effects. Potential thermal effects associated with the Project HVAC and HVDC buried cables were evaluated to assess potential risks to the benthic community. The depth of the cables relative to the where benthic organisms reside and the estimated changes in surrounding sediment temperatures associated with the cables were considered.

The target burial depth of the HVAC interarray cables and the HVDC submarine export cables is 3 to 6 ft (0.9 to 1.8 m). Burial may not be feasible in a small number of instances (estimated to occur for 10 percent of the areas where the cables may be placed), in which case the cables will be surface laid and have rocks, rock bags, or concrete mattresses placed over them as cover protection. The depth of the cover protection material will be 5 ft (1.5 m). At the base of the wind turbines and the offshore substation facilities, the cables will be covered by 6.6 to 13 ft (2 to 4 m) of cover material used for scour protection prior to the cables being buried at their target depth.

Benthic organisms residing in the sediment bed (i.e., infaunal species) and at the sediment surface (i.e., epifaunal species) are not expected to be present at depth immediately adjacent to the buried cables where elevated temperatures may occur. While temperature is one environmental determinant of benthic community distribution (Hiscock et al. 2004; Emeana et al. 2016), others include availability of oxygen, levels of organic material (i.e., “organic carbon”) and grain size (Thrush et al. 2003; Pratt et al. 2014; Soto et al. 2016; Hubler et al. 2016). Because oxygen and available organic carbon are typically limited to only the top inches of sediment, these factors are the primary determinants of the depth at which benthic organisms may reside. With respect to benthic organisms and the Project, comprehensive benthic community surveys have been performed for the Lease Area (MMT 2022a) and the HVDC submarine export cable corridors for both the Queens, New York and Waterford, Connecticut routes (MMT 2022b). Data from over 500 sample locations collected during this survey are comparable to other data for the continental shelf in showing that depth of biological activity is generally limited to the top 4 to 8 in (10 to 20 cm) (MMT 2022a, 2022b, USEPA 2015). With respect to grain size, the sediment of the Lease Area and cable corridors consist of a range of geological sediment types from clay and silt to coarser sand and pebbles, as well as biogenic sediment types (i.e., shell deposits). Overall, the predominant sediment types were sand (i.e., coarse unconsolidated substrate) and muddy sands (fine unconsolidated substrate) (MMT 2022a, 2022b).

Thermal tolerances of benthic organisms varies by species, but is generally assumed to span the range of seasonal temperature changes in the lower water column that occurs on the continental shelf of southern New England waters. Mountain (2020) found that seasonal range water temperatures across the Mid-Atlantic Bight shelf off the southeast coast of Long Island can vary by as much as 16.2 degrees Fahrenheit (°F) (9 degrees Celsius [°C]).

Heat emissions from buried cables can warm surrounding sediments, creating a thermal gradient that may extend up to tens of inches away from the cable (Taormina et al. 2018). The factors that determine the thermal gradient include the cable characteristics and transmission rate, as well as the characteristics of the surrounding sediments (e.g., ambient temperatures, permeability of sediments) (OSPAR Commission 2012; Emeana 2016). Temperatures at the surface of high voltage cables may reach approximately 160°F (70°C) [14] (Swaffield et al. 2008; Hughes et al. 2015). The use of high voltages minimizes heat loss and HVDC cables generally exhibit lower heat emissions than do HVAC cables at equal transmission rates (Viking Link 2017; Taormina et al. 2018)

In open water, unburied cables have negligible effect, because water is a relatively poor conductor of heat and because water currents quickly dissipate heat (Viking 2017; Tetra Tech 2021). For buried cables, heat transfer can occur both by conduction (transfer of thermal energy through direct contact)

[14] Based on an assumed conductor temperature of 194 degrees Fahrenheit (90 degrees Celsius).

and convection (transfer of thermal energy through the movement of a liquid) (Emeana et al. 2016). In continental shelf settings, finer-grained sediments associated with sand and mud are expected to exhibit both conductive heat transport and convective heat transport. In a laboratory experiment, Emeana et al. (2016) found that cable surface temperatures of 140°F (60°C) could result in an 18°F (10°C) change approximately 2.3ft (0.7 m) away from the cable in fine sands with medium permeability. Changes in temperature of 3.6°F (2°C)[15] occurred within 3.3 ft (1 m) within the same sediment.

In conclusion, the Project HVAC and HVDC buried cables at the target burial depth of 3 to 6 ft (0.9 to 1.8 m) are anticipated to result in *de minimis* risk to the benthic community that resides in the top 8 inches (20 cm) of sediment. Thermal gradients associated with the buried cables are expected to diminish to ambient conditions within 3.3 ft (1 m) or less. While this distance is larger than the shallowest proposed burial depth, when accounting for the thermal tolerance of benthic organisms and the cited range of bottom water temperatures in New England waters, the risk is anticipated to be de minimis. Risk is also anticipated to be *de minimis* in the relatively few instances where cables will be present at the surface and covered with rocks, rock bags or concrete mattresses as heat will rapidly dissipate in the water column.

Project-related marine debris. The potential of marine debris being released from Project-related vessels throughout the operations and maintenance phase is expected to be significantly less than during the construction phase, which itself is already expected to be negligible with mitigation measures in place for the Project assets.

Marine debris could have the potential to be generated from vessel and from wind turbines during routine operations and maintenance activities, which could result in a marine mammal becoming entangled or ingesting debris, potentially resulting in injury or death. As offshore personnel will be required to implement appropriate practices and protocols, the release of marine debris into Project Area waters is not anticipated.

Changes in water quality, including oil spills. Routine operations and maintenance activities are not expected to affect the turbidity and sedimentation of the surrounding waters. Potential impacts to water quality resulting from turbidity and sedimentation were discussed previously for the construction phase, and more details can be found in **Section 4.2 Water Quality** and **Appendix I Sediment Transport Analysis**.

In addition to turbidity and suspended particles being considered during the operations and maintenance phase, water quality has the potential to be impacted through the introduction of contaminants, including oil and fuel spills. For reasons described earlier, to address the potential for such spills and their ability to be an impact-producing factor on marine mammals, and measures should be taken to prevent the unintentional release of contaminants from Project-related vessels visiting the wind farm as part of the normal operations and maintenance phase. Beacon Wind has provided an OSRP (**Appendix E Oil Spill Response Plan**) that details the measures proposed to avoid inadvertent releases and spills and a protocol to be implemented should a spill event occur. Additional information can be found in **Section 8.12 Public Health and Safety**.

[15]The German Federal Agency of Nature Conservation has developed thermal guidelines for buried cables by recommending no more than a 2°C temperature elevation in seafloor sediments located 8 in (20 cm) below the surface to protect benthic organisms (Worzyk 2009).

Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts on marine mammals from impacts to water quality and spills:

- Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste; and
- The development and enforcement of an ORSP.

5.6.2.3 Decommissioning

mpacts during decommissioning activities are expected to be similar or less than those described for construction in **Section 5.6.2.1** based on present day understanding of available decommissioning approaches. It is important to note that advances in decommissioning methods /technologies are expected to occur throughout the operations phase of the Project and it is acknowledged that in 35 years technology advances are anticipated that could lessen impacts of decommissioning. Additionally, marine mammal species abundance and distribution may also have changed, requiring updated analysis; further data on the spatial and temporal distribution of marine mammals will also collected during the operations phase and will be used to inform a decommissioning assessment which would require updated analysis. A full decommissioning plan will be submitted to BOEM for approval prior to any decommissioning activities, and potential impacts will be evaluated at that time, in addition to any documentation and approval by NOAA Fisheries for an amendment to the MMPA incidental take authorization for construction and operation will be re-evaluated at the time of decommissioning. For additional information on the decommissioning activities that Beacon Wind anticipates will be needed for the Project, see **Section 3 Project Description**.

5.6.3 Summary of Avoidance, Minimization, and Mitigation Measures

In order to mitigate the potential impacts on marine mammals described above, Beacon Wind has implemented the following mitigation measures to avoid, minimize, and mitigate impacts through the project siting and design as described in **Section 5.6.2.1.** Beacon Wind intends to continue discussions and engagement with regulatory agencies and environmental nongovernmental organizations (ENGOs) throughout the life of the Project to develop an adaptive mitigation approach that allows for flexibility while providing the best and most protective mitigation measures.

5.6.3.1 *Construction*

During construction, Beacon Wind will commit to the following avoidance, minimization, and mitigation measures to mitigate impacts described in **Section 5.6.2.1**. Additional Project activity-specific mitigation measures will be added to Project protocols specific to construction upon receipt of a MMPA incidental take authorization from NOAA Fisheries:

- Continued engagement with regulatory agencies and ENGOs on potential mitigation and best practices, as appropriate;
- Development of an OSRP (Appendix E Oil Spill Response Plan) with clear notification and activation procedures to respond to an oil (or other hazardous) spill or substantial fluid discharge;
- Soft-start, pre-clearance, and shut-down procedures implemented to minimize potential impacts associated with noise generating activities, where feasible, for an agreed upon duration;

- Where pile-driven foundations are selected, Beacon Wind will apply clearance and exclusion zones as appropriate to underwater noise and impact thresholds with:
  - Qualified NOAA Fisheries approved PSOs;
  - Real-time monitoring systems, as appropriate;
  - Use of PAM systems;
  - Use of reduced visibility monitoring tools/technologies (e.g., infrared and/or thermal cameras);
- Where pile-driven foundations are selected, Beacon Wind will consider the potential use of commercially available noise reducing technologies, when technically feasible;
- Where pile-driven foundations are selected, pile driving will commence only when the clearance zones can be fully monitored;
- Where pile driven foundations are selected, Beacon Wind will adhere to established North Atlantic right whale pile driving seasonal restrictions in the geographic region of the Lease Area;
- PAM or cross-trained PSO/PAM operators will monitor for acoustic detections, with the PAM system not located on the pile-driving/installation vessel to avoid interference;
- Project-related vessels will comply with NOAA Fisheries speed restrictions within the Mid-Atlantic U.S. SMA for North Atlantic right whales of 10 knots (18.5 km/hr) or less for vessels 65 ft (20 m) or greater during the period of November 1 through April 30. Project-related vessels 65 ft (20 m) or greater will also comply with the 10-knot (18.5-km/hr.) speed restrictions in any DMA or visually triggered Slow Zone;
- Vessel collision avoidance mitigation measures for Project-related vessels working in or in transit to and from the Project Area, including a 1,640-ft (500-m) separation distance from North Atlantic right whales and a 328-ft (100-m) separation distance from other marine mammals;
- Reference materials onboard Project-related vessels will be provided for identification of marine mammals;
- Vessels larger than 300 gross tonnes moving into North Atlantic right whale habitat will check in as part of the North Atlantic Right Whale Mandatory Ship Reporting System, where they will be provided with updated reports of North Atlantic right whale sightings in the area, in addition to reminders of safe vessel speeds and movements within the management area. In the event of contact with a North Atlantic right whale, a report must be made immediately to NOAA Fisheries' National Marine Stranding Network;
- PSOs and/or Project personnel will regularly check NOAA Fisheries' website for any update on DMAs / Slow Zones;
- Project-related vessels will operate in accordance with the laws regulating the at-sea discharges of vessel generated waste;
- Complete pile-driving monitoring plan will be submitted to appropriate agencies for review and approval a minimum of 90 days prior to the commencement of any pile-driving activities;
- Any marine mammal or sea turtle inside the exclusion zone that results in a shutdown or power-down will be reported to BOEM within 24 hours; and
- Any potential vessel strikes, or dead/injured marine mammals or sea turtles (regardless of cause) will be reported to NOAA Fisheries Protected Resources Division.

In addition, Beacon Wind will consider the following avoidance, minimization, and mitigation measures to mitigate impacts described in **Section 5.6.2.1**:

- Use dedicated trained crew members (independent of PSOs) to help reduce the risk of collision under certain circumstances.

5.6.3.2 Operations and Maintenance

During operations, Beacon Wind will commit to the following avoidance, minimization, and mitigation measures to mitigate impacts described in **Section 5.6.2.2**:

- Continued engagement with regulatory agencies and ENGOs on potential mitigation and best practices, as appropriate;
- The development and implementation of an OSRP (**see Appendix E Oil Spill Response Plan**);
- Project-related vessels will comply with NOAA Fisheries speed restrictions within the Mid-Atlantic U.S. SMA for North Atlantic right whales of 10 knots (18.5 km/hr) or less for vessels 65 ft (20 m) or greater in length during the period of November 1 through April 30. Project-related vessels 65 ft (20 m) or greater will also comply with 10 knot (18.5 km/hr) speed restrictions in any DMA or visually-trigged Slow Zone;
- Vessel collision avoidance mitigation measures for Project-related vessels working in or in transit to and from the Project Area, including 1,640 ft (500 m) separation distance from North Atlantic right whales and 328-ft (100-m) separation distance from other marine mammals;
- Any vessel larger than 300 gross tonnes moving into North Atlantic right whale habitat will check in as part of the North Atlantic Right Whale Mandatory Ship Reporting System, where they will be provided with updated reports of North Atlantic right whale sightings in the area, in addition to reminders of safe vessel speeds and movements within the management area. In the event of contact with a North Atlantic right whale, a report must be made immediately to NOAA Fisheries' National Marine Stranding Network.
- PSOs and/or Project personnel will check NOAA Fisheries' website regularly for updates on DMAs / Slow Zones;
- Reference materials on board Project vessels will be provided for identification of marine mammals;
- Project-related vessels will operate in accordance with the laws regulating the at-sea discharges of vessel generated waste; and
- Any potential vessel strikes, or dead/injured marine mammals or sea turtles (regardless of cause) will be reported to NOAA Fisheries Protected Resources Division.

In addition, Beacon Wind will consider the following avoidance, minimization, and mitigation measures to mitigate impacts described in **Section 5.6.2.2**:

- Use dedicated trained crew members (independent of PSOs) to help reduce the risk of collision under certain circumstances;
- Use of SOV concept, supported by a CTV or smaller support vessel, to reduce vessel traffic associated with operations and maintenance for the Project, where technically and commercially feasible; and

- Development of appropriate monitoring program(s) in close coordination with regulatory agencies and stakeholders.

As indicated in the list of measures above, Beacon Wind proposes to monitor select marine mammal resources to clarify baseline conditions and reduce uncertainty in assessing changes in distribution or abundance of resources within the context of climate change and other large-scale regional variables. During the COP review process, Beacon Wind will work with regulatory agencies and stakeholders in development of appropriate program(s).

5.6.3.3 *Decommissioning*

Avoidance, minimization, and mitigation measures proposed to be implemented during decommissioning are expected to be similar to those experienced during construction and operations, as described in **Section 5.6.3.1** and **Section 5.6.3.2**. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities and avoidance, minimization, and mitigation measures for decommissioning will be proposed at that time.

5.6.4 References

TABLE 5.6-11. SUMMARY OF DATA SOURCES

Source	Includes	Available at	Metadata Link
BOEM	Lease Area	https://www.boem.gov/BOEM-Renewable-Energy-Geodatabase.zip	N/A
BOEM	State Territorial Waters	https://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/ATL_SLA(3).aspx	http://metadata.boem.gov/geospatial/OCS_SubmergedLandsActBoundary_Atlantic_NAD83.xml
Marine Geospatial Ecology Labs/Duke University	MDAT Cetacean Density	http://seamap.env.duke.edu/models/mdat/	http://seamap.env.duke.edu/models/mdat/Mammal/MDAT_Mammal_Model_Metadata.pdf
NOAA NCEI	Bathymetry	https://www.ngdc.noaa.gov/mgg/coastal/crm.html	N/A
OBIS SEAMAP	OBIS SEAMAP Sightings	http://seamap.env.duke.edu/species/	N/A
NOAA NMFS	Biologically Important Areas for Cetaceans: North Atlantic right whale	http://cetsound.noaa.gov/Assets/cetsound/data/CetMap_BIAWGS84.zip	https://inport.nmfs.noaa.gov/inport/item/23643
NOAA NMFS	North Atlantic Right Whale Seasonal	http://sero.nmfs.noaa.gov/maps_gis_data/protected_resources/management_are	http://sero.nmfs.noaa.gov/maps_gis_data/protected_resources/management_a

Source	Includes	Available at	Metadata Link
	Management Area	as/geodata/right_whale_sma_all.zip	reas/geodata/right_whale_sma_all_po.htm

Abend, A.G., and T.D. Smith. 1999. Review of distribution of the long-finned pilot whale (*Globicephala melas*) in the North Atlantic and Mediterranean. NOAA Technical Memorandum NMFS-NE-117, Northeast Fisheries Science Center, Woods Hole, Massachusetts.

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Aschettino, J.M., D. Engelhaupt, A. Engelhaupt, and M. Richlen. 2016. Mid-Atlantic Humpback Whale Monitoring, Virginia Beach, Virginia: 2015/16 Annual Progress Report. Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, Virginia, under Contract Nos. N62470-10-3011, Task Orders 03 and 54, and N62470-15-8006, Task Order 13, issued to HDR Inc., Virginia Beach, Virginia. August 2016.

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5.7 Sea Turtles

This section describes the sea turtle species known to be present, traverse, or incidentally occur in the waters within and surrounding the Project Area, which includes the Lease Area and waters adjacent to the submarine export cable routes. Potential impacts to sea turtles resulting from construction, operations, and decommissioning of the Project are discussed. Proposed Project-specific measures adopted by Beacon Wind are also described that are intended to avoid, minimize, and/or mitigate potential impacts to sea turtle species.

Other resources and assessments detailed within this document that are related to sea turtles include:

- Water Quality (**Section 4.2**);
- Underwater Acoustic Environment (**Section 4.4.2**);
- Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat (**Section 5.5**);
- Marine Mammals (Section 5.6);
- Sediment Transport Analysis (**Appendix I**);
- Underwater Acoustic Assessment (**Appendix L**);
- Ornithological and Marine Fauna Aerial Survey – APEM Studies (**Appendix O**); and
- Benthic Resources Characterization Reports (**Appendix S**).

Data Relied Upon and Studies Completed

For the purposes of this section, the Study Area includes the offshore waters and coastlines within and in the vicinity of the Lease Area, as well as the submarine export cable routes, and vessel routes where Project vessels are expected to traverse in the vicinity of the Lease Area (see **Figure 5.7-1**).

In the U.S. both NOAA Fisheries and the USFWS have shared jurisdiction over sea turtles. NOAA Fisheries is responsible for leading conservation and recovery of sea turtles in the marine environment, and the U.S. Fish and Wildlife Service is responsible for leading conservation and recovery of sea turtles on nesting beaches. NOAA Fisheries also works closely with other nations to ensure the global conservation and recovery of sea turtles through diplomatic efforts, scientific exchange, and capacity building.

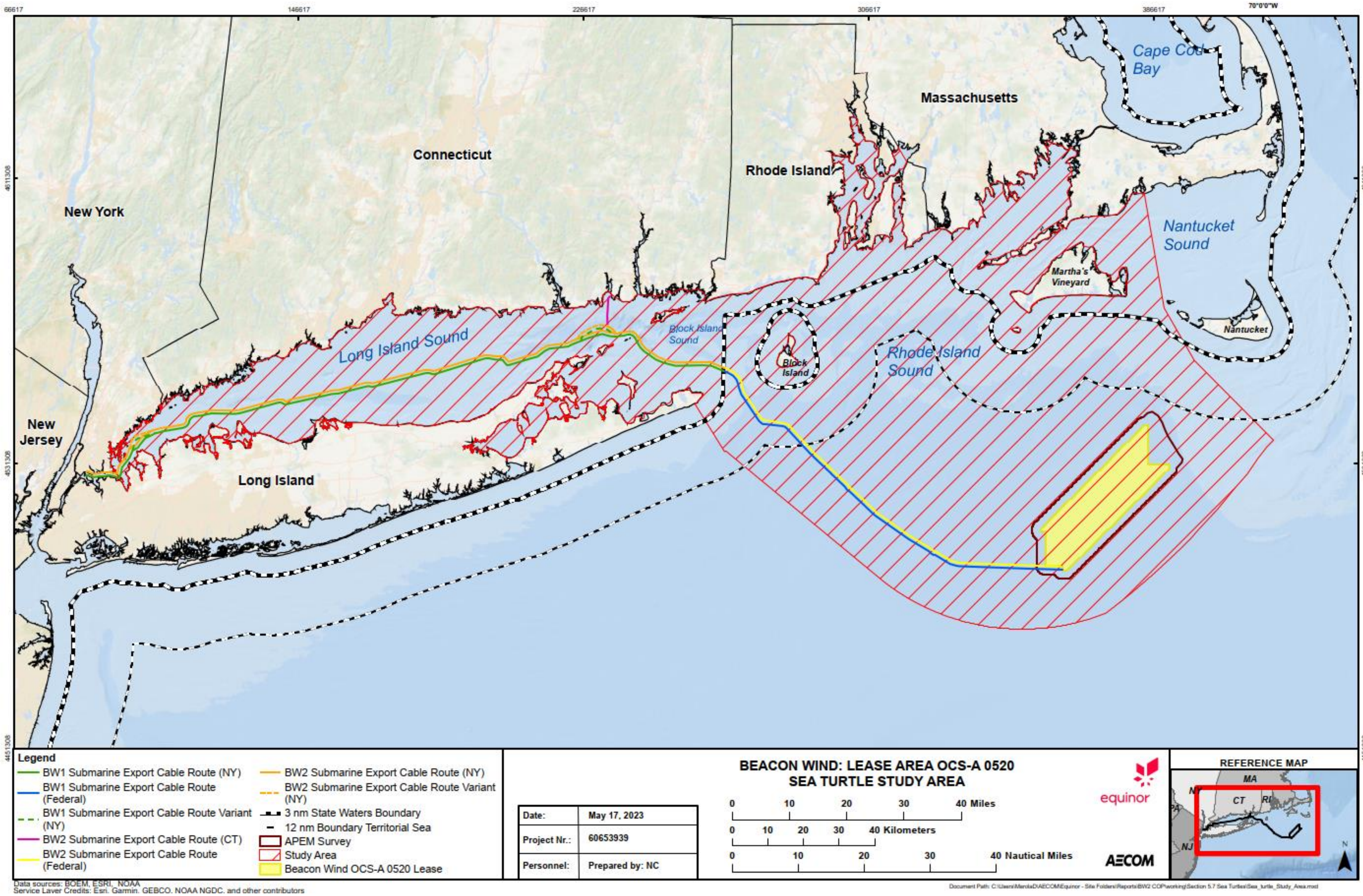
In accordance with BOEM's site characterization requirements in 30 CFR § 585.626(3) and BOEM's Guidelines for Providing Information on Marine Mammals and Sea Turtles for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 Subpart F (Marine Mammal and Sea Turtle Guidelines; BOEM 2019), this section relies on several sources of data and information in the assessment of sea turtles, which may be present in the Project Area. These include regionally-specific and Beacon Wind–led focused studies, including:

- Site-specific aerial surveys by Beacon Wind that included sea turtle sighting data (**Appendix O Ornithological and Marine Fauna Aerial Survey – APEM Studies**) (Normandeau-APEM 2020);
- Protected Species Observers (PSO) marine wildlife data collected during Beacon Wind surveys (Marine Ventures 2020 a – e, 2021 a – k, and Marine Ventures International, Inc 2021);
- Massachusetts Clean Energy Center and BOEM directed aerial surveys conducted by the New England Aquarium (NEA) in the MA/RI WEA and surrounding waters in six Campaigns from

October 2011 through September 2012, October 2012 through February 2014, March 2014 through June 2015, February 2017 through July 2018, October 2018 through August 2019, and March 2020 through August 2021 (Kraus et al. 2016; O'Brien et al. 2021a; O'Brien et al. 2021b; Quintana et al. 2019);

- Occurrence information compiled for the Rhode Island Special Area Management Plan and surrounding waters (Kenney and Vigness-Raposa 2009);
- Geospatial sighting information obtained from the OBIS datasets (OBIS SEAMAP 2021);
- U. S. Navy OPAREA Density Estimates (NODE) for the Northeast (https://seamap.env.duke.edu/serdp)
- NOAA AMAPPS (Hass et al. 2020; Palka 2015, 2016, 2017, 2018, and 2019); and
- Stranding data by state and applicable zone (Sea Turtle Stranding and Salvage Network [STSSN] 2021).

FIGURE 5.7-1. SEA TURTLE STUDY AREA



Beacon Wind collected Project-specific digital camera aerial survey sighting data and vessel-based visual sighting data that encompassed the Project Area (refer to **Appendix O Ornithological and Marine Fauna Aerial Survey – APEM Studies** for additional information). The Project Area included the Lease Area with a 1-nm (2-km) buffer surrounding it with an approximately 2-nm (4-km) buffer towards the northeast end (**Figure 5.7-1**). A total of 16 aerial digital surveys were conducted from December 2019 to November 2020 and observers recorded sightings of avian, marine mammal, sea turtle, and other large fauna including sharks, rays, and large fish assemblages. Surveys were conducted a minimum of once per month with two surveys in April, May, August, and September. Only two confirmed sea turtle sightings occurred during the 16 surveys from December 2019 to November 2020: one loggerhead and one Kemp's ridley, both observed in July 2020 (Normandeau-APEM 2020) (**Table 5.7-1** and **Figure 5.7-2**). The loggerhead sea turtle was observed within the Lease Area, while the Kemp's ridley sea turtle was seen in the southernmost point of the 1-nm (2-km) buffer.

From each monthly survey, individual digital still images were used to generate raw counts by species and were geo-referenced. Sightings within the boundaries of the two areas (the Lease Area and the 2-nm [4-km] buffer) were extracted using QGIS, providing raw count data. Per survey, the raw counts were then divided by the number of images collected to give the mean number of animals per image (i). Abundance estimates (N) for each survey month were then generated by multiplying the mean number of animals per image by the total number of images required to cover the entire study area (A): N = I A. Additional information on variance estimation and precision calculations as well as quality control measures undertaken throughout the process are available in **Appendix O Ornithological and Marine Fauna Aerial Survey – APEM Studies**. Based on this, the estimated abundance of loggerhead sea turtles in the Lease Area in July is seven, and estimated abundance within the Lease Area with the buffer zone is eight; density per km^2 is 0.01 in both areas. Estimated abundance within the buffer zone is zero. Similarly, for Kemp's ridley sea turtles the estimated abundance within the Lease Area with the buffer zone for July is eight, with a density of 0.01/ km^2, within the buffer zone only estimated abundance is nine with a density of 0.03/ km^2, with estimated abundance of zero within the Lease Area (Normandeau-APEM 2020).

The digital camera aerial data collected by Beacon Wind will supplement the data collected by other entities, including: the aerial survey data collected by the Massachusetts Clean Energy Center and BOEM from 2011 through 2021 covering the Massachusetts WEA and the MA/RI WEA and surrounding waters, the U.S. Navy NODES data (https://seamap.env.duke.edu/serdp), OBIS datasets, and the data presented by Kenney and Vigness-Raposa (Kenney and Vigness-Raposa 2009) covering the existing data for the Rhode Island Ocean Special Area Management Plan (SAMP) and surrounding waters including the Beacon Wind Study Area. These data are discussed in **Section 5.7.1.1** and sightings from these data are shown on **Figure 5.7-3**.

PSO visual sighting data specific to the Project Area were also collected during Project-related vessel-based surveys performed during surveys from 2020 - 2021, which includes sightings from the Lease Area, submarine export cable routes, and surrounding waters. The PSO monitoring, data collection, and reporting were conducted in compliance with Lease stipulations and supplemental stipulations required by BOEM. These data are summarized in **Table 5.7-2** and **Figure 5.7-2**. No sea turtles were observed during a geotechnical survey from October 6 through November 2, 2020 (RPS 2020). One unidentified sea turtle was observed on August 13, 2020 by PSOs on the M/V *Stril Explorer* during surveys from August 2020 through March 2021; one unidentified but probable green sea turtle was observed July 19, 2021 from the R/V *Dolphin*, and one loggerhead (June 7, 2021) and one unidentified sea turtle (June 13, 2021) were observed from the M/V *Deep Helder* (Marine Ventures 2020a – e and 2021a - k). Sighting data within the Study Area was organized by regional categories defined as follows:

- Lease Area (sighting fell within the Lease Area);
- Lease Area 1.2 – 2.5-mi (2 - 4-km) buffer (sighting fell within this buffer area of the Lease Area, not including the Lease Area itself). Note that the buffer is larger along the northeast side due to the shape of the Lease Area;
- Offshore installation corridor (sighting occurred within the submarine export cable routes, within a corridor of 328 ft [100 m] wide);
- Nearshore (sighting fell outside of Project Area and within state waters [within the 3-nm {5.56-km} limit from the coast]); and
- Offshore (sighting fell outside of the Project Area in federal waters [outside the 3-nm {5.56-km} limit from the coast]).

TABLE 5.7-1. AERIAL SURVEY SIGHTING DATA SUMMARY

Species	Lease Area	Lease Area 1.3 – 2.5 mi (2 - 4 km) Buffer	Submarine Export Cable Installation Corridors	Nearshore	Offshore
Kemp's Ridley	0	1	0	0	0
Loggerhead	1	0	0	0	0
Leatherback	0	0	0	0	0
Green	0	0	0	0	0
Sea Turtle (unidentified)	0	0	0	0	0

Note:
Both observations occurred in July 2020; surveys conducted monthly.
Source: Normandeau-APEM 2020

TABLE 5.7-2. PSO SIGHTING DATA SUMMARY

Species	Lease Area	Lease Area 1.3 mi (2 km) Buffer	Submarine Export Cable Installation Corridors	Nearshore	Offshore
Kemp's Ridley	0	0	0	0	0
Loggerhead	0	0	1	0	0
Leatherback	0	0	0	0	0
Green	0	0	0	1	0
Sea Turtle (unidentified)	0	0	1	0	1

Note:
All observations of sea turtles occurred in June, July and August 2020
Source: RPS 2020, Marine Ventures 2020a-e and 2021a-k

Several studies and additional surveys indicate sea turtles may occur seasonally in and around the Lease Area and along the submarine export cable routes. Species specific details are found in **Section 5.7.1.2**.

5.7.1 Affected Environment

The affected environment, as described, is defined as the coastal and offshore areas where sea turtles are known to be present, traverse, or incidentally occur and have the potential to be directly or indirectly affected by the construction, operations, and decommissioning of the Project. This includes, but is not limited to, the Lease Area, submarine export cable siting corridors, and export cable landfall sites. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Beacon Wind expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Beacon Wind will comply with in using these facilities.

This section describes sea turtle species that occur in the Study Area, which includes the Lease Area, offshore submarine export cable routes and Project related vessel routes from/to ports anticipated to be used. The Lease Area, offshore installation corridors, submarine export cable route landfall areas, and vessel routes are considered the affected environment. Ports and construction staging areas will be appropriately permitted and are governed by applicable environmental standards.

5.7.1.1 *Occurrence in the Study Area*

Four species of sea turtles may be seasonally found in coastal waters of New England including the Study Area. These species include the leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), and green (*Chelonia mydas*) sea turtles. As water temperatures off coastal New England increase in the spring, sea turtles begin to migrate north from their overwintering waters farther south. The Atlantic hawksbill (*Eretmochelys imbricata*) and olive ridley (*Lepidochelys olivacea*) sea turtles have more southerly or tropical ranges and their occurrence in the Project Area would be regarded as an incidental transient; therefore, they will not be included within this discussion. There are no known sea turtle nesting sites in the Study Area.

Table 5.7-3 provides a summary of key information for the four species found in coastal waters of New England and their potential to occur in or near the Project Area. The species-specific section describes the likelihood of occurrence within the Study Area. The likelihood of occurrence of each species in the Study Area is defined as follows:

- **Common** – occurring consistently in moderate to large numbers;
- **Regular** – occurring regularly, inhabitants at least seasonally and have been documented within the Lease Area and submarine export cable routes;
- **Uncommon** – occurring in low numbers or on an irregular basis;
- **Rare** – records for some years but limited; and
- **Not expected** – range includes the Lease Area and submarine export cable routes but due to habitat preferences and distribution information, species are not expected to occur in the Lease Area and submarine export cable routes although records may exist for adjacent waters.

Status, abundance, and seasonal occurrence of these species are listed in **Table 5.7-3** and each species is discussed in detail in **Section 5.7.1.2.** Seasonal occurrence is broken as: Winter (December - February), Spring (March - May), Summer (June - August), and Fall (September - November).

Critical habitat is defined by NOAA Fisheries as "specific areas within the geographical area occupied by the species at the time of listing that contain physical or biological features essential to conservation of the species and that may require special management considerations or protection; and specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation." There is no critical habitat for any sea turtle species within the Project Area.

Sea turtles are found in higher densities in the Project Area during summer and fall when the water is warmest but may also occur in the Project Area in winter and spring, in much lower numbers (**Figure 5.7-3**). Winter occurrences would be expected to be rare with most individuals likely to be cold-stunned, which may result in individuals resting or stranding on beaches. Aside from incidents of cold-stunning sea turtles only come on land during nesting periods, but there are no known nesting sites in the Project Area, nor is there critical habitat.

FIGURE 5.7-2. RECENT PSO (07/08/2020 TO 02/08/2021) AND AERIAL SURVEY (12/2019 TO 11/2020) SIGHTINGS

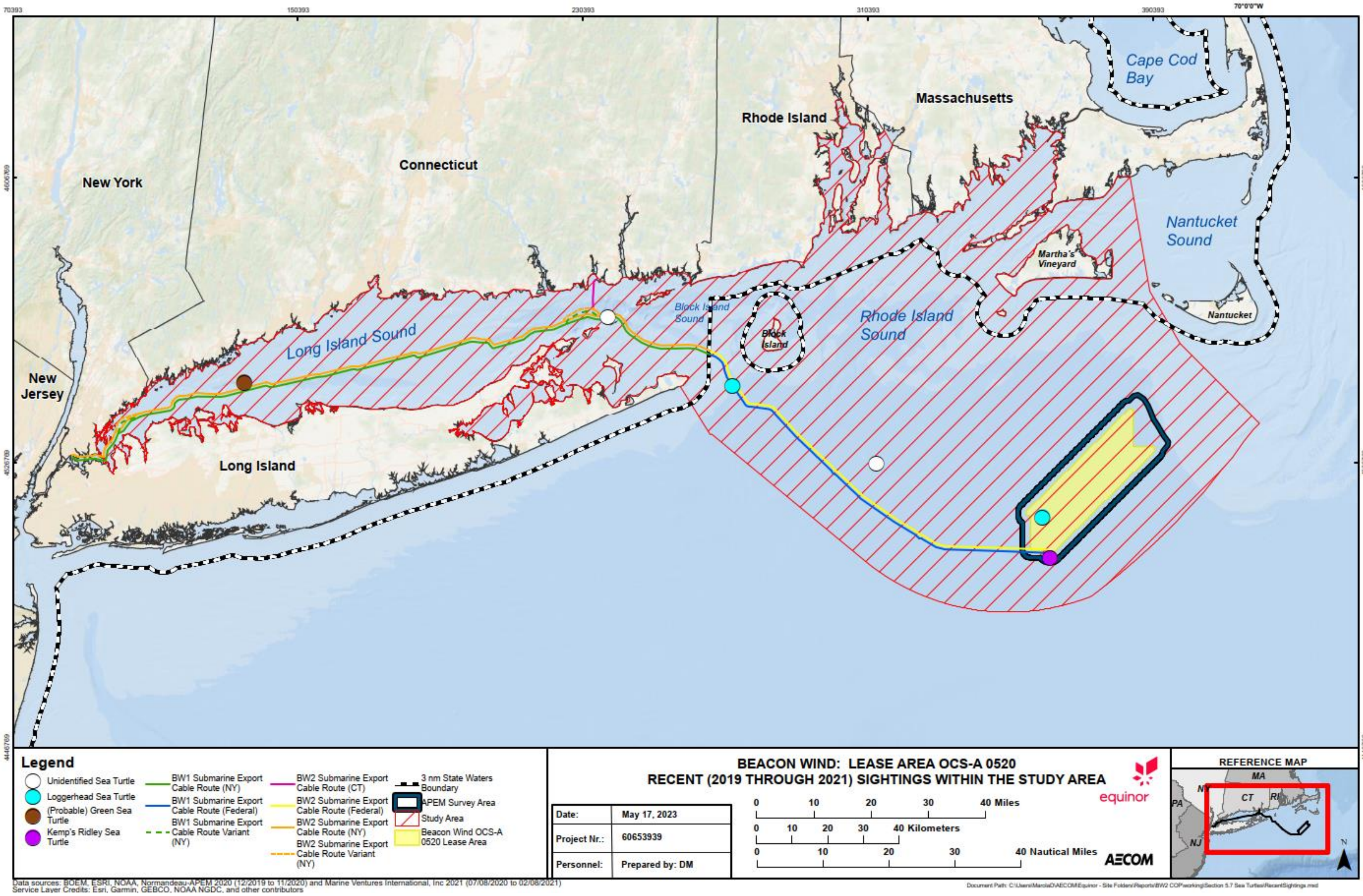
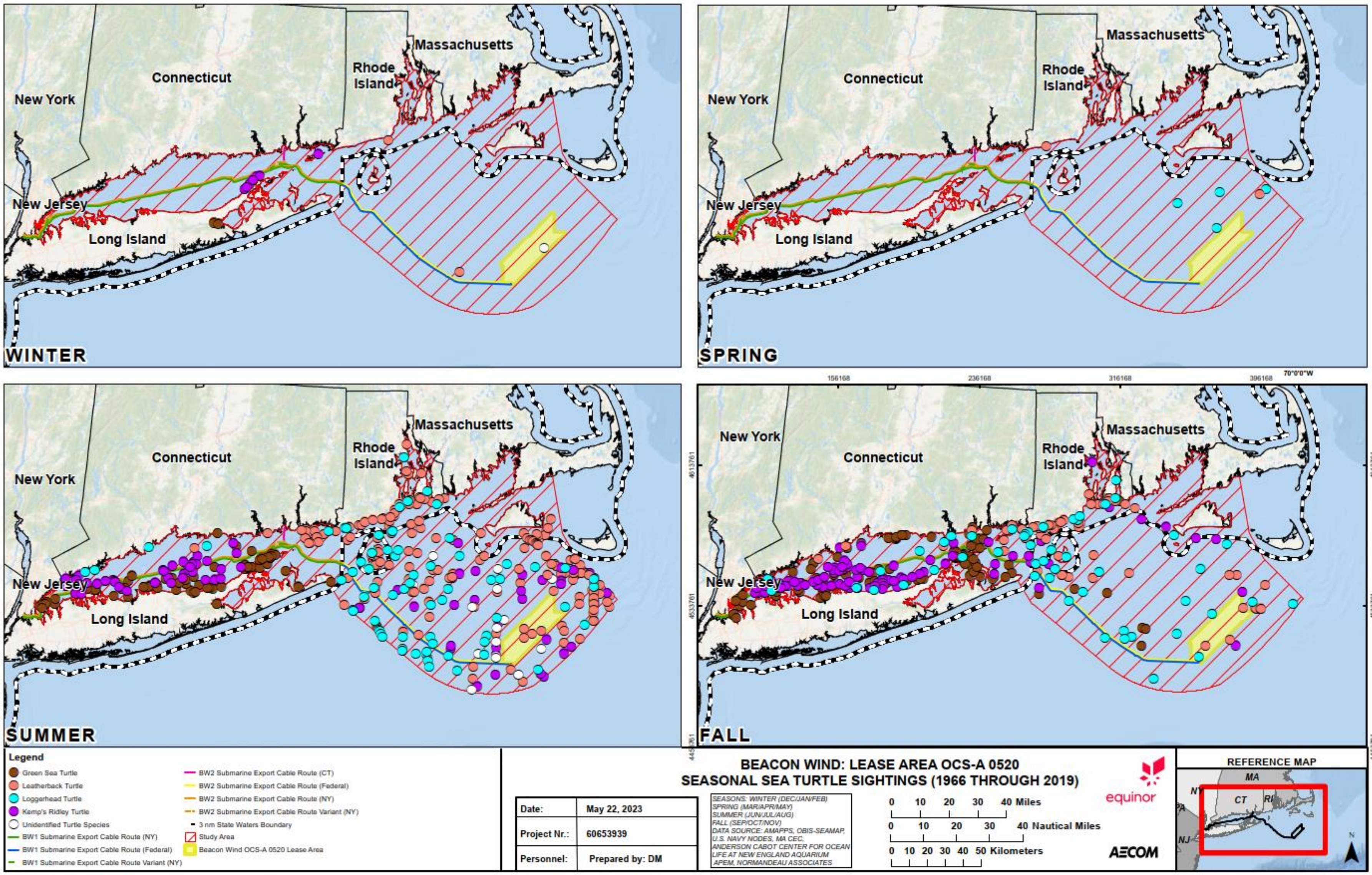


FIGURE 5.7-3. AVAILABLE SEA TURTLE SIGHTINGS DATA FROM 1966 THROUGH 2019 WITHIN THE STUDY AREA SHOWN SEASONALLY



Data Source: BOEM, ESRI, NOAA
Service Layer Credits: ESRI, GEBCO, NOAA NGDC, and other contributors

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TABLE 5.7-3. SEA TURTLE SPECIES KNOWN TO OCCUR IN THE STUDY AREA, AND THE STATE AND FEDERAL STATUS

Common Name	Scientific Name	Regulatory/ Federal Status	CT Status	MA Status	NY Status	RI Status	Estimated Population	Known Project Area Distribution	Likelihood of Occurrence in Project Area	Seasonal Occurrence in Project Area
Kemp's Ridley	*Lepidochelys kempii*	E	E	E	E	SGCN	248,307 (2012)	Nearshore and Offshore	Regular	Summer and Fall
Loggerhead	*Caretta caretta*	T	T	T	T	SGCN	32,000 – 56,000 nesting females (2000)	Nearshore and Offshore	Regular	Spring to Fall with peak in Summer
Green	*Chelonia mydas*	T	T	T	T	SCGN	N/A	Coastal and Nearshore –	Regular	Summer and Fall
Leatherback	*Dermochelys coriacea*	E	E	E	E	SGCN	34,000 – 94,000 (2007)	Coastal and Offshore	Regular	Spring to Fall with peak in Summer

Notes:

E = Endangered; FE = Federally Endangered; FT = Federally Threatened; N/A=Not Applicable; SGCN = Species of Greatest Conservation Need; T = Threatened.

Source: CT DEEP 2015; MA NHESP 2021; NMFS and USFWS 2013a; NMFS and USFWS 2013b; NMFS and USFWS 2007; NY SDEC 2015; RI NHS 2006; Seminoff et al. 2015

With the designation of WEAs, BOEM and other relevant federal agencies were required under NEPA to conduct environmental assessments of offshore development and construction plans. To meet NEPA requirements, six surveys (campaigns) of the Massachusetts WEA and the MA/RI WEA were conducted by the NEA from 2011 through 2021 in order to collect visual and acoustic baseline data on distribution, abundance, and temporal occurrence patterns of large, pelagic marine animals: Campaign 1 was conducted from October 2011 through September 2012; Campaign 2 from October 2012 through February 2014; Campaign 3 from March 2014 through June 2015; Campaign 4 from February 2017 to July 2018; and Campaign 5 from October 2018 to August 2019; and Campaign 6 from March 2020 through August 2021 (respectively: Kraus et al. 2016; Quintana et al. 2019, O'Brien et al. 2021a; and O'Brien et al. 2021b).

From these six surveys the following sea turtle sighting data were collected. During the surveys from Campaigns 1 - 3, three species of sea turtles were observed (leatherback, loggerhead, and Kemp's ridley), while only leatherback and loggerhead turtles were observed in the surveys for Campaigns 4, 5, and 6 (**Table 5.7-4**). Campaign 6A reported 15 detections of 20 sea turtles with the majority of detections occurring in the fall (n = 12) and only three detections in the summer (in July only). However, the report does not break down the species by season. Leatherback sea turtles were sighted on four separate days and all were observed over the Nantucket Shoals with only one exception. Two loggerhead sea turtles were observed, one in the central part of the survey area and the other near the western side of the study area. Sea turtle sightings were generally in the eastern part of their study area and would be outside the Beacon Wind Study Area (O'Brien et al 2021b). Leatherback sea turtles were the most commonly sighted species during the Campaigns, followed by loggerheads. Kemp's ridley sea turtles were only observed during Campaign 1, green sea turtles were not observed in any Campaign (but may be included in the unidentified sightings data), and sightings and numbers of the sea turtles declined over time.

TABLE 5.7-4. NUMBERS OF SEA TURTLES FROM SIGHTINGS IN THE MASSACHUSETTS CLEAN ENERGY CENTER/BOEM AERIAL SURVEYS CONDUCTED BY THE NEW ENGLAND AQUARIUM FROM 2011 THROUGH 2020

Species	Campaigns 1 – 3 (10/2011-6/2015)				Campaign 4 (2/2017 – 7/2018)				Campaign 5 (10/2018 – 8/2019)				Campaign 6A (3/2020 – 10/2020
	FA	WI	SP	SU	FA	WI	SP	SU	FA	WI	SP	SU	Total
Leatherback	61	0	2	98	3	0	0	13	0	0	0	6	17
Loggerhead	52	0	3	32	1	0	1	2	0	0	0	2	2
Kemp's Ridley	5	0	0	1	0	0	0	0	0	0	0	0	0
Green	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Sea Turtle	15	0	0	15	0	0	1	3	0	0	0	0	1

Note:
FA – Fall (September through November), WI – Winter (December through February), SP – Spring (March through May), SU – Summer (June through August).

Table 5.7-5 displays the Massachusetts Clean Energy Center/BOEM/NEA Campaigns 1 - 3 sighting data as effort-weighted average sighting rates (the number of animals per 621 mi [1,000 km]).

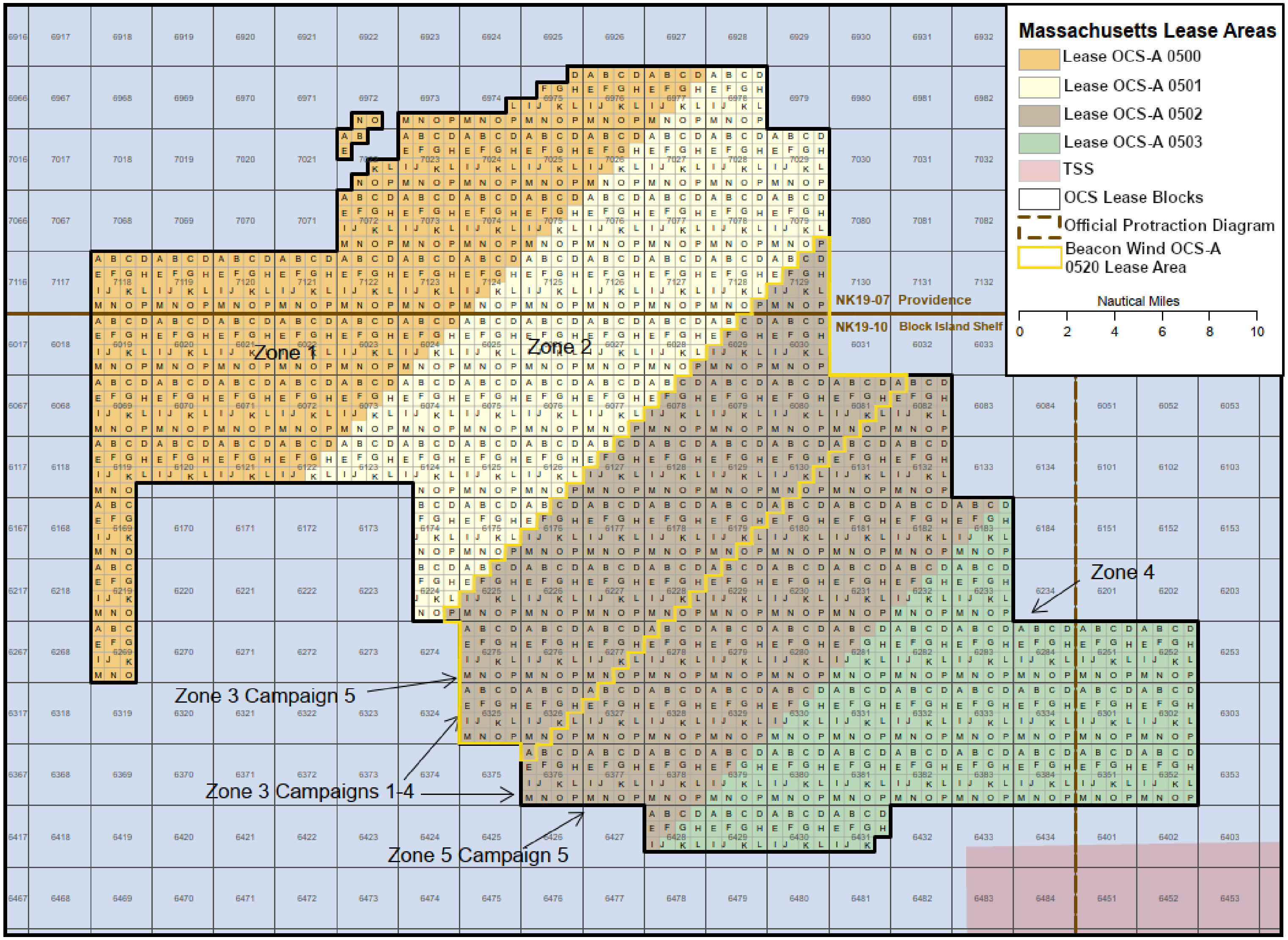
TABLE 5.7-5. EFFORT-WEIGHTED AVERAGE SIGHTING RATES FOR SEA TURTLE SPECIES (DEFINITE AND PROBABLE IDENTIFICATION ONLY) AND ALL SEA TURTLES COMBINED, BY SEASON DURING CAMPAIGNS 1-3.

	Fall (8,263.04 mi [13,298.08 km])			Winter (7,360.87 mi [11,846.17 km])			Spring (14,507.90 mi [23,348.20 km])			Summer (11,608.17 mi [18,683.15 km])		
Species	SR	S	A	SR	S	A	SR	S	A	SR	S	A
Leatherback	4.59	59	62	0	0	0	0.08	2	2	4.65	92	95
Loggerhead	3.97	45	45	0	0	0	0.07	2	2	1.52	31	31
Kemp's Ridley	N/A	4	4	N/A	0	0	N/A	0	0	N/A	0	0
All Sea turtles	10.46	133	140	0	0	0	0.19	5	5	8.66	146	165

Notes:
SR = the number of animals per 621 mi (1000 km); S = Number of sightings; A = Number of animals observed.
Total effort (km) is shown below each season identification.
Source: Kraus et al. 2016

During these surveys, the highest densities of leatherback sea turtles were found consistently in the area just south of Nantucket, outside the Lease Area. This area to the northeast of the Massachusetts WEA is considered a hot spot for leatherback sea turtles. In Campaigns 1 - 3, Kraus et al. (Kraus et al. 2016) report that sea turtles were distributed throughout Massachusetts WEA Zones 1 - 4 (**Figure 5.7-4)** in both summer and fall but were only present in Massachusetts WEA Zones 1 and 2 in the spring sightings. The Lease Area is in Zone 3. Quintana et al. (Quintana et al. 2019) reported the observation of a single leatherback sea turtle within the Lease Area in Zone 3 during the Campaign 4 surveys. O'Brien et al. (O'Brien et al. 2021a) show the only sighting within the Massachusetts WEA during Campaign 5 as a single loggerhead in the southwestern corner of Zone 4.

FIGURE 5.7-4. ZONES USED DURING MASSACHUSETTS CLEAN ENERGY CENTER/BOEM/NEW ENGLAND AQUARIUM AERIAL SURVEYS



During the 2015 AMAPPS aerial survey conducted from December 5, 2014 through January 14, 2015 only one loggerhead sea turtle and one unidentified dead sea turtle were observed, both south of Long Island, New York (Palka 2015). The surveys were conducted in nearshore and offshore waters of the northwestern Atlantic off coastal New England and south of Long Island, New York. The lack of sea turtle sightings is not unexpected due to the timing of the survey (winter).

Three vessel-based surveys were conducted during the 2016 AMAPPS effort: June 27 through July 14; July 18 through August 5; and August 9 through August 25. A total of 49 individual sea turtles were observed by two teams of visual observers, with some but not all recorded by both groups; therefore, actual totals are difficult to ascertain. Observers recorded 11 leatherback sea turtles, 33 loggerhead sea turtles, and five unidentified sea turtles. The majority of effort was in greater than 100-m water depth with only two short transects done south of Massachusetts in less than 100-m water depth. No sea turtles were recorded from these transects, and the majority of loggerhead sea turtle observations were made south of New Jersey.

Aerial AMAPPS surveys were conducted from August 14 through September 28, 2016 and October 15 through November 18, 2016 (Palka 2016). More than 400 sea turtles were observed with most being loggerhead sea turtles during the summer, but in the fall less than 20 individuals were observed and half were leatherback sea turtles. Most of these were recordings from south of Long Island, with a cluster of leatherback sea turtle observations south of Nantucket, and a few loggerhead sea turtles being observed in the Massachusetts WEA area.

A total of 165 sea turtles were detected in the 2017 AMAPPS aerial surveys conducted from June 6, through July 15 (Palka 2017). Most of these were loggerhead sea turtles or unidentified sea turtles with a handful of Kemp’s ridley sea turtles and green sea turtles that were located south of Long Island on the continental shelf. Most of the leatherback sea turtles were observed on the Scotian Shelf, south of Nova Scotia.

The AMAPPS aerial surveys conducted from November 21, 2017 through January 4, 2018 recorded a total of nine sea turtles in the northern leg of the abundance surveys (Palka 2018). One Kemp’s ridley sea turtle and one unidentified sea turtle were observed in western Long Island Sound, and the remaining seven sea turtles (one leatherback sea turtle, two loggerhead sea turtles, and four unidentified sea turtles) were observed outside the Massachusetts WEA boundaries.

The 2019 AMAPPS spring and fall aerial surveys recorded a total of 14 sea turtles in the northern leg of the abundance surveys conducted from April 3 through May 15, and October 13 through November 24, 2019 (Palka 2019). Two sea turtles were detected in the spring: one loggerhead sea turtle in nearly 2,000-m depth off New Jersey and one unidentified sea turtle on the northern edge of Georges Bank. Twelve sea turtles (one green sea turtle, four leatherback sea turtles, and seven loggerhead sea turtles) were detected during the fall survey from Long Island Sound, New York (one loggerhead sea turtle and one leatherback sea turtle) to the southern edge of Georges Bank. No sightings fell within the Massachusetts WEA.

Field work during the 2020 AMAPPS season was limited due to Covid-19 restrictions. Crews of four went out on small boats to tag leatherback sea turtles, but they did not report overall numbers of individuals observed (Haas et al. 2020).

Some sea turtles do not migrate southward in the fall for unknown reasons. It is possible that some turtles may forage in shallow bays and inlets and do not migrate in time prior to water temperature dropping (NOAA Fisheries 2012). Sea turtles that remain in northern waters after the first week of November can be affected by “cold stunning”, which occurs when temperatures drop rapidly or unexpectedly. Cold stunning refers to the hypothermic reaction that occurs when sea turtles are exposed to prolonged cold-water temperatures and as a result undergo symptoms that may include decreased heart rate, decreased circulation, lethargy, shock, pneumonia, and possibly death. Cold stunning in the Study Area typically peaks in the month of November, with a reduction in incidents through December and January (Burke et al. 1994; Morreale et al. 1992; Morreale and Standora 1998). Depending on the source and temporal period reported, numbers of cold-stunned sea turtles have varied, although overall there has been an increase over time. Kenney and Vigness-Raposa (Kenney and Vigness-Raposa 2010) reported that in 1985, 56 sea turtles were found cold-stunned in eastern Long Island. Griffin et al. (Griffin et al. 2019) states that, before 2009, there were only two years in which numbers of cold-stunned turtles exceeded 100. However, Griffin et al. (Griffin et al. 2019) reported that, in 2014, more than 1,100 Kemp's ridley sea turtles stranded in New England waters.

Cold stunning typically affects juveniles more than adults (Kenney and Vigness-Raposa 2010). Models show that higher cold-stunning years will occur when sea surface temperatures are warmer, since warmer temperatures are likely to modify seasonal distributions; affect currents, eddies, and thermoclines that factor into sea turtle movements and presence; and cause sea turtles to occur in more northerly areas. A mismatch between typical foraging periods and colder temperatures can occur. As sea turtles are ectothermic and depend on external sources of heat to determine their body temperature, cold water is not a preferred or optimal habitat.

There are also several other existing threats that are shared among sea turtle species. Along the U.S. Atlantic Coast, anthropogenic threats that pose the greatest population-level effects on sea turtles are from fisheries bycatch and habitat loss, which have both indirect and direct effects (82 Federal Register 57565). Other threats include (USFWS 2018a-d):

- Entanglement with fishing gear (ghost nest, discarded line, or gear);
- Vessel strikes; and
- Degradation of nesting habitat in other portions of their range, either from physical reduction or from lighting effects.

5.7.1.2 Species Overview

Based on mapping of the publicly-available data sources listed in the introduction, of the four species of sea turtle that have been documented within the Study Area, the loggerhead sea turtle is most abundant and widespread throughout the area. Leatherback sea turtles are found in higher densities nearer to coastlines. In the Study Area, Kemp’s ridley and green sea turtles are more likely to be found in the waters of Long Island Sound than within the Lease Area. Sea turtle species are more commonly found in the summer and fall months when water temperatures are warmest. As water temperatures throughout coastal New England rise in the spring, sea turtles begin to migrate north from their overwintering waters further south. There is no sea turtle nesting in any of the coastal areas that the Project Area encompasses. A single Kemp’s ridley sea turtle nested on the southern coast of Long Island, New York in 2018. A brief natural history species description is provided in the subsequent species-specific sections.

5.7.1.2.1 Kemp's Ridley Sea Turtle (Lepidochelys kempii)

The Kemp's ridley sea turtle is listed as endangered throughout its range under the U.S. ESA and as critically endangered on the International Union for Conservation of Nature (IUCN) Red List (NMFS and USFWS 2015). They are distributed throughout the Gulf of Mexico and Atlantic coast from Florida to the Grand Banks and Nova Scotia, Canada with few records near the Azores, waters off Morocco, and within the Mediterranean Sea. Adult Kemp's ridley sea turtles are found in nearshore coastal (neritic) habitats in the Gulf of Mexico that include muddy or sandy bottoms where their preferred food (crabs) can be found (NMFS and USFWS 2015).

Females nest primarily in Tamaulipas, Mexico in large groups from April to July. In the U.S., nesting occurs primarily in Texas and occasionally in Florida, Alabama, Georgia, South Carolina, and North Carolina (NMFS and USFW 2015). In 2018, a single Kemp's ridley sea turtle nested on West Beach on the Rockaway peninsula on southern Long Island, New York. Hatchlings emerge after two months and remain out at sea in the currents often associated with rafts of Sargassum to escape predators. Individuals encountered off the northeastern U.S. are mostly juveniles (NMFS and USFW 2015). Juveniles migrate to habitats along the U.S. Atlantic continental shelf from Florida to New England when they reach approximately 7.9 in (20 cm) in carapace length, which takes one to four years (Kenney and Vigness-Raposa 2010). At this point they transition from a pelagic existence to a benthic-feeding juvenile stage and migrate into developmental habitats. Developmental habitats are coastal areas sheltered from high winds and waves (embayments, estuaries, and nearshore temperate waters) that also provide rich food sources of crabs and other invertebrates (mollusks, natural and synthetic debris, sea horses, cownose rays, jellyfish, and tunicates) (Kenney and Vigness-Raposa 2010). Older juveniles and adults feed on crabs, mollusks, fish, and jellyfish in sublittoral coastal areas on muddy or sandy bottoms, rarely venturing deeper than 160 ft (48.8 m). Prolonged exposure to water at 50°F or lower can cause Kemp's ridleys to become cold-stunned (sluggish behavior and reduced activity due to exposure to cold water) (NMFS et al. 2011).

In general, juvenile and adult Kemp's ridley sea turtles migrate north in the spring as water temperatures warm, arriving in mid-Atlantic waters in May. As the waters cool in the fall, the trend is reversed with most sea turtles leaving the area by the end of November (NMFS et al. 2011). While analyzing data for the Rhode Island SAMP (**Figure 5.7-5**) Kenney and Vigness-Raposa reported only 14 records of Kemp's ridley sea turtles in the Rhode Island study area (area directly south of Rhode Island extending just south of Long Island, New York and Martha's Vineyard, Massachusetts) with 12 occurring in summer and two in the fall (Kenney and Vigness-Raposa 2010). The sightings were far too few for them to generate relative abundances. The authors note that the occurrence records for the species are biased due to two factors: most are too small to be detected from surveys, and that the shallow bays and estuaries utilized by the species within the study area are usually excluded from survey designs. They note that the juveniles are relatively common around eastern Long Island and in Cape Cod Bay, and state that small individuals may regularly transit the Rhode Island and SAMP study areas (Kenney and Vigness-Raposa 2010). Kemp's ridley sea turtles have been observed in the waters of southeastern New England, but they are less common than leatherbacks or loggerheads.

The historically reported sightings, from the publicly-available data sources listed in the introduction to this section, of Kemp's ridley sea turtles in the Study Area are depicted on **Figure 5.7-6**. While Kemp's ridley sea turtles have been observed within and near the Lease Area they are more commonly found along the submarine export cable routes in Long Island Sound. They are expected in the Study Area in summer and fall, and while there were some winter sightings they were likely cold-stunned animals.

Figure 5.7-5. Depiction of Rhode Island SAMP (pink outline), Rhode Island Study Area (red outline) and the Area Used for Extracting Data for the Relative Abundance Modeling Procedure (green outline). From Kenney & Vigness-Raposa, 2010

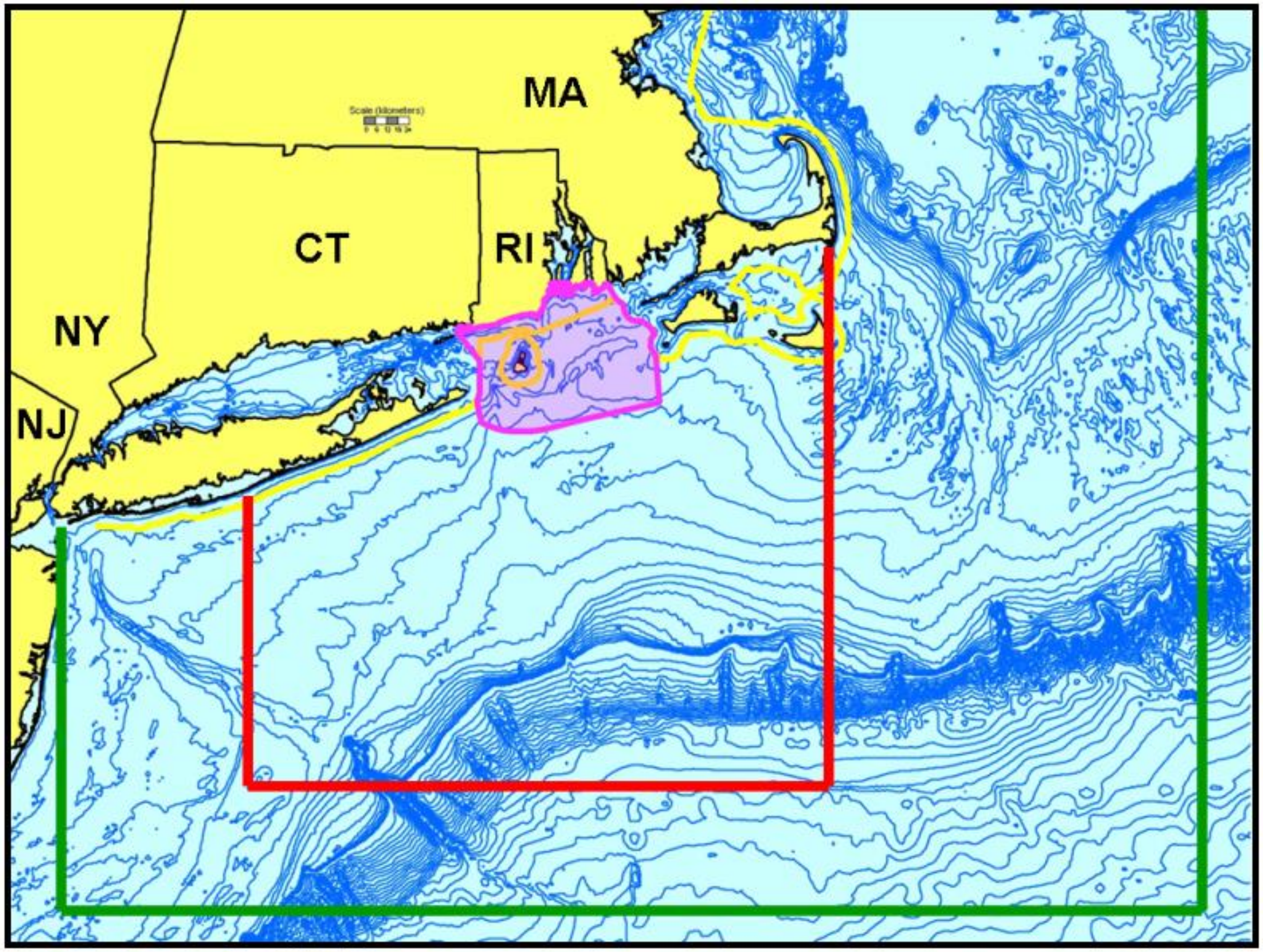
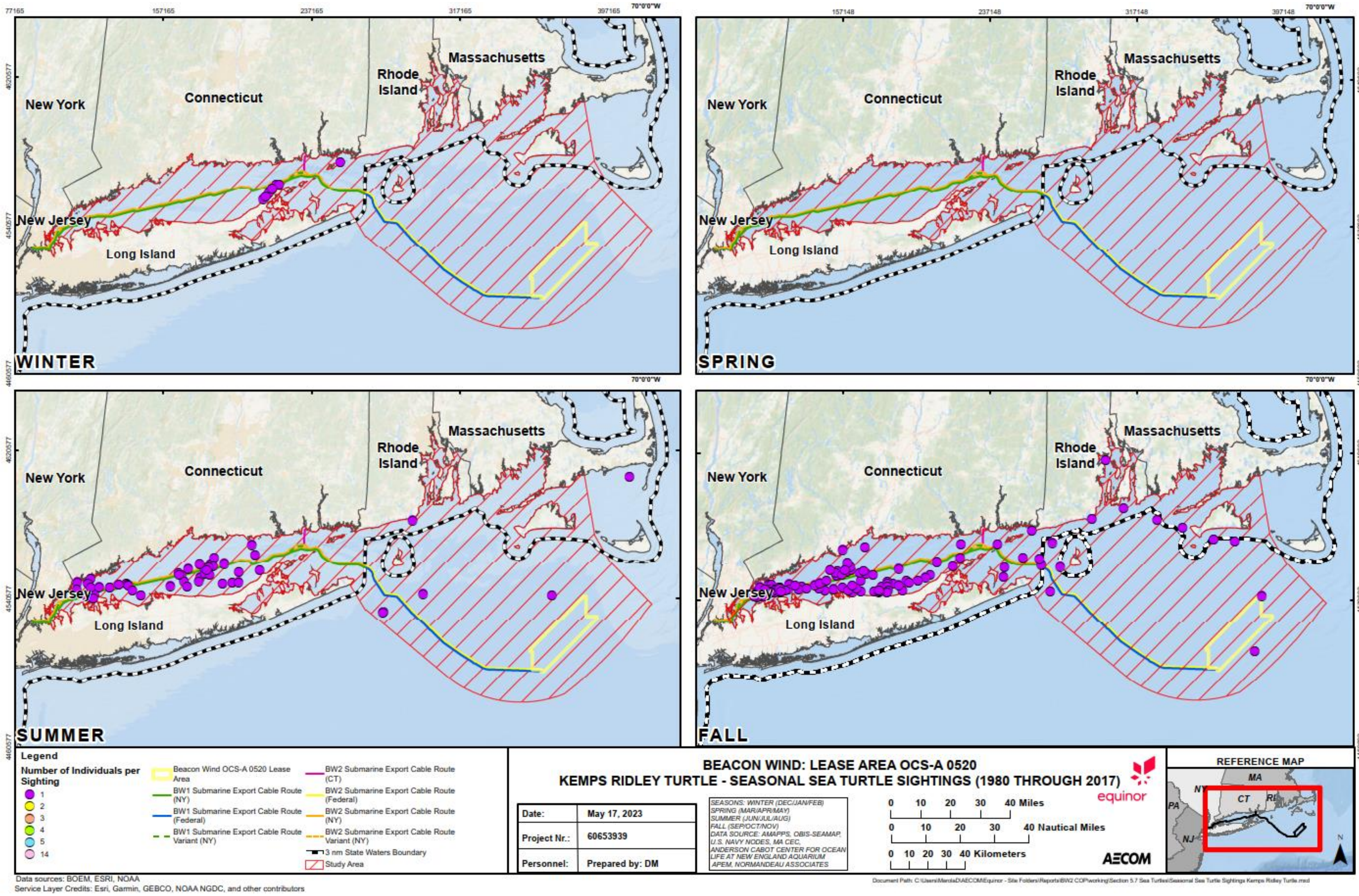


FIGURE 5.7-6. HISTORICAL SIGHTINGS (1980 THROUGH 2017) OF KEMP'S RIDLEY SEA TURTLES IN THE STUDY AREA



5.7.1.2.2 Loggerhead Sea Turtle (Caretta caretta)

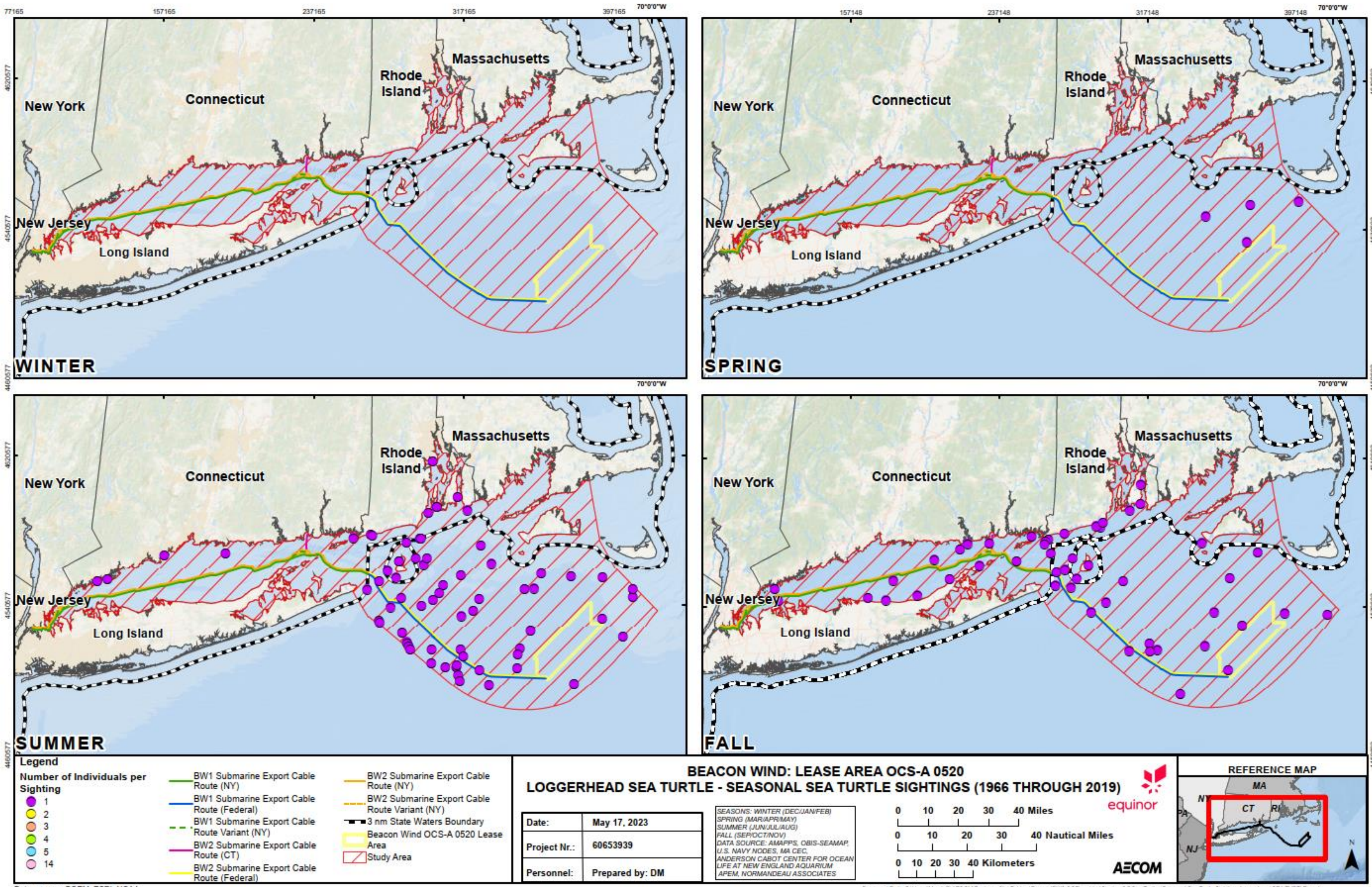
The loggerhead sea turtle occurs worldwide, with nine DPSs identified under the ESA, seven of which occur outside the U.S. EEZ plus the North Pacific and the Northwest Atlantic Ocean (50 CFR Parts 223 and 224). Under the ESA, a DPS is a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The Northwest Atlantic Ocean DPS is classified as Threatened under the U.S. ESA and as Endangered on the IUCN Red List (NMFS and USFWS 2007). In the Atlantic, loggerhead sea turtles occur from Newfoundland, Canada to Argentina. Critical habitat for this DPS includes parts of the Gulf of Mexico and the Atlantic Ocean south of Delaware. There is no critical habitat designated in the Project Area.

On the Atlantic coast, female loggerheads nest from April to early September primarily on narrow, steep, high energy, coarse-grained beaches along the Atlantic coast of Florida, Georgia, South Carolina, and North Carolina, as well as along the Florida and Alabama coasts in the Gulf of Mexico (NMFS and USFWS 2007). NOAA Fisheries estimates the total number of nests in the U.S. is less than 100,000 per year (NMFS and USFWS 2007). Hatchlings emerge between June and November and swim or are swept away from land toward offshore ocean currents, where they become associated with Sargassum habitats, driftlines, and other convergence zones (NMFS and USFWS 2007). After leaving the oceanic zone, neritic (inshore marine environments from the surface to the seafloor where water depths do not exceed 200 m) juvenile loggerheads migrate to continental shelf waters from Cape Cod Bay, Massachusetts to Texas (NMFS and USFWS 2007). Non-nesting adult loggerheads utilize estuarine areas with more open ocean access (i.e., Chesapeake Bay) primarily during warmer seasons. Seasonal use of mid-Atlantic shelf waters occurs during summer months, especially offshore New Jersey, Delaware, and Virginia (NMFS and USFWS 2007).

Small juveniles feed on pelagic invertebrates (siphonophores, jellies, and salps) as well as gastropods, barnacles, and isopods; in developmental habitats juveniles feed predominantly on crabs, while adults feed on a wide variety of benthic prey (bivalves, gastropods, crabs, sea pens, anemones, and seaweeds) (Kenney and Vigness-Raposa 2010). In general, juvenile and adult loggerhead sea turtles migrate north in the spring as water temperatures warm, arriving in mid-Atlantic waters in May. As the waters cool in the fall, the trend is reversed with most sea turtles leaving the area by the end of November.

Although loggerhead sea turtles are much more abundant off the northeastern U.S. than leatherbacks, they are less likely to be seen in cooler and nearshore waters. Of the 233 sightings, strandings, and bycatch records of loggerhead sea turtles in the Rhode Island study area from 1963 to 2006, one was from spring, 171 from summer, and 61 from the fall (zero in winter) (Kenney and Vigness-Raposa 2010). During Northeast large pelagic surveys loggerhead sea turtles were mainly observed in August (27 individuals) and September (45 individuals): 72 of 78 observations in surveys from October 2011 through June 2015 (Krause et al. 2016). The remainder of the observations included one individual each in April and May and four in July. The historically reported sightings from the publicly-available data of loggerhead sea turtles in the Study Area are depicted on **Figure 5.7-7**. Loggerhead sea turtles are more commonly found in the offshore area within the Study Area. They are not found within the Study Area in winter or spring but are relatively common in summer and fall. In the summer, they may be found along the Connecticut coastline, and in fall may be observed in the waters of Long Island Sound.

FIGURE 5.7-7. HISTORICAL SIGHTINGS (1996 THROUGH 2019) OF LOGGERHEAD SEA TURTLES IN THE STUDY AREA



Data sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

5.7.1.2.3 Leatherback Sea Turtle (Dermochelys coriacea)

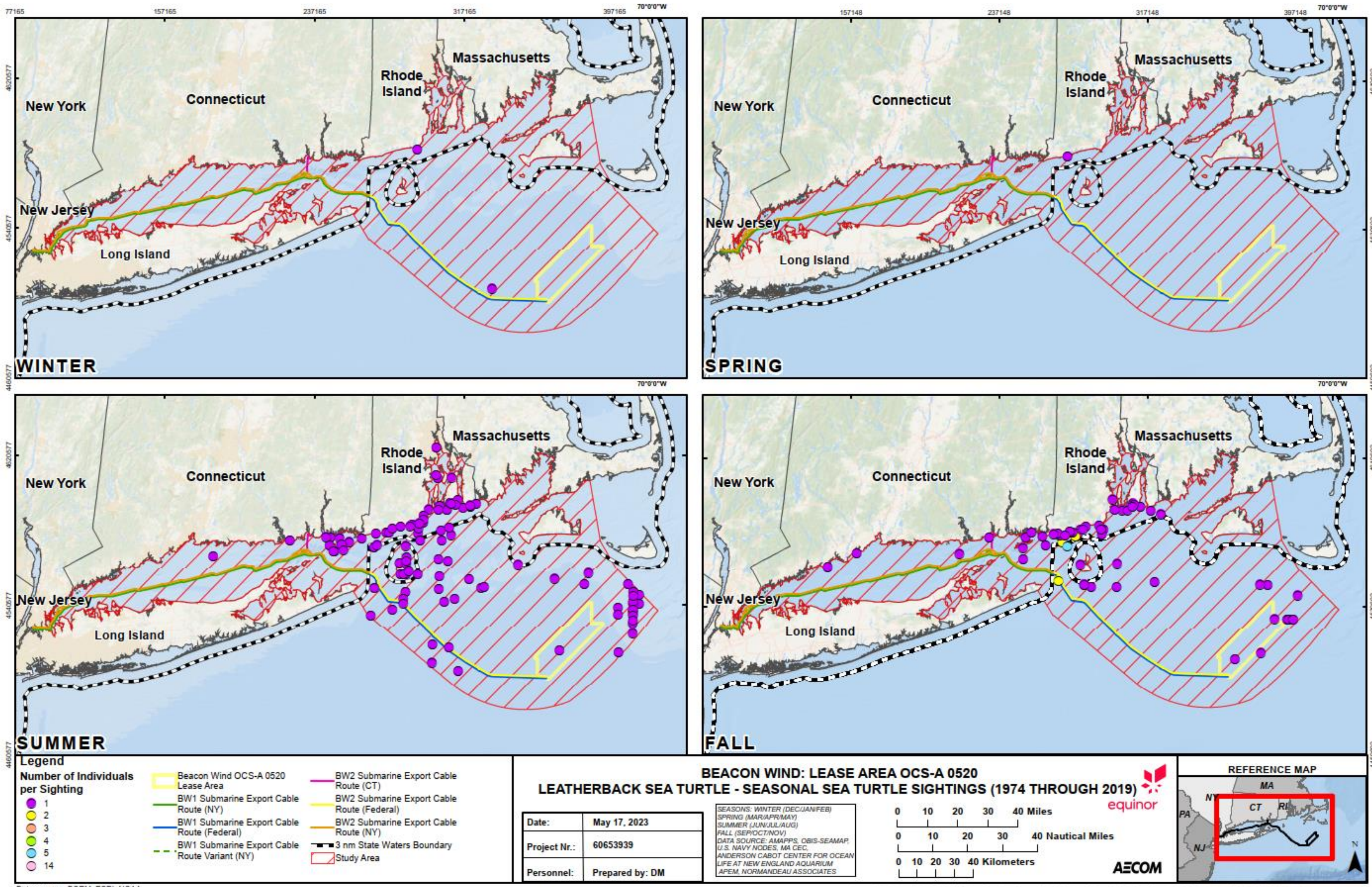
The leatherback sea turtle is listed as endangered under the ESA throughout its range, which includes both the Atlantic and Pacific Oceans. This highly migratory species of sea turtle is the largest sea turtle in the world, weighing 750 to 1,000 pounds with a shell length of 5 to 6 ft (1.5 to 1.8 m) (NMFS and USFW 2013a). Leatherback sea turtles feed on soft-bodied pelagic prey including jellyfish and salps (pelagic tunicates), as they lack the strong jaws necessary to eat hard-shelled prey. Unlike other sea turtle species, leatherback sea turtles are more dependent on prey availability and reproductive requirements than temperature for determining their distribution because they are able to maintain a body temperature well above ambient (Kenney and Vigness-Raposa 2010). The most significant nesting locations near the U.S. Atlantic coast are found in Puerto Rico, Virgin Islands, and Southeast Florida (NMFS and USFWS 2013).

Leatherback sea turtles were sighted commonly in summer in shelf waters from North Carolina to Maine, and in much lower numbers in spring and fall. Nearshore waters south of central Long Island had the densest aggregation of sightings (Kenney and Vigness-Raposa 2010).

Leatherback sea turtles are relatively dispersed and not particularly abundant within the boundary of the mapped area of the SAMP, with areas of higher abundance beyond the boundary, especially south of Martha’s Vineyard and Nantucket in the fall (Kenney and Vigness-Raposa 2010).

The historically reported sightings of leatherback sea turtles in the Study Area are depicted on **Figure 5.7-8**. Leatherback sea turtles may be found in the Study Area rarely in the spring but are much more common in summer and fall. They may be observed within the Lease Area, but as Kraus et al. (Kraus et al. 2016) reported there is a much higher density of this species just south of Nantucket in summer and fall than in the surrounding waters. Seasonal abundance estimates within the area of the Northeast large pelagic survey range from 0 in winter and spring, a range of 9-90 in summer, and 6-99 in autumn (Krause et al 2016). They have historically been observed in the eastern waters of Long Island Sound, but are not commonly seen in the open waters of the Sound.

FIGURE 5.7-8. HISTORICAL SIGHTINGS (1974 THROUGH 2019) OF LEATHERBACK SEA TURTLES IN THE STUDY AREA



Data sources: BOEM, ESRI, NOAA
Service Layer Credits: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

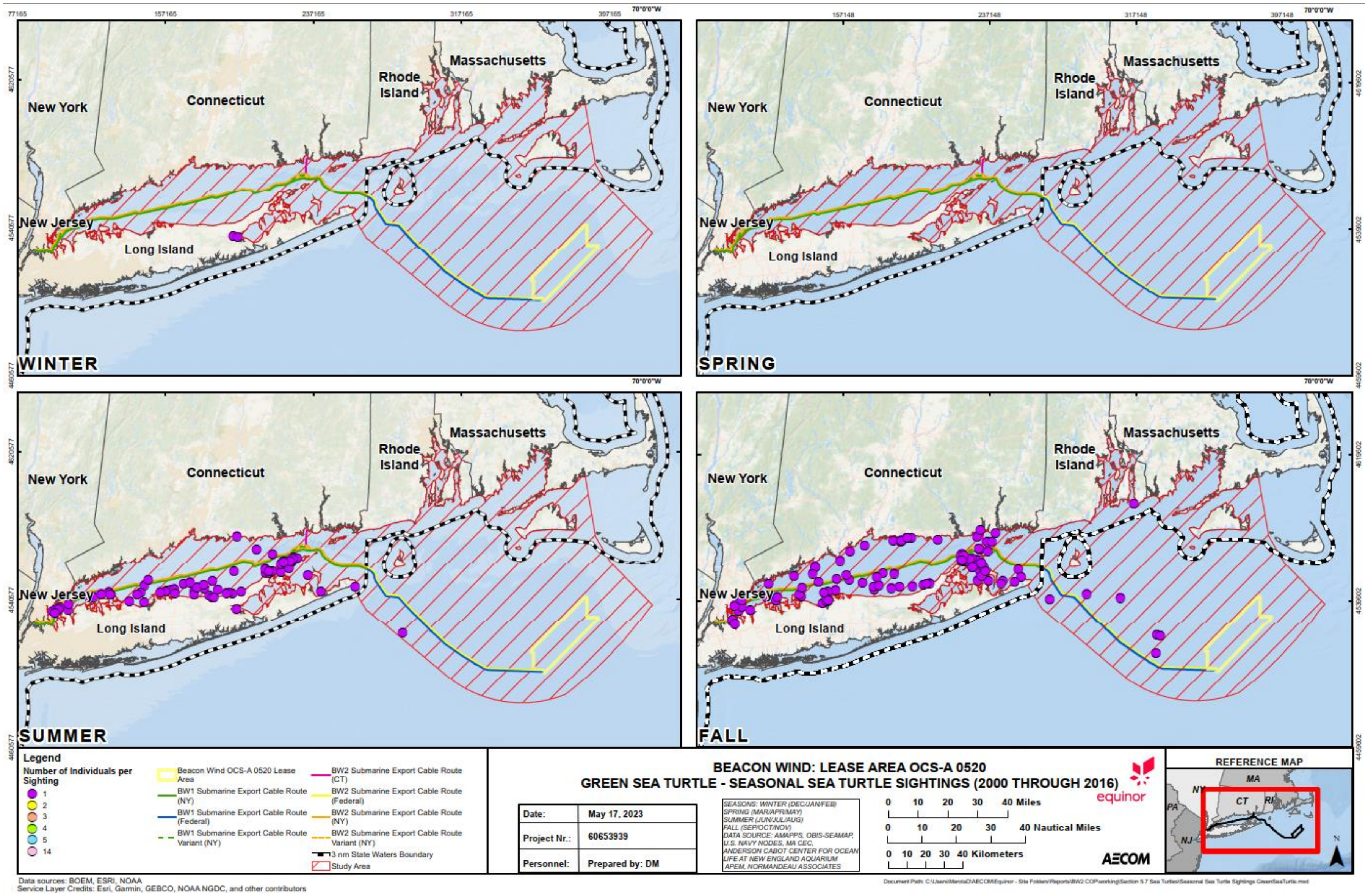
5.7.1.2.4 Green Sea Turtle (Chelonia mydas)

The North Atlantic DPS of green sea turtle is listed as threatened under the U.S. ESA. The range of the threatened green sea turtle in U.S. Atlantic waters includes inshore and nearshore waters from Massachusetts to Texas, occupying beaches for nesting, open ocean for convergence zones, and coastal areas for benthic feeding. The majority of their lives is spent in coastal foraging grounds, relying on marine algae and seagrass as the primary constituent of their diet, though some populations also forage heavily on invertebrates (Seminoff et al. 2015). Green turtles found in the Study Area are part of the North Atlantic DPS.

Nesting in the U.S. North Atlantic Ocean occurs on continental and island beaches from Florida south to Mexico (Seminoff et al. 2015). Nesting occurs from June to September, with peaks in June and July. Hatchlings emerge after two months and swim to offshore areas where they are thought to live for years feeding close to the surface. Green sea turtles live in the open-ocean waters of the Gulf Stream and North Atlantic Gyre during the first five to six years of life. In the western area of the North Atlantic Ocean, juveniles forage as far north as Cape Cod Bay, Massachusetts and south throughout the Caribbean. As ocean temperatures increase in the spring, green sea turtles migrate from southeastern U.S. waters to the estuarine habitats of Long Island Sound, Peconic Bay, and possibly Nantucket Sound, where an abundance of algae and eelgrass occurs.

Green sea turtles are less common in the Lease Area than leatherback or loggerhead sea turtles because they prefer shallow waters. The historically reported sightings of green sea turtles in the Study Area are depicted on **Figure 5.7-9**. Historically, they have not been observed in the Lease Area but are more commonly seen along the submarine export cable routes within Long Island Sound. They are seasonal, only found in summer and fall. The rare observations in winter were likely cold-stunned individuals.

FIGURE 5.7-9. HISTORICAL SIGHTINGS (2000 THROUGH 2016) OF GREEN SEA TURTLES IN THE STUDY AREA



5.7.2 Impacts Analysis for Construction, Operations, and Decommissioning

The potential impacts resulting from the construction, operations, and decommissioning of the Project are based on the maximum design scenario from the PDE (see **Section 3 Project Description**). For sea turtles, the maximum design scenario is the maximum number of fixed structures, and therefore fixed structures in the water, as described in **Table 5.7-6**. The current design scenario for the Project includes the installation of up to 155 wind turbines and two offshore substation facilities within the Lease Area. The wind turbines will be placed at 1x1-nm (1.9x1.9-km) spacings in a predetermined north/south–east/west grid throughout the Lease Area. The foundation types that will be used for the Project include monopiles, piled jackets, or suction bucket jackets for wind turbines, and piled jacket or suction bucket foundations for the two offshore substation facilities (see **Section 3.3.1 Offshore Infrastructure** for descriptions). Calculations supporting the maximum design scenario are shown in **Table 5.7-6, Table 5.7-7**, and **Table 5.7-8**.

TABLE 5.7-6. SUMMARY OF MAXIMUM DESIGN SCENARIO PARAMETERS FOR SEA TURTLES

Parameter	Maximum Design Scenario	Rationale
Construction		
Offshore structures	Based on full build-out of the Project (BW1 and BW2) (155 turbines and two offshore substation facilities).	Representative of the maximum number of structures.
Wind turbine foundation	Monopile, piled jacket	Representative of foundation options that would result in the maximum introduction of underwater noise.
Wind turbine foundation installation method	Pile driving	Representative of the installation method that would result in the loudest underwater noise generated.
Duration offshore installation	Based on full build-out of the Project (BW1 and BW2) (155 wind turbines and two offshore substation facilities).	Representative of the longest period of foundation installation via pile driving.
Underwater noise pile driving - single monopile	Pile diameter: 43 ft (43 m) Max penetration: 180 ft (55 m) Max hammer energy: 6,600 kJ[16] Total max pile driving duration per foundation: 4.8 hours Total duration for 155 wind turbines: BW1 and BW2: 744 hours	The longest temporal duration of impact for monopiles, which equates to the maximum number of pile-driving events.

[16] Total rated energy shown; actual effective energy level will not exceed 6,023 kJ.

Parameter	Maximum Design Scenario	Rationale
Underwater noise pile driving – piled jacket	Pile diameter: 14.7 ft (4.5 m) Max penetration: 230 ft (70 m) Number of piles per foundation: 4 Max hammer energy: 2,300 kJ[17] Total max pile driving duration per foundation: 64 hours (6.1 hours per pile) Total duration for 155 wind turbines: BW1 and BW2: 3,100 hours	The longest temporal duration of impact for piled jackets, which equates to the maximum number of pile-driving events.
Underwater noise pile driving – piled offshore substation facilities	Pile diameter: 9.8 ft (3 m) Max penetration: 328 ft (100 m) Max number of corner legs piled: 4 Max hammer energy: 2,850 kJ[18] Total max pile driving duration per pile: 8.3 hours Total number of piles for: BW1: 3 BW2: 6 Total number of piles per leg: BW1: 12 BW2: 24 Total duration for two offshore substation facilities: BW1 and BW2: 470 hours	The longest temporal duration of impact for piled jackets for two offshore substations. 299 hours is considered the maximum amount of time required to drive pile driven jackets for two offshore substation facilities (active pile driving).
Project-related vessels	Based on full build-out of the Project (BW1 and BW2) (155 wind turbines, two offshore substation facilities, submarine export cables, and interarray cables) and maximum associated vessels.	Representative of the maximum number of Project-related vessels for collision risk and underwater vessel noise.
Operations and Maintenance		
Wind turbines	Based on a full build-out of the Project (BW1 and BW2) (155 wind turbines).	Representative of the maximum underwater noise generated by operational wind turbines.
Project-related vessels	Based on full build-out of the Project (BW1 and BW2) (155 wind turbines, two offshore substation facilities, submarine export cables, and associated interarray cables). Based on maximum number of vessels and movements for servicing and inspections.	Representative of the maximum predicted Project-related vessels for collision risk, underwater noise, and anchor snags.

[17] Total rated energy shown; actual effective energy level will not exceed 1,959 kJ.
[18] Total rated energy shown; actual effective energy level will not exceed 1,959 kJ.

Parameter	Maximum Design Scenario	Rationale
Wind turbine and offshore substation foundation facilities and scour protection Habitat loss	<u>Wind Turbine</u> Based on suction bucket jacket, which represents the maximum overall footprint (155 x 3.0 ac [1.2 ha] with scour protection). Total 465 ac (188 ha) including scour protection. <u>Offshore Substation Facilities</u> Based on suction bucket jacket, which represents the maximum overall footprint (2 x 5.2 ac [2.1 ha] with scour protection. Total 10.4 ac (4.2 ha) including scour protection.	Representative of the maximum area of foundation and scour protection installed, which would result in the maximum long-term loss of seabed habitat.
Interarray cables	Based on a full build-out of the Project (BW1 and BW2) with the maximum number of structures (155 wind turbines and two offshore substation facilities) to connect: BW1: 162 nm (300 km) BW2: 162 nm (300 km)	Representative of the maximum length of interarray cables, which would result in the maximum exposure to EMF within the Lease Area.
Submarine export cables	Based on a full build-out of the Project (BW1 and BW2) • BW1 to Queens, New York (202 nm [375 km]). • BW2: ○ To Queens, New York (202 nm [375 km]) or ○ To Waterford, Connecticut (113 nm [209 km]).	Representative of the maximum number and length of submarine export cables, which would result in the maximum exposure to EMF on the cable route.

TABLE 5.7-7. SUPPORTING CALCULATIONS: MAXIMUM DESIGN SCENARIO FOR BENTHIC IMPACTS OFFSHORE – TOTAL HABITAT CONVERSION TO HARDBOTTOM

Type and Size	Number of Structures	Foundation Diameter at Substrate	Total Foundation Footprint with Scour Protection	Total Benthic Habitat Conversion	Rank by Total Habitat Conversion (max. first)
Wind Turbines					
Suction Bucket jacket	155	66 ft (20 m) a/	3.0 ac (1.2 ha)	465 ac (188 ha)	1
Piled Jacket	155	14.7 ft (4.5 m) b/	1.9 ac (0.77 ha)	295 ac (119 ha)	2
Monopile	155	43 ft (13 m)	1.24 ac (0.50 ha)	192 ac (78 ha)	3
Offshore Substation Facilities					
Suction Bucket Jacket	2	65 ft (20 m) a/	5.2 ac (2.1 ha)	10.4 ac (4.2 ha)	1
Piled Jacket	2	9.8 ft (3.0 m) b/	4 ac (1.6 ha)	8 ac (3.2 ha)	2

Note:
Additional information about foundations and scour protection is provided in **Section 3.3.1 Offshore Infrastructure**.
a/ Maximum diameter of individual bucket; represents up to four buckets per wind turbine or offshore substation foundation.
b/ Maximum diameter of individual piles; represents up to four piles per wind turbine foundation and up to 16 piles per offshore substation foundation.

TABLE 5.7-8. SUPPORTING CALCULATIONS: TOTAL TEMPORARY BENTHIC IMPACT FROM OTHER PROJECT COMPONENTS

Component	Distance	Width of Impact	Total Benthic Temporary Habitat Impact
Submarine Export Cables a/			
BW1 to Queens, New York	202 nm (375 km)	33 ft (10m)	929 ac (376 ha)
BW2 to Queens, New York	202 nm (375 km)	33 ft (10m)	929 ac (376 ha)
BW2 to Waterford, Connecticut	113 nm (209 km)	33 ft (10m)	520ac (210 ha)
Interarray Cables a/			
BW1	162 nm (300 km)	33 ft (10m)	746 ac (302 ha)
BW2	162 nm (300 km)	33 ft (10m)	746 ac (302 ha)
Other Construction Components b/ c/			
Anchoring	TBD	3,000 ft (914 m)	TBD

Component	Distance	Width of Impact	Total Benthic Temporary Habitat Impact

Note:
TBD – To be determined
a/ Footprint is a conservative estimate based on the widest trench generating tool (e.g., jet plow) and its outer width of disturbance.
b/ Mats are installed within the same footprint as proposed scour measures and therefore do not incur a separate temporary impact outside of what has already been accounted with permanent scour measures.
c/ Project is not proposing chain sweep during vessel installation activities.

There are no known nesting sites in the Study Area and no critical habitat for sea turtles in the Project Area. No onshore impacts to sea turtles are expected; therefore, only potential offshore impacts will be discussed below.

5.7.2.1 *Construction*

Impacts to sea turtles during the construction phase are expected to be similar to those discussed for marine mammals in **Section 5.6 Marine Mammals**. The highest density of sea turtle occurrences in the Project Area is in late spring through fall (April through October), which would be when these potential impacts are likely to have the greatest effect. The combined annual sea turtle density estimates for the species combined (loggerhead and Kemp's ridley sea turtles) in the Lease Area are less than 10 animals per 38.6 mi^2 (100 km^2) (Normandeau - APEM 2020). The aerial surveys did not observe leatherback or green sea turtles in the Lease Area; therefore, no density estimates were provided for these species. While density estimates are low, four species of sea turtles might be found within the Project Area, especially during the summer and fall.

During construction, the potential impact-producing factors to sea turtle species may include:

- Installation of offshore components including foundations, wind turbines, offshore substation facilities, submarine export cables, and interarray cables, and associated vessel traffic.

The following impacts may occur as a consequence of the impact producing factors identified above:

- Short-term (<2 year) disturbance of habitat;
- Short-term (<2 year) loss of local prey species and availability;
- Short-term (<2 year) increase in construction-related lighting;
- Short-term (<2 year) increase in marine debris;
- Short-term (<2 year) increased risk for entanglement and entrapment in Project-related equipment;
- Short-term (<2 year) increase in Project-related underwater noise;
- Short-term (<2 year) increase for vessel strike risk due to increased vessel traffic; and
- Short-term (<2 year) potential for a change to water quality and oil spills.

Short-term disturbance of habitat. A temporary disturbance to the benthic habitat will occur during installation of the foundations and submarine export and interarray cables. The disturbance will occur over time during the construction period, and actual areas of disturbance will be localized with cable installation being linear over time and foundations installed sequentially. The nearshore portions of the Project are most likely to provide prey for juvenile sea turtles and are where the most impact to sea turtle habitat would be expected. Green, Kemp's ridley, and loggerhead sea turtles might be found in the nearshore habitats of Long Island Sound, while leatherback sea turtles are more often seen within Block Island Sound and points further east. Juvenile and occasionally adult green sea turtles have been seen in sea grass beds off the eastern side of Long Island. Beacon Wind has mitigated this impact to the extent possible by avoiding known locations of eelgrass. Sea turtles are mobile and would be expected to move away from the temporary installation sites but would be expected to return when installation is complete. Therefore, no permanent disturbance to or displacement from suitable habitat is expected for sea turtles in the Project Area. The disturbance to the seafloor in Long Island Sound is expected to return to pre-installation conditions within a relatively short period of time (see **Section 4.2 Water Quality** and **Appendix I Sediment Transport Analysis**). Beacon Wind has avoided sensitive benthic habitats where feasible in siting foundations and cables which minimized disturbance to sensitive habitat features. Additional effects from wind turbine foundations and the potential attraction to them by sea turtles is addressed in **Section 5.7.2.2**.

Short-term loss of local prey species: Installation activities may temporarily disturb local prey species within the Project Area, impacting sea turtles' ability to forage in these areas. Most of the foraging is done on eelgrass and for invertebrates (crabs, mollusks, horseshoe crabs and sea pens) inhabiting Atlantic coastal habitats (Morreale and Standora 2005, Plotkin and Spotila 2002, and Dodd and Byles 2003). Project siting to avoid impacts to seagrass beds and other submerged aquatic vegetation as well as the potential use of HDD or other trenchless methodologies at the landfall (328 x 328 ft [100 x 100 m] HDD at Queens, New York and 250 x 250 ft [76 x 76 m] at Waterford, Connecticut) will minimize loss of some foraging area. Due to the construction methods proposed in the paragraph above, there will be a large amount of suitable foraging habitat that will not be under installation in adjacent areas to those under installation that can be used by sea turtles looking for benthic organisms. The soft bottom benthic habitat disturbed by foundation installation and cable laying would be expected to recover within a relatively short time frame (See **Section 5.5 Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat**).

Short-term increase in construction-related lighting. Deck and safety lighting will be found on Project-related construction and support vessels located within and transiting to and from the Lease Area, the submarine export cable routes, and the staging and construction areas. Lighting has the potential to impact sea turtles, though the most destructive impact of lighting is to hatchlings leaving natal beaches. Since there are no known nesting sites in the Project Area, impacts are not expected to this life stage of sea turtle. Project-related deck and safety lighting will not illuminate surrounding waters; therefore, it is not expected to have an impact on sea turtle activities or behavior.

Short-term introduction of marine debris. Marine debris may be introduced into the marine environment during construction and installation activities from construction vessels. Sea turtles may become entangled in or ingest debris, which may result in injury or death. Marn et al. 2020, Senko et al. 2020, and Wilcox et al. 2018 have documented the impacts from marine debris. However, offshore personnel and vessel contractors will be required to implement debris control practices and protocols, and the release of marine debris into Project Area waters is not anticipated. Project-related vessels will abide with the laws regulating the at-sea discharge of vessel-generated waste.

Short-term increased risk for entrapment and entanglement in Project-related equipment. The installation of submarine cables and potential presence of cables associated with installation equipment in the water column could potentially lead to the entrapment or entanglement of sea turtle species. However, cable laying operations are slow, progressing at speeds of less than 1 knot. These activities are a known source of impact on sea turtles, though impact is unlikely as it would only occur if an individual is in the direct path of the jet plow or seabed preparation activities (Murray 2011). Sea turtles in the area of cable laying would be expected to be able to avoid any interaction with these operations. Because the cable will be taut as it is unrolled and laid in the trench, no risk of entanglement is expected. Entanglement of any species of sea turtle during the cable laying operation is extremely unlikely to occur. Loggerhead, green, and Kemp's ridley sea turtles forage benthically, and, though it is unlikely, may be entrained by cable laying and seabed preparation operations. In areas with large sand waves, dredging may be utilized for cable burial. Dredging that may be utilized in pre-sweeping and pre-trenching activities operations may entrain sea turtles (Ramirez et al. 2017). While the majority of sea turtles located in the Project Area during cable-laying and seabed preparation operations would be expected to be capable of moving out of the area, in the very unlikely event that any species are caught (entrained) or restricted in movement by this equipment, they could experience injury or mortality.

Short-term increase in Project-related underwater noise. Underwater noise will be generated by several installation operations: pile driving, jet-plowing, dredging, and Project-related vessel and aircraft noise. An acoustic assessment was completed for the Project and includes a full description of the underwater noise modeling with methodology and inputs (**Appendix L Underwater Acoustic Assessment**).

Little is known about how sea turtles use sound in their environment. Due to insufficient data on the hearing capabilities of sea turtles, impacts of sound are not well documented. Available data does suggest that sea turtles detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues and can respond to acoustic cues (Piniak et al. 2012). Research examining the ability of sea turtles to avoid collisions with vessels shows that they may rely more on their vision rather than auditory cues (Hazel et al. 2009). Sea turtles may rely on acoustic cues (e.g., from breaking waves) to identify nesting beaches and are also likely to rely on non-acoustic cues for navigation, such as magnetic fields and light. Sea turtles are not known to produce sounds underwater for communication. As such, sound likely plays a limited role in a sea turtles' environment and natural history.

There are a few studies on sea turtle hearing and, overall, research indicates that hearing in sea turtles is in the lower frequencies, typically below 1,600 Hz. One study indicated that the range of highest sensitivity is between 100 and 700 Hz (Piniak et al. 2012). Research indicates that adult sea turtles hear frequencies ranging from 50 to 1,200 Hz, while juveniles can hear frequencies up to 1,600 Hz (Bartol et al. 1999; Bartol and Ketten 2006; Lavender et al. 2012, 2014; Martin et al. 2012; Piniak et al. 2012; Ridgway et al. 1969). There are studies reporting hearing ranges and thresholds for different species and life stages of sea turtles, but the data is limited because of the small number of individuals tested and is not definitive. Known hearing ranges are as follows: leatherbacks from 50 to 1,200 Hz (Piniak et al. 2012); loggerheads, depending on the study, between 50 and 100 Hz on the lower end and up to 800 to 1,120 Hz on the upper end (Martin et al. 2012); Kemp's ridley from100 to 500 Hz (Bartol and Ketton 2006); and green sea turtles from 50 to 1,600 Hz. (Piniak et al. 2012). A behavioral study in loggerhead sea turtles indicated startle responses were elicited from sources between 50 and 800 Hz (Martin et al. 2012).

An extensive review of current scientific literature and studies revealed no known sea turtle deaths or injuries caused by pile driving. The injury and behavioral thresholds for sea turtles are set by NOAA Fisheries for impulsive signals at 204 SEL (weighted) dB re 1 µPa^2 s and 232 Lp,pk (unweighted) dB re 1 µPa, respectively and for non-impulsive signals at 220 SEL (weighted) dB re 1 µPa$^2 \cdot$ s. Field observations made during seismic surveys have indicated avoidance behaviors by sea turtles when in the vicinity of seismic surveys, which produce noise that is considered impulsive (a broadband signal characterized by sudden onset and short duration) (DeRuiter and Doukara 2012; Holst et al. 2006; Weir 2007). During pile driving operations associated with installation of the Block Island Wind Farm in 2015, the distances to measured sea turtle behavioral threshold isopleths ranged from 3,314 to 7,382 ft (1,010 to 2,250 m) from the pile source; distances to the injury threshold isopleths ranged from less than 33 to 243 ft (10 to 74 m) from the pile source (Tetra Tech 2016). This data indicates that there is the potential for sea turtles to be affected by pile driving noise. Potential impacts to sea turtles from pile driving, if they were to occur, would most likely occur during summer and fall when sea turtle abundance in the Project Area peaks. However, any potential impacts are expected to be limited as sea turtles in the vicinity of the Project Area during pile driving activities would be expected to relocate temporarily to areas outside of the zone of influence. It is generally expected that, as sea turtles have ample available oceanic habitat outside of the Project Area, these species would move into other open ocean habitat or adjust course during migration when in the vicinity of noise-producing activities.

Lease Area Modeling

In support of this COP, underwater sound propagation modeling was completed in order to predict the level of underwater noise expected during Project-related construction activities in the Project Area. Sound fields produced during impact pile driving for installation of foundations were estimated by modeling the vibration of the pile when struck with a hammer, determining a far-field representation of the pile as a sound source, and then propagating the sound from the apparent source into the environment.

Piles deform when driven with impact hammers, creating a bulge that travels down the pile and radiates sound into the surrounding air, water, and seabed. This sound may be received as a direct transmission from the sound source to biological receivers (such as sea turtles) through the water or as the result of reflected paths from the surface or re-radiated into the water from the seabed. Sound transmission depends on many environmental parameters, such as the sound speeds in water and substrates. It also depends on the sound production parameters of the pile and how it is driven, including the pile material, size (length, diameter, and thickness) and the make and energy of the hammer.

As detailed in **Appendix L Underwater Acoustic Assessment** sound fields were modeled for tapered monopile foundations and piled jacket foundations to determine the acoustic propagation and to develop estimates for the numbers of sea turtles that could potentially be exposed to sound levels above regulatory thresholds. These models account for several parameters that describe the operation—pile type, material, size, and length—the pile driving equipment, and approximate pile penetration depth

The analysis and results detailed in **Appendix L Underwater Acoustic Assessment,** will be used to inform development of mitigation measures that may be applied during construction of the Project, in consultation with BOEM and NOAA Fisheries. The Project will obtain necessary permits to address potential impacts to sea turtles from underwater noise and will establish appropriate and practicable mitigation and monitoring measures through discussions with regulatory agencies. **Appendix L Underwater Acoustic Assessment** details the source modeling results, acoustic propagation modeling results, and exposure modeling results for sea turtles.

Goal Posts and Casing Pipe Modeling

Submarine export cable landfall construction activities will include the installation of temporary casing pipe and goalposts which would require impact pile driving, and/or pneumatic pipe ramming to install casing pipe in support of horizontal directional drilling which would require the temporary installation of cylindrical steel "goal post" piles via impact pile driving. Pneumatic pipe ramming and impact pile driving produce underwater sounds that have the potential to impact sea turtles. The isopleth distances to thresholds corresponding to potential injury and behavioral disruption of sea turtles were computed by propagating measured source levels at potential cable landfall construction areas and then comparing the resulting sound fields to regulatory thresholds. Sea turtle exposure estimates were then calculated based on expected construction scenarios for casing pipe installation and goal post pile driving. **Appendix L Underwater Acoustic Assessment** details the results of acoustic and exposure modeling for goal posts and casing pipe.

Underwater Noise Measures

Beacon Wind expects to propose and implement the following measures during construction and installation to avoid, minimize, and mitigate the potential impacts from underwater noise:

- Where pile-driven foundations are selected, Beacon Wind will apply monitoring and exclusion zones as appropriate to underwater noise assessments and impact thresholds, enforced by:
- NOAA Fisheries-approved PSOs; and
- Real-time monitoring systems, as appropriate.
- Where pile-driven foundations are selected, pile driving will occur during only the daytime, unless technologies are available to allow for sufficient detection at night;
- Soft starts and shut-down procedures as appropriate to thresholds of noise-emitting survey equipment, where technically feasible;
- Ramping up of noise generating activities for an agreed upon duration based on consultation with the authorities;
- Use of reduced visibility monitoring tools/ technologies (e.g., night vision, infrared, and/or thermal cameras);
- Consideration of the potential use of commercially and technically available noise-reducing technologies as appropriate to assessments;
- Consideration of the use of dedicated trained crew members (independent of PSOs) to help reduce the risk of collision under certain circumstances; and
- Provide reference materials on board Project vessels for the identification of sea turtles.

Vessel traffic noise may affect sea turtles, but effects are anticipated to be minimal. Vessel noise is the dominant source of underwater noise at low frequencies ranging from 20 to 200 Hz and is increasing in the world's oceans (Hildebrand 2009; Rolland et al. 2012). Individual ships have different noise signatures; however, ship noise is typically in the range of 195 dB (re 1 $\mu PA^2/Hz$ at 1 m) for fast-moving (above 20 knots [37 km/hr]) supertankers to 140 dB (re 1 $\mu PA^2/Hz$ at 1 m) for small fishing vessels (National Research Council 2003). Wind energy and high sea states also produce noise in this frequency range. The frequency ranges for vessel noise overlap with sea turtles' known hearing ranges (less than 1,000 Hz) and are expected to be audible but would be within the typical conditions in sea turtles' ocean environments. Impacts from vessel traffic noise may elicit behavioral changes in individuals near vessels, such as diving, changing swimming speed, or changing direction in order to avoid the noise. However, due to the existing noise from vessel traffic in the area, impacts are not anticipated to be greater than ambient conditions.

Short-term increased risk for ship strikes due to the increase in vessel traffic. A short-term increase in Project-related installation and support vessel traffic within the Lease Area, along the submarine export cable routes, and along the transit routes to and from the staging and construction area is anticipated during installation, with an approximate short-term increase of vessel traffic in the area above baseline conditions (**Appendix J Air Quality Calculations and Emissions**) for the anticipated types of vessels, number of transits, and ports of origin. Sea turtles near surface waters within these areas would be susceptible to vessel strikes or collisions, physical disturbances, and disturbance from vessel noise, which may inflict disturbance, injury, or result in mortality. Project vessels will follow existing shipping lanes to the extent feasible and practicable.

Sea turtles can detect approaching vessels, likely by sight rather than by sound, and seem to react more to slower-moving vessels (2.2 knots [4.1 km/hr]) than to faster vessels (5.9 knots [10.9 km/hr] or greater) (Hazel et al. 2009). Although sea turtles likely hear and see approaching vessels, they may not be able to avoid all collisions, and high-speed collisions with large objects can be fatal to sea turtles. Stranding data frequently documents mortality from vessel collision; however, these collisions tend to occur in shallow coastal and inshore waters with higher densities of vessels traveling at accelerated speeds (CH2M HILL Engineers Inc. [CH2M HILL] 2018).

The most susceptible species to ship strike in the Project Area are leatherback and loggerhead sea turtles. In the summer season, leatherbacks are susceptible near coastal areas, in addition to offshore, if co-located with transiting vessels. Juvenile loggerheads found in coastal waters during foraging and resting are also susceptible, as their smaller size makes it more difficult to detect them in the water (Kenney and Vigness-Raposa 2010). Individuals present in the area during winter would likely be cold-stunned, may be closer to the surface, and may be less able to avoid strikes. Within the Study Area, Kemp's ridley and green sea turtles are primarily found within Long Island Sound. Loggerhead sea turtles are found predominantly offshore, within and around the Lease Area. The three species are typically observed as single individuals. Leatherback sea turtles are often seen in groups, with observations from the Study Area numbering from one to five. Leatherbacks are often observed along the coastline, and as stated earlier have a hot spot of occurrence south of Nantucket. Loggerheads and leatherbacks are not often observed within Long Island Sound. Beacon Wind proposes to implement measures for vessel collision avoidance, minimization, and mitigation to marine mammals which will also be beneficial to sea turtles. These measures are described in **Section 8.7**.

Additionally, as sea surface temperatures drop in the fall and winter months, it is common for sea turtles, in particular loggerhead and Kemp's ridley turtles, to be affected by the drop in water temperature and become cold-stunned. The cold affects their diving capacities and constrains them to floating motionless at the surface, becoming more prone to ship strike (Burke et al. 1991; Hochscheid et al. 2010; Meylan and Sadove 1986). Beacon Wind proposes to implement measures to avoid, minimize, and mitigate the impacts of vessel collisions through measures in place for marine mammals, which will be indirectly beneficial to sea turtles. These mitigation measures are described in **Section 5.6 Marine Mammals**.

Short-term potential for change in water quality, including oil spills. Installation activities that disturb the seafloor (e.g., foundation and submarine cable installation) will result in short-term increases in turbidity and sedimentation in the Project Area. Potential impacts to water quality are further discussed in **Section 4.2 Water Quality** and in **Appendix I Sediment Transport Analysis**.

In addition to turbidity, water quality has the potential to be impacted through the introduction of contaminants, including oil and fuel spills and releases from, for example, grout used to seal the monopile to the transition piece. Jet-plowing and seabed preparation activities also have the potential to release contaminants in resuspended sediments; but Beacon Wind has sited the submarine export and interarray cables to avoid current and historic disposal grounds to the extent practicable. Beacon Wind has also completed chemical analysis of sediments and will take the necessary precautions during installation activities in any location where contaminants may be present in high concentrations where there is high likelihood of exposure to sensitive species.

An offshore oil spill in the open ocean is carried by currents and winds and may cross the various habitats that are used by different life stages of sea turtles. Floating oil means the same individual may encounter the spill multiple times when breaking the surface to breathe causing ingestion of oil into the respiratory and digestive tracts. Sea turtles may also encounter sinking oil in the water column or on the seafloor. Eggs in nests may absorb oil through their porous shells potentially harming the baby inside, and female sea turtles can pass oil compounds to developing young. There are no habitual nesting areas in the Study Area; however, nesting sea turtles and hatchlings may also encounter oil on contaminated beaches. Though there are no nesting beaches within the Project Area, possible oil spills from Project-related activities have the potential for dispersal into habitats located in distant directions.

Beacon Wind has provided an OSRP (**Appendix E Oil Spill Response Plan**) that details proposed measures to avoid inadvertent releases and spills and developed a protocol to be implemented in the event of a spill. Additional information can be found in **Section 8.12 Public Health and Safety**. Additionally, Project-related vessels will operate in accordance with laws regulating the at-sea discharge of vessel-generated waste.

5.7.2.2 *Operations and Maintenance*

Potential impact-producing factors to sea turtles during operations and maintenance include:

- Presence of new permanent structures (i.e., foundations, wind turbines, and offshore substation facilities); and
- Presence of new buried submarine export and interarray cables.

With the following potential consequential impact-producing factors:

- Modification of habitat;
- Project-related EMF;
- Project-related thermal effects;
- Project-related lighting;
- Project-related marine debris;
- Project-related underwater noise;
- Increased risk for vessel strikes due to increased vessel traffic; and

- Changes in water quality, including oil spills.

Modification of habitat. Installation of the foundations and scour protection will result in the conversion of some of the seafloor from soft-bottom to hard-bottom habitat. This conversion has the potential effect of reducing the available habitat for bottom-foraging individuals and by creating new hardbottom habitat. No long-term impacts to seagrass or other submerged aquatic vegetation is anticipated as these habitats are not found within the Lease Area. The artificial hardbottom habitat created by the foundations and scour protection is likely to attract sea turtles as it would provide beneficial conditions for foraging as well as providing some shelter and may serve as a structure for removing biological build-up from their carapace (CH2M HILL 2018). Installation of semi-permanent and permanent structures for open ocean wind turbines have been known to create a ‘reef effect’, which increases the biodiversity of the area in which the artificial structure is placed. The small invertebrate life and fish species that aggregate on these foundation structures will draw in larger predators; this “reef effect” has the potential to attract sea turtles for feeding on alternate prey sources such as jellyfish and algae attached to the foundation and the turbine. This ‘reef effect’ is thought to have a positive impact on species, including sea turtles, as it increases foraging habitat. The introduction of artificial reef habitat attracts benthic and pelagic fish species, and provides substrate for sessile invertebrates, thus increasing prey availability for sea turtles. Therefore, introducing habitat has an overall long-term beneficial impact to sea turtles. The artificial reef habitat may also in turn result in increases in temporary residence times for sea turtles in the area; this phenomenon has been documented at oil and gas platforms in the Gulf of Mexico. These findings suggest similar effects may be anticipated around foundations for offshore wind turbines in the Project Area. Artificial structures increase the biodiversity and may increase prey availability for sea turtles by providing substrate for sessile invertebrates. Offshore wind turbines may also attract recreational fisherman to the area, which poses entanglement and ingestion risk to sea turtles as have occurred at artificial reefs. Entanglement or ingestion would be expected to be adverse only at the individual, not population level. Entanglement in anthropogenic debris is also a known threat for sea turtles in every ocean basin (Duncan et al. 2017). Were a sea turtle to become entangled in fishing line or ingest fishing line, the effects would be expected to be adverse on that individual sea turtle (Barnette 2017).

Another type of offshore structure associated with the Beacon Wind Project is an offshore converter station, located within the offshore substation facilities. Each offshore substation will include a CWIS to regulate temperature of the electrical converter equipment, that will utilize up to 10.6 mgd of once-through non-contact cooling water that may result in the entrainment of egg and larval stages of ichthyoplankton species, as discussed in **Section 5.5 Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat**. Ocean water will be drawn in from the water column, approximately 49-131 ft (15-40 m) below the water surface. The flow required by the converter station is several orders of magnitude lower than the flow (500 to 2,900 mgd) required for similar cooling water intake structures for many coastal power plants throughout the northeast (EPA 2010). While individual eggs and larvae of commercially or recreationally-managed species in the immediate vicinity of the intake may be subject to entrainment through the cooling water system, this discrete intake location is not expected to result in measurable impacts to fish or shellfish populations or managed fisheries stocks on a local or regional scale. After the water passes through the CWIS, water will be discharged back into the water column approximately 66-112 ft (20-34 m) below the water surface. Discharged water temperature will be approximately 87.8°F (31°C) when the seawater inlet temperature is 68°F (20°C), though for much of the year the seawater will be cooler and the discharge temperature will accordingly be lower. Discharged water will not exceed 96.8°F (36°C), and this maximum temperature would correlate to a CWIS operating at a much smaller discharge volume than the maximum. This release of heated water will be localized to the area around the discharge points at the two offshore substation facilities and is expected to dissipate into the surrounding water column, resulting in an increase in the temperature of the water in the immediate vicinity of the offshore substation facilities. Within a short distance from the CWIS, the temperature difference from surrounding seawater will drop to undetectable levels, and is not expected to result in measurable impacts to fish or shellfish populations or managed fisheries stocks. No impingement of juvenile or adult fish is anticipated from operation of the CWIS.

The design, configuration, and operation of the offshore substation facilities' cooling systems will be permitted as part of an individual NPDES permit and additional details will be included in the permit application submitted to the EPA. Beacon Wind will actively work with EPA to understand any additional modelling and assessment that may be required for this system.

Project-related EMF. Electric and magnetic fields (EMF) may result from the installation of the submarine cables (see **Section 8.10 Marine Energy and Infrastructure** and **Appendix CC Offshore Electric and Magnetic Field Assessment** for additional information). Data on EMF and its impacts to marine fauna is limited and the sensitivity to field strength of either electric or magnetic fields is addressed as a proxy. While it is known that EMF sensitivities vary greatly by species, and that benthic species may be more affected by magnetic fields, it is not well understood how sea turtles react to either electric or magnetic fields. Sea turtles can sense magnetic fields and have the ability to use the earth's magnetic field for long range navigation, migration, and orientation, with multiple studies showing magnetosensitivity and behavioral responses to field intensities ranging from 0.0047 to 4000 µT for loggerheads and 29.3 to 200 µT for green sea turtles (Tricas and Gill 2011). Anatomical, life history, and behavioral similarities suggest that other species of sea turtles that have not been studied could be responsive at similar threshold levels. AC cables buried to a depth of 3.3 ft (1 m) would emit field intensities less than 0.005 µT to 82 ft (25 m) above the cable and 78.7 ft (24 m) along the seafloor, and a DC system is modeled at emitting field intensities less than 0.05 µT as high as at least 164 ft (50 m) above the cable and 223.1 ft (68 m) along the seafloor (Tricas and Gill 2011). Based on the expected intensities to be emitted from the submarine cable (**Section 8.10 Marine Energy and Infrastructure** and **Appendix CC Offshore Electric and Magnetic Field Assessment**) it is likely that sea turtles will be capable of sensing these magnetic fields. There are no data on impacts from underwater EMF to sea turtles but hatchlings and juveniles utilizing relatively shallow, nearshore waters near the submarine export cables would not be able to avoid magnetic field alterations potentially extending 164 ft (50 m) from the bottom and may be vulnerable, as would juveniles and adults foraging on the bottom within range (up to 223.1 ft [68 m] along the seafloor) of the offshore cables (Tricas and Gill 2011). It is unknown how EMF may impact navigation and migration as some experiments have shown sea turtles have the ability to compensate for "miscues" (Tricas and Gill 2011) and may be able to overcome the EMF emissions from the submarine cable.

During operations, cables transmitting the produced electricity will emit magnetic and induced electric fields. This could affect the movements and navigation of sea turtles or some of the prey species that are sensitive to electric or magnetic fields, especially elasmobranchs or some teleost fish and decapod crustaceans. Changes in these geomagnetic fields could potentially impact a sea turtle's ability to navigate at sea, as well as affect their movement patterns (Normandeau et al. 2011; Taormina et al. 2018). Experiments show that sea turtles can detect changes in magnetic fields, which may cause them to deviate from their original direction (Lohmann and Lohmann 1996; Lohmann et al. 1999). Sea turtles also use nonmagnetic cues for navigation and migration, and these additional cues may compensate for variations in magnetic fields. There are indications that an overall geomagnetic sense is used and is critical for primary orientation necessary to travel towards areas that are important at various life stages (e.g., nesting beaches or feeding grounds), but detail and fine-scale navigation is accomplished via olfactory and visual cues (Normandeau et al. 2011). If located in the immediate area (within about 650 ft [200 m]) where electromagnetic devices are being used, sea turtles could deviate from their original movements, especially during feeding bouts. However, the extent of this disturbance is likely to be inconsequential. Potential impacts of exposure to electric and magnetic stressors are not expected to result in substantial changes to an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and are not expected to result in population-level impacts. As the magnetic and induced electric fields of the submarine export cables are expected to generate a relatively low intensity of EMF in the Project Area, impacts to sea turtle species are not anticipated to result in short-term behavioral disturbance. In addition, the heat generated by the transport of electricity through the submarine export cables are also not known to impact sea turtles (Taormina et al. 2018).

In a study, field measurements in the vicinity of two cables buried at 3.3 ft (1 m) below the benthic surface indicated an increase of approximately 2.5 °F (1.4 °C) at 7.9 in (20 cm) depth above the cable. While the study did stipulate that the applicability of the results to other projects is uncertain, due to the variation of relevant environmental and project factors, it concluded that impacts would not be significant based on the current data, in addition to the narrow cable corridors and weak thermal radiation (Taormina et al. 2018). Therefore, any potential impacts to prey species would likely be minimal and confined to a small area in the immediate vicinity of the submarine export cables. Given the highly mobile nature of sea turtles and the prevalence of other equal or greater value habitat in proximity to the Study Area, Beacon Wind does not anticipate any impacts to prey availability based on increases from heat. Similarly, any EMF-related effects on infaunal benthic invertebrates would be in a very narrow corridor surrounding the submarine export cables and are also not expected to affect the availability of potential prey for any species. Beacon Wind has conducted engineering surveys to identify areas where sufficient submarine export cable burial is likely to be achievable, with target burial depths from a minimum of 3 to 6 ft (0.9 to 1.8 m). Burial will act as a buffer between EMF and the associated submarine export cable generated heat and the sea turtles, further reducing exposure levels. In areas where sufficient burial is not feasible, and where additional cable protection is deemed necessary, surface cable protection will provide an additional barrier to EMF and heat exposure.

Thermal Effects. Potential thermal effects associated with the Project HVAC and HVDC buried cables were evaluated to assess potential risks to the benthic community. The depth of the cables relative to the where benthic organisms reside and the estimated changes in surrounding sediment temperatures associated with the cables were considered.

The target burial depth of the HVAC interarray cables and the HVDC submarine export cables is 3 to 6 ft (0.9 to 1.8 m). Burial may not be feasible in a small number of instances (estimated to occur for 10% of the areas where the cables may be placed), in which case the cables will be surface laid and have rocks, rock bags, or concrete mattresses placed over them as cover protection. The depth of the cover protection material will be 5 ft (1.5 m). At the base of the wind turbines and the offshore substation facilities, the cables will be covered by 6.6 to 13 ft (2 to 4 m) of cover material used for scour protection prior to the cables being buried at their target depth.

Benthic organisms residing in the sediment bed (i.e., infaunal species) and at the sediment surface (i.e., epifaunal species) are not expected to be present at depth immediately adjacent to the buried cables where elevated temperatures may occur. While temperature is one environmental determinant of benthic community distribution (Hiscock et al. 2004; Emeana et al. 2016), others include availability of oxygen, levels of organic material (i.e., "organic carbon") and grain size (Thrush et al. 2003; Pratt et al. 2014; Soto et al. 2016; Hubler et al. 2016). Because oxygen and available organic carbon are typically limited to only the top inches of sediment, these factors are the primary determinants of the depth at which benthic organisms may reside. With respect to benthic organisms and the Project, comprehensive benthic community surveys have been performed for the Lease Area (MMT 2022a) and the HVDC submarine export cable corridors for both the Queens, New York and Waterford, Connecticut routes (MMT 2022b). Data from over 500 sample locations collected during this survey are comparable to other data for the continental shelf in showing that depth of biological activity is generally limited to the top 4 to 8 in (10 to 20 cm) (MMT 2022a, 2022b, USEPA 2015). With respect to grain size, the sediment of the Lease Area and cable corridors consist of a range of geological sediment types from clay and silt to coarser sand and pebbles, as well as biogenic sediment types (i.e., shell deposits). Overall, the predominant sediment types were sand (i.e., coarse unconsolidated substrate) and muddy sands (fine unconsolidated substrate) (MMT 2022a, 2022b).

Thermal tolerances of benthic organisms varies by species, but is generally assumed to span the range of seasonal temperature changes in the lower water column that occurs on the continental shelf of southern New England waters. Mountain (2020) found that seasonal range water temperatures across the Mid-Atlantic Bight shelf off the southeast coast of Long Island can vary by as much as 16.2 degrees Fahrenheit (°F) (9 degrees Celsius [°C]).

Heat emissions from buried cables can warm surrounding sediments, creating a thermal gradient that may extend up to tens of inches away from the cable (Taormina et al. 2018). The factors that determine the thermal gradient include the cable characteristics and transmission rate, as well as the characteristics of the surrounding sediments (e.g., ambient temperatures, permeability of sediments) (OSPAR Commission 2012; Emeana 2016). Temperatures at the surface of high voltage cables may reach approximately 160°F (70°C) [19] (Swaffield et al. 2008; Hughes et al. 2015). The use of high voltages minimizes heat loss and HVDC cables generally exhibit lower heat emissions than do HVAC cables at equal transmission rates (Viking Link 2017; Taormina et al. 2018)

In open water, unburied cables have negligible effect, because water is a relatively poor conductor of heat and because water currents quickly dissipate heat (Viking 2017; Tetra Tech 2021). For buried cables, heat transfer can occur both by conduction (transfer of thermal energy through direct contact) and convection (transfer of thermal energy through the movement of a liquid) (Emeana et al. 2016). In continental shelf settings, finer-grained sediments associated with sand and mud are expected to exhibit both conductive heat transport and convective heat transport. In a laboratory experiment, Emeana et al. (2016) found that cable surface temperatures of 140°F (60°C) could result in an 18°F (10°C) change approximately 2.3ft (0.7 m) away from the cable in fine sands with medium permeability. Changes in temperature of 3.6°F (2°C)[20] occurred within 3.3 ft (1 m) within the same sediment.

[19]Based on an assumed conductor temperature of 194 degrees Fahrenheit (90 degrees Celsius).

[20]The German Federal Agency of Nature Conservation has developed thermal guidelines for buried cables by recommending no more than a 2°C temperature elevation in seafloor sediments located 8 in (20 cm) below the surface to protect benthic organisms (Worzyk 2009).

In conclusion, the Project HVAC and HVDC buried cables at the target burial depth of 3 to 6 ft (0.9 to 1.8 m) are anticipated to result in *de minimis* risk to the benthic community that resides in the top 8 inches (20 cm) of sediment. Thermal gradients associated with the buried cables are expected to diminish to ambient conditions within 3.3 ft (1 m) or less. While this distance is larger than the shallowest proposed burial depth, when accounting for the thermal tolerance of benthic organisms and the cited range of bottom water temperatures in New England waters, the risk is anticipated to be de minimis. Risk is also anticipated to be *de minimis* in the relatively few instances where cables will be present at the surface and covered with rocks, rock bags or concrete mattresses as heat will rapidly dissipate in the water column.

Project-related lighting. Project-related operations and support vessels located within and transiting to and from the Lease Area will contain deck and safety lighting, and safety lighting will be included on the wind turbines and offshore substation facilities. As described for the construction phase, this lighting will not intentionally illuminate surrounding waters and, therefore, is not expected to effect sea turtles. Beacon Wind will work with appropriate regulatory agencies regarding lighting requirements.

Introduction of marine debris. Marine debris generated during operational activities could result in sea turtles becoming entangled in or ingesting debris, resulting in injury or death. However, offshore personnel will be required to implement appropriate practices and protocols; therefore, the release of marine debris into Project Area waters is not anticipated.

Changes in water quality, including oil spills. Routine maintenance activities during operation have the potential to result in short-term increases in turbidity and sedimentation in the Project Area, which may directly or indirectly affect sea turtles. **Section 4.2 Water Quality** and **Appendix I Sediment Transport Analysis** discuss potential impacts to water quality from turbidity. As discussed, the increase in turbidity and/or contaminant release from re-suspended sediments is not expected to exceed background levels experienced during natural events and will be short-term and temporary. Therefore, sea turtles are not expected to be exposed to conditions exceeding their current environment.

In addition to turbidity, water quality has the potential to be impacted through the introduction of contaminants, including oil and fuel spills. For reasons described in **Section 5.7.2.1**, such spills have impacts on sea turtles. Beacon Wind has provided an OSRP (**Appendix E Oil Spill Response Plan**) that details all measures proposed to avoid inadvertent releases and spills, and provides a protocol to be implemented should a spill event occur. Additional information can be found in **Section 8.7 Marine Transportation and Navigation**. Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts on sea turtles from impacts to water quality and spills:

- Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste; and
- The development and enforcement of an OSRP.

Underwater noise. Operational activities, including routine maintenance, may have the potential to create a slight increase in the ambient underwater noise in the Project Area (see **Appendix L Underwater Acoustic Assessment**), but the noise levels typically produced by offshore wind areas is well below injurious and behavioral thresholds established by NOAA Fisheries for sea turtle populations. Therefore, sea turtles are not expected to be exposed to conditions exceeding their current environment.

Vessel traffic increases resulting from Project-related operations are expected to be negligible in comparison to the average traffic observed in the vicinity of the cable route and Lease Area due to generally high vessel traffic in the region; therefore, noise from Project-related operations and support vessel traffic is not anticipated to be greater than the ambient noise levels in the Project Area. Due to the rate of existing vessel traffic in the area, the noise associated with Project-related supply vessels transiting to and from the offshore facilities will have a negligible contribution to total ambient underwater sound levels. The nearshore vessel activity will be typically concentrated within and near industrial port areas and will be typical of existing noise in those areas. As previously discussed, impacts from vessel noise may elicit behavioral changes (diving, changing swimming speed, changing direction) by individual sea turtles to avoid the noise source. Impacts are not expected to be greater than ambient conditions due to the existing noise from typical vessel traffic within and near the Project Area and in the shipping lanes. However, due to the existing noise from traffic in the Project Area, impacts are not anticipated to be greater than ambient conditions.

Project-related vessel traffic. Beacon Wind's preferred operations solution for the Project is a SOV concept, supported by a CTV or smaller support vessel that will remain offshore in the Project site for a period of approximately two weeks, returning to shore for 24 hours for refueling, re-supplying, and crew changes. This SOV concept significantly reduces the overall vessel transits from the Project site to shore as compared to the maximum design scenario of multiple crew transfer vessels making daily return trips. Under the SOV concept the reduction of vessel traffic will reduce the risk of ship-strike and vessel noise. However, should an SOV concept not be technically and commercially suitable, Beacon Wind requires the ability to select another alternative described in the PDE. Sea turtles are likely to benefit from mitigation required to reduce the risk of Project-related vessel strikes on marine mammals as described in **Section 5.6**. Likely mitigation measures will include vessel speed restrictions as appropriate and vessel collision avoidance measures including a separation distance from sea turtle species.

Beacon Wind proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Project-related vessel speed restrictions, as appropriate, for sea turtles while transiting to and from the Lease Area;
- Project-related vessels will comply with NOAA Fisheries speed restrictions within the Mid-Atlantic U.S. SMA for right whales of 10 knots (18.5 km/h.) or less for vessels 65 ft (20 m) or greater during the period of November 1 through April 30. Project-related vessels will also comply with the 10-knot (less than 18.5-km/hr) speed restrictions in any DMA; and
- from the Lease Area, including a 164-ft (50-m) separation distance from sea turtle species.

5.7.2.3 Decommissioning

Impacts during decommissioning activities are expected to be similar or less than those described for construction (see **Section 5.7.2.1**). Advances in decommissioning methods and technologies are expected to occur during the operations phase of the Project, and sea turtle abundance and distribution may also change which would require updated analysis. Furthermore, data on the spatial and temporal distribution of sea turtles will be collected during the operations phase and will be used to inform a decommissioning assessment. A full decommissioning plan will be submitted to BOEM for approval prior to Beacon Wind initiating any decommissioning activities. Potential impacts will be evaluated at that time, in addition to documentation and approval by NOAA Fisheries. For additional information on the decommissioning activities that Beacon Wind anticipates will be needed for the Project, please see **Section 3 Project Description**.

5.7.3 Summary of Avoidance, Minimization, and Mitigation Measures

In order to mitigate the potential impact-producing factors described above, Beacon Wind has implemented the following mitigation measures to avoid, minimize, and mitigate impacts through project-siting and design. Note that Beacon Wind intends to continue discussions and engagement with regulatory agencies and ENGOs throughout the life of the Project to develop an adaptive mitigation approach that allows for flexibility, while providing the best and most protective mitigation measures.

5.7.3.1 *Construction*

During construction, Beacon Wind will commit to the following measures to avoid, minimize, and mitigate impacts described in **Section 5.7.2.1.** Additional activity-specific mitigation measures will be added to BW1 and BW2 protocols upon receipt of an IHA from NOAA Fisheries:

- Continued engagement with regulatory agencies on potential mitigations and best practices, as appropriate;
- The development and enforcement of an OSRP (**Appendix E Oil Spill Response Plan**);
- Where pile-driven foundations are selected, Beacon Wind will apply monitoring and exclusion zones, as appropriate, to underwater noise assessments and impact thresholds, enforced by:
- Qualified NOAA Fisheries approved PSOs,
- Real-time monitoring systems, as appropriate, and/or
- Ramping up of noise generating activities for an agreed upon duration;
- Where pile-driven foundations are selected, pile driving will occur during only the daytime, unless technologies are available to allow for sufficient detection at night;
- Vessel collision avoidance measures for Project-related vessels transiting to and from the Lease Area, including a 164-ft (50-m) separation distance from sea turtles;
- Project-related vessels will comply with NOAA Fisheries speed restrictions within the Mid-Atlantic U.S. SMA for right whales of 10 knots (18.5 km/hr) or less for vessels 65 ft (20 m) or greater during the period of November 1 through April 30. Project-related vessels will also comply with the 10-knot (less than 18.5-km/hr) speed restrictions in any DMA;
- Adherence to vessel strike avoidance measures as advised by NOAA Fisheries;
- Provide reference materials on board Project vessels for identification of sea turtles; and
- Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste.

In addition, during construction, Beacon Wind will consider the following avoidance, minimization, and mitigation measures to mitigate impacts described in **Section 5.7.2.1**:

- Where pile-driven foundations are selected, Beacon Wind will consider the potential use of commercially-available and technically-feasible noise reducing technologies, in accordance with associated authorizations;
- Siting of Project components to avoid and minimize impacts to habitat of high value to sea turtles, directly and indirectly; and

- Use dedicated trained crew members (independent of PSOs) to help reduce the risk of collision with sea turtles under certain circumstances.

5.7.3.2 Operations and Maintenance

During operations, Beacon Wind will commit to the following measures to avoid, minimize, and mitigate impacts described in **Section 5.7.2.2**:

- Continued engagement with regulatory agencies on potential mitigations and best practices, as appropriate;
- The development and enforcement of an OSRP (**Appendix E Oil Spill Response Plan**);
- Vessel collision avoidance measures for Project-related vessels working in or in transit to and from the Lease Area including a 164-ft (50-m) separation distance from sea turtles;
- Project-related vessels will comply with NOAA Fisheries speed restrictions within the Mid-Atlantic U.S. SMA for right whales of 10 knots (18.5 km/hr) or less for vessels 65 ft (20 m) or greater during the period of November 1 through April 30. Project-related vessels will also comply with the 10-knot (less than 18.5-km/hr) speed restrictions in any DMA; and
- Vessel and structure lighting that minimizes illumination of the sea surface where feasible and subject to approval.

In addition, during operations and maintenance, Beacon Wind will consider the following avoidance, minimization, and mitigation measure to mitigate impacts described in **Section 5.7.2.2**:

- Development of appropriate monitoring program(s) in close coordination with regulatory agencies and stakeholders.

As indicated in the list of measures above, Beacon Wind proposes to monitor select sea turtle resources to clarify baseline conditions and reduce uncertainty in assessing changes in distribution or abundance of resources within the context of climate change and other large-scale regional variables. During the COP review process, Beacon Wind will work with regulatory agencies and stakeholders in the development of appropriate program(s) during the COP review process.

5.7.3.3 *Decommissioning*

Avoidance, minimization, and mitigation measures proposed during decommissioning activities are expected to be similar to those implemented during construction and operations and maintenance (see **Section 5.7.3.1** and **Section 5.7.3.2**). A full decommissioning plan will be approved by BOEM prior to Beacon Wind initiating any decommissioning activities. Avoidance, minimization and mitigation measures will be proposed at that time.

5.7.4 References

TABLE 5.7-9. SUMMARY OF DATA SOURCES

Source	Includes	Available at	Metadata Link
BOEM	Lease Area	https://www.boem.gov/BOEM-Renewable-Energy-Geodatabase.zip	N/A

Source	Includes	Available at	Metadata Link
BOEM	State Territorial Waters Boundary	https://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/ATL_SLA(3).aspx	http://metadata.boem.gov/geospatial/OCS_SubmergedLandsActBoundary_Atlantic_NAD83.xml
OBIS/ SEAMAP 2021	OBIS SEAMAP Sightings	http://seamap.env.duke.edu/species/	N/A
OBIS SEAMAP	Sea Turtle Density	http://seamap.env.duke.edu/species/	N/A

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